




# Wildland Recreation Research in the Western Lake Superior Basin

An Annotated Bibliography

David W. Lime  
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## **Availability**

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## ABSTRACT

A wealth of basic and applied research on wildland recreation use and management has been conducted in the western Lake Superior basin during the past four decades. This annotated bibliography includes 193 research-based citations focusing on: (1) visitors to these wildland areas--who they are and how they use these resources, (2) investigations of environmental impacts resulting from recreation use, (3) studies of the economic impacts of wildland recreation, and (4) techniques to manage wildland visitor use and resources.

**Key Words:** ecological and social research, wilderness, trend monitoring, resource-based tourism

# INTRODUCTION

As its purpose, this annotated bibliography brings together published scientific research on wildland recreational use and management in the western Lake Superior basin. For the purpose of this bibliography, this geographic region includes the Quetico-Superior Ecosystem in northeastern Minnesota and northwestern Ontario as well as other wildland settings in western Lake Superior. As such, published research has been included from : (1) the Boundary Waters Canoe Area Wilderness, (2) other wildland environments in the remainder of the Superior National Forest, (3) Quetico Provincial Park, (4) Voyageurs National Park, and (5) Apostle Islands National Lakeshore.

The majority of this research has been conducted in Minnesota's Boundary Waters Canoe Area Wilderness and adjacent Quetico Provincial Park in Ontario. Only limited research has been completed in national park units in this region, with the exception of Apostle Islands National Lakeshore where most recreation-related studies have been of the recreation users. Surprisingly, no published studies have been reported from Isle Royale National Park.

The bibliography not only references publications that report results of research conducted in these settings but also includes material that relies heavily on the results of research--such as wilderness management and policy papers that include research findings as part of their presentation.

Research conducted in these wildland settings since the 1950's has made a significant contribution to our understanding of how and by whom wilderness and wildlands are used by the public for recreational pursuits. At the same time, such research illustrates how wildland settings provide recreational and other benefits to the public; how visitors impact soil, vegetation, and wildlife by their presence; how wilderness recreation impacts local and regional economies--both positively and negatively; and, how and under what conditions various resource management strategies accomplish management's goals and objectives.

This bibliography clearly demonstrates the breadth and richness of research conducted in this region. It also helps confirm that the results of this research **have been used by managers and administrators to make decisions** concerning wildland resources and visitor use. Results of this work have been especially helpful in the management of Minnesota's Boundary Waters Canoe Area Wilderness which is internationally known for its innovative wilderness management programs. The bibliography also suggests that for many areas of concern there have been precious few research activities. For example, few investigations explore the interactions between recreation users and wildlife. The role of public agencies in tourism and economic development near wilderness also has received limited research in this region. Therefore, examination of this literature should benefit discussions concerning needs for future research and monitoring.

Most of the literature included in the bibliography is available in libraries or can be obtained from the authors or the publishers. Some references, however, such as master's theses, doctoral dissertations, and unpublished reports may be difficult to secure, but they are

included because of the important contribution they make to understanding the recreational system of the region.

The 193 bibliography references included herein were collected through June 1, 1990.

The bibliography is organized into four sections. Within each section citations are arranged alphabetically by author. However, many references are cited in more than one section. Therefore, all references are numbered. If a reference is relevant to more than one section, it appears with its annotation in the first appropriate section and is referenced by number only at the beginning of all other relevant sections. As an aid to locating references, an author index is provided at the end of the bibliography.

**Section 1, Investigations of Recreational Use and Users**, focuses on the visitors to wildland recreation settings--how are they used and by whom. Articles cited examine amounts and patterns of recreational use as well as the recreationists' socioeconomic characteristics, motivations for engaging in wildland recreation pursuits, and preferences for specific activities and settings.

**Section 2, Investigations of Environmental Impacts**, includes studies that investigate the impacts that people or the recreation activity have on wildland resources such as the effects of trampling on soil and vegetation, the impacts to trees resulting from inappropriate visitor behavior, and the impacts of gasoline motors on water quality. Also included are references addressing systems to monitor wilderness resource impacts and conditions.

**Section 3, Investigations of Tourism and Economic Development**, identifies research that has explored tourism and economic development activities and potentials in communities adjacent to wildland resources.

**Section 4, Investigations of Wildland Recreation Resource Management**, focuses on studies addressing wilderness planning and management techniques and strategies to accomplish desired user and wildland resource management objectives. This includes research on campsite and trail management, site maintenance, visitor information and education, and use rationing strategies. Also included are conceptual and background papers on research methods, needs, and programs.

# SECTION 1

## Investigations of Recreational Use and Users

1. Adelman, Bonnie J., T. A. Heberlein, and T. M. Bonnicksen. 1982. Social psychological explanations for the persistence of a conflict between paddling canoeists and motorcraft users in the Boundary Waters Canoe Area. *Leisure Sciences* 5(1):45-62.

A one-way conflict has existed between paddling canoeists and motorcraft users in the Boundary Waters Canoe Area (BWCA) for many years. This paper, using social psychological attraction theory, attempts to explain why the conflict occurs and why it persists in a particular area. An examination was made of perceived similarity, perceptions of the BWCA, reasons for coming to the BWCA, competition for resources, and greeting behaviors as factors influencing the asymmetric antipathy. The data were collected from two high density use areas within the area. A field questionnaire, followed by a mailed questionnaire, was administered to 300 people. The response rate was 65 percent. The data analysis reveals that the factors listed above do influence the asymmetric relationship, and differences in them help to perpetuate the conflict.

2. Ahlgren, Clifford, and Isabel Ahlgren. 1984. Balsam fir lob tree. *Lob Trees in the Wilderness*, ch. 8, 145-70. Minneapolis, MN: University of Minnesota Press. 218 pp.

This chapter presents a historical account of Boundary Waters Canoe Area Wilderness (BWCA) land acquisition, wilderness preservation, and recreational use. Past BWCA land use conflicts are explored. At the same time, a discussion of recreational use conflicts is included. Finally, trends in recreational use and demands for use in this wilderness are examined.

3. Anderson, Charles G., and David W. Lime. 1984. Boundary Water Canoe Area-Quetico Provincial Park: An international partnership. *Western Wildlands* 10(2):13-19.

Working cooperatively with researchers to gather necessary background information, wildland managers both in Canada and the United States have implemented innovative programs to improve public contacts, redistribute recreation use and reduce congestion, reduce resource impacts of campsites, curtail littering, and reduce conflicts between nonmotorized and motorized travelers.

4. Anderson, Dorothy H. 1980. Long-time Boundary Waters visitors change use patterns. *Naturalist* 31(4):2-5.

The article explains the "recreation displacement" process by examining changes which long-time visitors have made in their use of the Boundary Waters Canoe Area Wilderness. Results of a 1980 study revealed that as many as three-fourths of those who visited the Boundary Waters were displaced. Factors found most likely to precipitate displacement were depreciative behaviors, nonwilderness uses, wilderness degradation, and encounters with other users.

5. Anderson, Dorothy H. 1980. Displacement of visitors within the Boundary Waters Canoe Area Wilderness. Ph.D. Dissertation. Fort Collins, CO: Colorado State University. 138 pp.

This study focused on "recreation displacement" and specifically attempts: 1) to identify recreation visitors who have changed their patterns of use within the Boundary Waters, 2) to identify whether changes in use patterns are a result of displacement, 3) to identify setting attributes that may influence displacement, and 4) to suggest the managerial relevance of study findings. Data were gathered in 1980 using a mailback questionnaire. Questionnaires were sent to a sample of visitors who entered the Boundary Waters during the 1978 or 1979 summer use season and who obtained their entry permits from the Voyageur Visitor Center in Ely, Minnesota. Study findings revealed that nearly all respondents had made one or more kinds of change in their recreational use of the area over time.

6. Anderson, Dorothy H. 1981. The effect of user experience on displacement. In *Proceedings of Applied Geography Conference*, eds. J. W. Frazier and B. J. Epstein, 272-79, October 22-24, Vol. 4, Tempe, AZ. 439 pp.

Wilderness visitors were grouped into one of four experience categories based on the number of trips they had made to the Boundary Waters Canoe Area Wilderness in Minnesota. Beginners, moderately experienced users, and veterans were equally likely to be displaced from entry points because of litter, noise, overuse, encounters with large groups, and motorboats.

7. Anderson, Dorothy H., and Perry J. Brown. 1984. The displacement process in recreation. *Journal of Leisure Research* 16(1):61-73.

The article presents the recreation displacement process from a social-psychological perspective and models it within an attitude-behavior framework. The displacement process is illustrated with empirical results from a study of use within the Boundary Waters Canoe Area Wilderness of northern Minnesota. Findings show that factors of displacement include litter, noise, overuse, and visual encounters with others. In most cases recreation resource administrators should be able to managerially control displacing factors.



8. Anderson, Dorothy H., Earl C. Leatherberry, and David W. Lime. 1978. *An annotated bibliography on river recreation*. General Technical Report NC-41. St. Paul, MN: USDA Forest Service, North Central Forest Experiment Station. 62 pp.

River recreation has experienced widespread growth and popularity and has become a major issue in planning, management, and research. More than 300 citations documenting various aspects of the river recreation policy, recreation use, resource and economic impacts, and resource management are presented. Selected literature from the Boundary Waters Canoe Area Wilderness is included.

9. Ballman, Gary, and Uel Blank. 1982. *Impact! Ely area tourism: \$11.6 million per year*. Report prepared for the Ely Area Development Council. St. Paul, MN: Agricultural Extension Service, University of Minnesota. 7 pp.

The report describes the kinds or types of tourists vacationing in Ely, Minnesota. They are classified according to the types of accommodations they use while in the area. Steps necessary to increase the number of tourism dollars spent in Ely are explored.

10. Blank, Uel, and Timothy B. Knopp. 1983. *Tourism market potentials on the North Shore*. Research Note no. 5. St. Paul, MN: Minnesota Sea Grant Program, University of Minnesota. 5 pp.

This report highlights the travel/tourism industry of the North Shore in economic parameters. The authors summarize North Shore tourism trends and economic problems. Potentials for market improvements are discussed as well.

11. Blank, Uel, Wilbur R. Maki, and Kathleen M. Novak. n.d. *Decision systems research for the tourism/recreation industry*. REIFS Report no. 21. St. Paul, MN: Regional Economic Impact Forecasting and Simulation (REIFS), Department of Agricultural and Applied Economics, University of Minnesota. 22 pp.

This report explores a prototype information system built on existing tourism/recreation data. The authors propose to shift the emphasis of tourism/recreation research from impact and market studies to decision information and the means for improving its quality, accessibility, and application. The prototype information system includes information about recreational users, recreational destination areas, linkage between users and the recreation destination area, the facility base of recreation activities, and enroute activities. The data examples focus on the use of recreation resources in northeast Minnesota.

12. Blank, Uel, Lawrence R. Simonson, Gary Ballman, Cynthia Brown, Arnold Heikkila, and Michael Petkovich. 1980. *A needs assessment of tourism firms serving the Boundary Waters Canoe Area Wilderness vicinity*. St. Paul, MN: Agricultural Extension Service, University of Minnesota. 75 pp.

This report provides guidelines for assistance to private tourism-related firms and communities near the Boundary Waters Canoe Area Wilderness (BWCAW). In doing so, this report: 1) documents the role of private operations in providing access to the BWCAW and the importance of tourism in the local economies; 2) provides evidence of area sales indicating an overall pattern of sales losses in real terms; 3) identifies the nature and extent of need for financial and other types of assistance; and 4) suggest criteria for providing the indicated assistance.

13. Bright, Alan, and Michael Manfredo. 1989. *A model for evaluating the effects of a recreation information campaign and an evaluation of BWCAW 1988 wilderness communication efforts*. Final report. Fort Collins, CO: Department of Recreation Resources and Landscape Architecture, College of Forestry and Natural Resources, Colorado State University. 62 pp.

Few studies are available to assist managers in developing, evaluating, and refining communication techniques. The purpose of this study was to propose and test a model of communication effects in recreation settings. The model proposed in this study focuses on (1) the cognitive process of persuasion and (2) the recipient factors which effect this process. An evaluation of the effectiveness of the 1988 Boundary Waters Canoe Area Wilderness communication program is used to test the model.

14. Bultena, Gordon L., and Marvin Taves. 1961. Changing wilderness images and forestry policy. *Journal of Forestry* 59(3):167-71.

The article is concerned with the motives inducing vacationers to visit a forested recreation area, how they interpreted their visit, and the implications for forest policy and management. Data were obtained in two studies (one conducted in 1956, the other in 1958) and included 428 interviews with auto-access campground campers and canoeists in the roadless area of the Quetico Provincial Park and the Superior National Forest. The study indicates that one of major management problem is preserving the wilderness image which visitors cherish, while at the same time providing minimal facilities to satisfy the most urgent demands of those desiring improvements.

15. Dawson, Chad P., and J. Clark Laundergan. 1985. *Recreational Boating on Western Lake Superior during 1984*. Superior Advisory Note no. 18. Duluth, MN: Minnesota Sea Grant Extension Program, University of Minnesota-Duluth. 7 pp.

The article discusses results obtained from a 1984 summer survey of western Lake Superior boaters conducted by the Minnesota Sea Grant program. The report includes descriptions of the average boater, boat characteristics, boat use, boater needs, and the quality of experience. The 1984 results presented bring up to date a similar survey conducted in 1976.

16. Dawson, Chad P., and J. Clark Laundergan. 1985. *1984 Western Lake Superior Recreational Boating Needs and Use Patterns*. Duluth, MN: Minnesota Sea Grant Extension Program, University of Minnesota-Duluth. 96 pp.

The study is a survey of boaters who berth their boats at marinas or are members of boating/yacht clubs and associations throughout the western Lake Superior area during 1984. The survey concentrates on characteristics of boaters and boats, boat use, home ports, and recreational facilities and needs. The researchers feel their study indicates a growing imbalance between demand for recreation experience and the ability of the nation to supply them.

17. Dawson, Chad P., and Karen Plass. 1985. *Western Lake Superior Marinas*. Superior Advisory Note no. 17. Duluth, MN: Minnesota Sea Grant Extension Program, University of Minnesota-Duluth. 8 pp.

The article presents the information from a study of marinas in western Lake Superior conducted during the summer of 1984. The study included marina characteristics, occupancy rates, type of boats, sales and services, slip rental rates, and boat launching and storage rates.

18. Frissell, Sidney S., and Donald P. Duncan. 1965. Campsite preference and deterioration in the Quetico-Superior Canoe Country. *Journal of Forestry* 63(4):256-60.

The report describes research undertaken in the Quetico-Superior Canoe Country of Minnesota and Ontario to determine (a) preferences of canoeists for campsites, (b) character and degree of campsite deterioration, and (c) feasibility of developing prediction equations for campsite durability of alternative sites that might be developed in the future to disperse camping use.

19. Frissell, Sidney S., Jr. 1963. Recreational use of campsites in the Quetico-Superior Canoe Country. M.S. Thesis. St. Paul, MN: University of Minnesota. 66 pp.

During the summer of 1962, 33 canoe parties to the Quetico-Superior Canoe Country were interviewed using an open-ended questionnaire. The objective was to determine the characteristics of preferred campsites. All parties were camping when interviewed and were questioned about the site they occupied. Twenty campsites also were evaluated as to their physical characteristics and to determine changes that take place with use, the causes of such change, and the factors affecting the durability of sites.

20. G. R. Barron and Company, Inc. 1989. *A marketing plan for Voyageurs National Park and resort area*. Minneapolis/St. Paul, MN: G. R. Barron and Company, Inc. 47 pp. (plus appendices).

The report articulates a marketing plan prepared for the Voyageurs Country Tourism Coalition--an organization of resort owners surrounding Voyageurs National Park. Results suggest a potential increase per year in visitorship to the park by an additional 10 to 20 percent with a concentrated marketing effort. Economic benefits to the region and local communities likewise would grow. Recommendations to implement such a marketing effort also are presented.

21. Gladden, James Nelson. 1984. *Wilderness values and the politics of paradigm shifts: The case of the Boundary Waters Canoe Area*. Ph.D. Dissertation. Bloomington, IN: Indiana University. 362 pp.

This dissertation explores the political consequences of a shift in values toward the use of natural resources in a case study of the Boundary Waters Canoe Area (BWCA). Gladden focuses on the move to reduce motorized boats within the BWCA and the political strategies of various groups and individuals. He claims a paradigm shift has occurred in the American political culture toward biocentric values and hence the reduction of motorized use within the BWCA.

22. Gordon Lusty Survey Research, Ltd. 1968. *A study of visitor attitudes towards Quetico Provincial Park*. Toronto: Parks Branch, Ontario Department of Landscape and Forestry. 106 pp.

Based on a mail survey of 1967 visitors to Quetico Provincial Park, this study examines the attitudes and habits of specific types of visitors: "group" visitors, canoers, canoers with motors, and motorboaters. The report also delineates the actual routes used on trips within Quetico.

23. Hamborg, Roland. 1982. A study of the effect of visitor knowledge of regulations in the Boundary Waters Canoe Area Wilderness. Masters/Plan B Paper. Minneapolis, MN: University of Minnesota. 61 pp.

This study investigated the general knowledge Boundary Waters Canoe Area Wilderness (BWCAW) visitors have concerning BWCAW rules. The study also investigated whether visitor education methods affect knowledge levels and the attitudes and knowledge levels of a sample population who had contact with portage crews during their BWCAW visit. A telephone survey was used to contact BWCAW campers who came from Minneapolis-St. Paul, Minnesota.

24. Heberlein, Thomas A., and Geraldine E. Alfano. 1983. *Social carrying capacity for boating Apostle Island National Lakeshore*. Center for Resource Policy Studies Report WIS-SG-84-764. Madison, WI: Center for Resource Policy Studies, University of Wisconsin-Madison. 85 pp.

During the summer of 1981, boater use patterns in the Apostle Islands National Lakeshore were examined to determine whether social carrying capacity had been exceeded by the increase in use level. Boats were counted both from flyovers and rangers; these counts provided measures of system use level and site specific use level. The number of empty slips at marinas were also counted every day as an index of boats entering the system (input use level).

25. Heberlein, Thomas A., Geraldine E. Alfano, and Laurie H. Ervin. 1986. Using a social carrying capacity model to estimate the effects of marina development at the Apostle Islands National Lakeshore. *Leisure Sciences* 8(3):257-74.

This research focuses on the policy question: what will be the effects on the boating experience of adding additional marina slips at Apostle Island National Lakeshore? This research also explores a more basic research issue: can a social carrying capacity model, developed on relatively linear wilderness system, be useful in more complex systems involving nonwilderness recreation? Survey data showed that boaters had clear preferences for mooring with 15 or fewer boats at each site. The projections showed that up to 200 new slips could be added at mainland sites before this preference standard was greatly exceeded. The social carrying capacity model was found to be useful both for developing projections and measuring visitor preferences, suggesting that it is applicable to complex nonwilderness settings.

26. Heberlein, Thomas A., Trudy A. McKinnell, and Laurie H. Ervin. 1986. *Recreational boating in the Apostle Islands National Lakeshore: Current boaters and trends of the last decade*. Paper presented at the International Association for Great Lakes Research 29th Conference, May 26-29. Toronto: Scarborough Campus, University of Toronto. 14 pp.

This study compares 1985 boaters with 1975 boaters at Apostle Islands National Lakeshore in Lake Superior. In 1975, those who anchored offshore or docked at the Islands were studied. In 1985, a new sample of boaters were obtained and mailed questionnaires. Use levels increased at the Apostle Islands by 86 percent between 1977 and 1985, and the number of mainland slips available had increased by nearly 200 in the last five years. The major change in the ten year period, besides the increasing use, was a doubling of the percent of chartering (30% to 59%). The 1985 population is less concerned about crowding than the 1975 group in spite of greater numbers, suggesting a shift to a more tolerant population of boaters.

27. Heberlein, Thomas A., and Jerry J. Vaske. 1979. *The Apostle Islands visitor in 1975*. Working Paper no. 11. Madison, WI: Center for Resource Policy Studies, University of Wisconsin. 255 pp.

The report presents a research program designed to serve as a baseline for visitor use impacts on the Apostle Islands National Lakeshore Area. A visitor survey identified use levels, visitor use patterns, user characteristics, visitor expectations, and a description of policy issues.

28. Heberlein, Thomas A., and Stephen C. Proudman. 1986. *Declining canoe use and social carrying capacity: A 1975-1985 comparison at a Northwoods river*. Paper presented at the First Symposium on Social Science in Resource Management, May 12-16, 1986, Corvallis, OR: Oregon State University. 31 pp.

This report compares 1975 and 1985 survey results of recreational users of the Upper Bois Brule River in northern Wisconsin. The results show a decrease in canoe use and levels of contacts between canoers. The report explores the reasons for the decline in use and the implication for recreation satisfaction and social carrying capacity.

29. Higgs, Joseph F. 1977. A visitor distribution program for the Boundary Water Canoe Area. *Naturalist* 28(4):22-29.

The article discusses the various Forest Service programs implemented following a 1976 study of Boundary Waters Canoe Area Wilderness (BWCA) permit data collected over a 7-year period. The study showed an 86 percent visitor increase to the BWCA. To deal with the increasing numbers of visitors, the Forest Service implemented a long-term reservation system, which included 25 percent of the entry points and a short-term reservation system for the remaining 75 percent.

30. Hollenhorst, Steve, and David Olson. 1990. Who gets the permits? A study of organized and large party use of the Boundary Waters Canoe Area Wilderness. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 390-96. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

Unobtrusive observation techniques were used to investigate organized and large party overnight use in the Boundary Waters Canoe Area Wilderness. Organizations are an important part of the local economy and provide unique wilderness opportunities for many visitors. Unfortunately, organizational groups pose serious management problems. Wilderness management is challenged with ensuring adequate control of these problems while still providing for the needs of these visitors.

31. Hulbert, James H., and Joseph F. Higgins. 1977. BWCA visitor distribution system. *Journal of Forestry* 75(6):338-40.

To prevent resource deterioration and ensure opportunity for high quality wilderness experiences, managers of the Boundary Waters Canoe Area initiated a system to limit the number of permits issued for each entry point. Entry quotas were determined from the carrying capacity of the area's many canoe routes. The system operated successfully in 1976, its first year of operation.

32. Hutchinson, Jay G., and David W. Lime. 1972. In search of campsites. *Naturalist* 23(3&4):18-23.

Describes, through pictures and captions, some of the findings from a 1971 study in the Boundary Waters Canoe Area that used a trip diary to determine how and why boaters and canoeists choose wilderness campsites.

33. Jones, Pamela E. 1987. An evaluation of the "BWCAW User Education Program": A cognitive and behavioral analysis. Ph.D. Dissertation. Minneapolis, MN: University of Minnesota. 182 pp.

The study examined the immediate and long-term cognitive and behavioral changes of participants in a "Boundary Waters Canoe Area Wilderness User Education Program." The goal of the study was to determine whether the program influenced participant intentions to practice minimum impact techniques through self-reported camping behavior and use of Fishbein and Ajzen's reasoned action theory. The study also discusses prediction factors.

34. Jones, Pamela E., and Leo H. McAvoy. 1987. An evaluation of a wilderness users education program: A cognitive and behavioral analysis. In *Proceedings of the Research Symposium: 1987 National Interpreters Workshop*, eds. L. Brochu and M. Legg, 56-63, Nov. 1-5, St. Louis, MO. St. Louis, MO: The Association of Interpretive Naturalists and Western Interpreters Association. 109 pp.

This research investigates the effectiveness of a specific wilderness education program sponsored by managers of the Boundary Waters Canoe Area Wilderness. Results indicate that participants have significantly improved knowledge, attitude, behavior, beliefs and intentions regarding minimum impact camping techniques both immediately after and three months after program attendance.

35. Knopp, Timothy B., and Uel Blank. 1983. *The north shore experience*. Research Report no. 8. St. Paul, MN: Minnesota Sea Grant Program, University of Minnesota. 91 pp.

The report presents the results of a recreation survey of North Shore tourists in 1981. The researchers conclude that North Shore tourists prefer a more meditative, appreciative experience rather than a consumptive, artificially contrived experience. The researchers also offer a "Ladder Model" for guiding future developments and marketing of the North Shore.

36. Knopp, Timothy B., and Uel Blank. 1984. *The North Shore's travel/tourism industry and its market segments*. Research Report no. 7. St. Paul, MN: Minnesota Sea Grant Program, University of Minnesota. 99 pp.

The report describes the travel/tourism industry of Lake Superior's North Shore in economic parameters. The report documents over 24 million tourist dollars spent in the region annually, where the dollars were spent, by whom, and the economic impact to the North Shore area. The potential for market improvement also is explored.

37. Kohls, Steven J. 1986. *Human behavior and attitudes towards wilderness and its associated wildlife. A case study of the Boundary Waters Canoe Area Wilderness*. Special Project Report. New Haven, CT: Yale University. 169 pp.

The intention of this study was (1) to identify major socio-demographic characteristics of visitors to the Boundary Waters Canoe Area Wilderness, (2) to examine visitor motivations and satisfactions, relative to wilderness wildlife and contrast these to other values associated with the wilderness experience, (3) to determine which type of species encountered by visitors add most to their enjoyment, (4) to identify the characteristics of wildlife species which are perceived to be associated with wilderness and, (5) to examine both visitor knowledge and attitudes toward wildlife and to contrast these results with visitor demographics, motivations, and satisfactions. A survey of canoeists was the primary means of gathering data.



38. Langdon, James W. 1965. Problems and limnological aspects of recreational lakes of the Boundary Waters Canoe Area. Master Thesis. East Lansing, MI: Michigan State University. 117 pp.

The report discusses physical, chemical, and biological characteristics of specific Boundary Waters Canoe Area Wilderness (BWCAW) lakes and investigates reports of pollution of Shagawa Lake as well as other lakes within the BWCAW. The study notes many undesirable camping habits such as littering, campsite defacement, and timber destruction, and presents characteristics of local residents and recreational users of the BWCAW. It is proposed that management of the BWCAW be placed in the hands of one person on the Superior National Forest who has a broad background in recreation and management of resources—especially water resources.

39. Leatherberry, Earl C. 1977. *Minnesota canoe and kayak owners: Characteristics and patterns of use*. Research Paper NC-171. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 8 pp.

Registered Minnesota owners of canoes and kayaks were studied in the mid-1970's. One percent of the registered paddle canoe owners and ten percent of registered kayak owners were randomly sampled. An initial questionnaire with two follow-ups yielded 460 usable canoeist and 98 usable kayakist questionnaires. Socioeconomic characteristics, experience with canoeing and kayaking, and characteristics of use were reported. Travel to the Boundary Waters Canoe Area also is described. Management implications also are presented.

40. Lime, David W. 1969. Wilderness-like recreation opportunities adjacent to the Boundary Waters Canoe Area. *Naturalist* 20(1):36-41.

The paper suggests that there are numerous wilderness-like recreation opportunities adjacent to Minnesota's Boundary Waters Canoe Area throughout the remainder of the Superior National Forest. If these opportunities were made known to potential recreation campers to northeastern Minnesota, demand and overuse in some portions of the area could be substantially lessened. The implications of these findings to water-based recreation management are noted. Also, a discussion focuses on the kinds of information needed to help recreation users choose among alternative areas and sites within the area.

41. Lime, David W. 1969. A spatial analysis of auto-camping in the Superior National Forest of Minnesota: Models of campground selection behavior. Ph.D. Dissertation, Pittsburgh, PA: University of Pittsburgh. 285 pp.

This dissertation characterizes factors that explain recreationists' decisions to visit specific sites within a given recreation area. The study describes the decision-making processes and environmental perceptions of the recreating public in their selection behavior. Specifically, the investigation focuses on how selection motives are related to a site's location or accessibility, its internal or onsite characteristics, as well as other human-related factors. The study was conducted during the peak of the camping season (August) in 1967 and 1968. The study consisted of five steps: (1) determining the degree of use intensity at 34 campgrounds, (2) determining the relation between use intensity and campground environmental perception variables, (3) determining campground selection factors based on interview questions, (4) determining the correlation between campers behavior and distribution use analysis, and (5) comparing the decisions for campground location of resource managers and campers campground preferences.

42. Lime, David W. 1971. *Factors influencing campground use in the Superior National Forest of Minnesota*. Research Paper NC-60. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 18 pp.

From a study of Superior National Forest campground use in 1967 and 1968, relationships were determined between the intensity of use and 74 site and locational characteristics. Campers were interviewed to learn what factors influenced their choice of a particular campground. From this knowledge recommendations concerning management as well as the needs for further research were discussed.

43. Lime, David W. 1972. Behavioral research in outdoor recreation management: An example of how visitors select campgrounds. In *Environment and the Soil Sciences: Perspectives and Applications*, eds. J. F. Wohlwill and D. H. Carson, 198-206. Washington, D.C.: American Psychological Association, Inc. 300 pp.

The author discusses weaknesses of traditional outdoor recreation management, how managers can benefit from an understanding of public attitudes, and one behavioral study of auto-access camping in the Superior National Forest and its implications for management.

44. Lime, David W. 1972. *Large groups in the Boundary Water Canoe Area--their numbers, characteristics, and impacts*. Research Note NC-142. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 4 pp.

The author discusses the impact of "large" parties in the Boundary Waters Canoe Area Wilderness in terms of their effect on the resource and on the experience of other visitors. At the same time, a description of the amount of use by large groups and the visitors most likely to be affected by various party size limitations is presented.

45. Lime, David W. 1975. Sources of congestion and visitor dissatisfaction in the Boundary Waters Canoe Area. In *Proceedings, The Quetico-Superior Foundation 1975 Institute on the Boundary Waters Canoe Area*, 68-82, May 9, Duluth, MN. Minneapolis, MN: Quetico-Superior Foundation. 102 pp.

The report summarizes trends in visitor use since the advent of the Wilderness Permit in 1966. The report also reviews a 1971 study of visitor attitudes and perceptions of crowding. It is determined that positive shifts in use suggest a greater significance of the Boundary Waters Canoe Area as a national wilderness resource. Several management actions to reduce crowding are discussed.

46. Lime, David W. 1976. Wildlife is for nonhunters, too. *Journal of Forestry* 74(9):600-04.

The author suggests that forest managers have a mandate to offer a wide variety of wildlife experiences to a broad segment of the public because a large number of recreationists value wildlife for nonhunting purposes.

47. Lime, David W. 1977. When the wilderness gets crowded. *Naturalist* 28(4):2-7.

The article summarizes trends in Boundary Waters Canoe Area (BWCA) use previously identified in several studies conducted by North Central Forest Experiment Station since the advent of the Wilderness Permit in 1966. Two significant trends are: (1) increasingly heavy use and congestion in the BWCA, but only on certain routes and at certain times and (2) the significance of the BWCA as a national wilderness resource is increasing.

48. Lime, David W. 1978. Moose as a nongame recreational resource. In *Proceedings of the Tenth North American Moose Workshop*, 110-34, March 26, 1974, Duluth, MN. St. Paul, MN: Minnesota Department of Natural Resources. 316 pp.

The paper identifies the role of moose as a nongame, recreational resource and its importance to forest recreationists; suggests ways to increase opportunities for people to encounter moose; and, points out the benefits to the public as well as wildlife managers from increasing opportunities for people to encounter moose and other animals in the wild.

49. Lime, David W. 1979. Visitor observation: A tool in appraising interpretive activities. In *Proceedings Association of Interpretive Naturalists Workshop*, 49-55, Feb. 13-17, 1979, Bloomington, MN. Bloomington, MN: Association of Interpretive Naturalists. 76 pp.

An observational study was conducted in July and August 1973 at the Forest Service Voyageur and Sylvania Visitor Information Centers. Each center was studied for 14 days, and over 550 visitors were observed. The focus was to determine how the centers were used as opposed to who the visitors were. The data collection format included sex, estimated age, estimated group composition, incidence of depreciative behavior, total time in center, use of center facilities, total time on self-guided nature trail, total time in exhibit room, time spent at each exhibit, and kinds of information given to visitors who approached information desk.

50. Lime, David W. 1987. Observing visitors as a method of studying use in information centers: Compositions from a 1973 and 1983 study in Minnesota. In *Proceedings of the Research Symposium: 1987 National Interpreters Workshop*, eds. L. Brochu and M. Legg, 70-78, Nov. 1-5, St. Louis, MO. St. Louis, MO: The Association of Interpretive Naturalists and Western Interpreters Association. 109 pp.

This report focuses on systematic observation as a data-gathering technique to help field managers evaluate interpretive activities and services. Results reaffirm the value of the observation technique, not only to describe the physical and social characteristics of the audience, but also to collect important information about what the visitor does in the Voyageurs Visitor Center. It is suggested that center staff can gather such information as part of their work schedules.

51. Lime, David W. (ed.) 1990. *Managing America's Enduring Wilderness Resource*. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

This book documents the activities of the 1989 international conference "Managing America's Enduring Wilderness Resource," held in Minnesota, September 11-17, 1989. More than a dozen presentations included in this publication are directly related to research, planning, and management of northeastern Minnesota wildlands.

52. Lime, David W., Dorothy H. Anderson, and L. David Mech. 1978. Interpreting wildlife through guided expeditions. *Journal of Interpretation* 3(2):10-16.

Two 1974 studies in the Superior National Forest of Minnesota demonstrate some positive effects people gain from encountering wildlife. Participants in wolf-howling safaris and wildlife-sign safaris (including students from a local school system) enjoyed indirect encounters with wildlife.

53. Lime, David W., and Charles T. Cushwa. 1969. *Wildlife esthetics and auto campers in the Superior National Forest*. Research Paper NC-32. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 8 pp.

Many resource managers feel that a high percentage of excursions to forested areas are planned with the objective of seeing wildlife. However, a study of campers in the Superior National Forest did not show wildlife to be a primary attraction of the area, although it was an important supplementary attraction.

54. Lime, David W., and Grace A. Lorence. 1974. *Improving estimates of wilderness use from mandatory travel permits*. Research Paper NC-101. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 7 pp.

Described in this paper is a method used in the Boundary Water Canoe Area for obtaining better visitor use estimates. Compliance rates of different groups are presented and suggestions of ways to increase compliance are presented as well.

55. Lime, David W., and Robert C. Lucas. 1977. Good information improves the wilderness experience. *Naturalist* 28(4):18-21.

The study indicated that an informational brochure is effective for distributing visitor use in the Boundary Waters Canoe Area—provided it is supplied to the user well in advance of the use season. Also, the study concludes that the wilderness permit system is an effective mechanism to reach future wilderness visitors.

56. Lime, David W., Leo H. McAvoy, Curtis Schatz, and David G. Pitt. 1989. *Recreational boating on Lake Superior*. Tourism Center Research Summary no. 5, CD-FO-3880. St. Paul, MN: Minnesota Extension Service, University of Minnesota. 6 pp.

A statewide survey of registered Minnesota boat owners was conducted in 1988 by the University of Minnesota and the Minnesota Department of Natural Resources for the purpose of answering, among other questions, questions related to recreational boating use on Lake Superior. Specific questions addressed in this study are: 1) how does the lake rate as a resource for recreational boating, 2) what problems or barriers to quality boating do boaters perceive regarding the lake, and 3) how can these barriers be remedied?

57. Loesch, Michael A., Lawrence C. Merriam, Jr., and Timothy B. Knopp. 1978. *The opinions of Minnesota residents toward: Voyageurs National Park*. Station Bulletin 522. St. Paul, MN: Agricultural Experiment Station, University of Minnesota. 15 pp.

This study seeks to identify and evaluate the impacts of Voyageurs National Park upon the residents of selected Minnesota communities and to identify factors that significantly contribute to the attitudes toward the park. Minnesota residents in the communities of International Falls, Virginia, Duluth, and Roseville were the focus of this study.

58. Lucas, Robert C. 1962. *The Quetico-Superior area: Recreational use in relation to capacity*. Ph.D. Dissertation. Minneapolis, MN: University of Minnesota. 378 pp.

The author explores the patterns of recreational use (types, amounts, distribution) throughout the Quetico-Superior region. From these patterns, the author relates use to other qualities of the area and user attitudes towards the region. This study identifies major conflicts between various types of wilderness recreation users. Factors that set use limits, current use figures, and trends for varying types of use are discussed.

59. Lucas, Robert C. 1963. *Visitor reaction to timber harvesting in the Boundary Waters Canoe Area*. Research Note LS-2. St. Paul, MN: Lake States Forest Experiment Station, USDA Forest Service. 3 pp.

At the time of this study, the Boundary Waters Canoe Area of the Superior National Forest was the only National Forest location managed for both wilderness-type recreation and timber. Sample groups, interviewed at access points after their visits, seldom noticed logging (18% of all groups) and only 30 percent of those noticing logging said they were bothered by it.

60. Lucas, Robert C. 1964. *The recreational capacity of the Quetico-Superior area*. Research Paper LS-15. St. Paul, MN: Lake States Forest Experiment Station, USDA Forest Service. 34 pp.

Visitor use of the Quetico-Superior Wilderness region continues to grow each year, raising questions about recreational capacity and what are acceptable limits of use. Wilderness qualities were the main attraction for canoe trippers; other visitors considered fishing or scenery primary. Canoeists saw the wilderness as smaller than other visitors. Canoeists also felt the wilderness was overcrowded at lower levels of use and objected strongly to motorboats. A method for measuring capacity indicated total use is close to capacity, but more area is underused than overused. Use projections point to severe overuse. Implications for zoning and visitor regulations are explored.

61. Lucas, Robert C. 1964. *The recreational use of the Quetico-Superior area*. Research Paper LS-8. St. Paul, MN: Lake States Forest Experiment Station, USDA Forest Service. 50 pp.

During summer 1961, about 72,000 people visited the Boundary Waters Canoe Area for an average stay of 4.4 days. Canoeists were the largest group. Maps depicting patterns of visitor use for both canoeists and motor users showed very uneven distributions. Nearness to Canada seemed most important of the factors related to use concentrations. Visits have been climbing rapidly; canoeing seems likely to increase most in the future.

62. Lucas, Robert C. 1964. Wilderness perception and use: The example of the Boundary Waters Canoe Area. *National Resources Journal* 3(1):394-411.

The study examines the perception of wilderness by visitors to Minnesota's Boundary Waters Canoe Area. The study also discusses conflicts between user groups and between management policies and visitors. A comparison of the perceptions of wilderness held by resource managers and various user groups is included. Finally, an outline of possible management alternatives for this area and similar wildland settings is presented.

63. Lucas, Robert C. 1964. Wilderness-user concepts. *Naturalist* 15(4):22-29.

This article attempts to define, or redefine, wilderness and what it means to the user public. In a study conducted in the Quetico-Superior region by the Lake States Forest Experiment Station in 1960-61, three aspects of wilderness perception were explored: 1) the importance of the area's wilderness qualities as an attraction, 2) the area considered wilderness, and 3) the amounts and types of use considered appropriate in the wilderness. Great differences in views on all three aspects were found. However, the variation was largely reduced when visitors to the Quetico-Superior were classified on the basis of the type of recreation they were engaging in.

64. Lucas, Robert C. 1965. *The importance of fishing as an attraction and activity in the Quetico-Superior Area*. Research Note LS-61. St. Paul, MN: Lake States Forest Experiment Station, USDA Forest Service. 3 pp.

Opinions concerning the importance of fishing as a Lake States recreational attraction vary. Data from the Quetico-Superior show large variation between types of visitors. Resort guests fished the most and were disappointed most often; paddling canoeists fished least and seldom complained.

65. Lucas, Robert C. 1965. User concepts of wilderness and their implications for resource management. In *New Horizons for Resources Research: Issues and methodology* (Papers of the 1964 Western Resources Conferences), 29-39. Boulder, CO: University of Colorado Press.

The research was designed to address use distribution estimates, use projections, and recreational carrying capacity in an aesthetic sense. The researchers questioned users of the Quetico Provincial Park and the Superior National Forest. Management implications also are discussed.

66. Lucas, Robert C. 1967. *The changing recreational use of the Boundary Waters Canoe Area*. Research Note NC-42. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 4 pp.

Number of visitors to the Boundary Waters Canoe Area have increased at least 19 percent annually from 1961 to 1966. The greatest increase was in number of canoeists and boaters, which rose about 10 percent annually.

67. Lucas, Robert C., and George B. Priddle. 1964. Environmental perception: A comparison of two wilderness areas. *Annals of the Association of American Geographers* 54(3):428-29.

The abstract summarizes research conducted in the Algonquin Provincial Park and Quetico-Superior Area (made up of Ontario's Quetico Provincial Park and the Boundary Waters Canoe Area of the Superior National Forest in Minnesota). The research focused on user's perception of the wilderness.

68. Madell, Michael R. 1987. Knowledge and attitudes concerning black bears by uses of selected auto campgrounds in the Tofte District of the superior National Forest. Masters/Plan B Paper. Minneapolis, MN: University of Minnesota. 127 pp.

This study investigated the public's level of knowledge concerning black bears, their level of stewardship towards black bears, and their perceptions about the U.S. Forest Service's interpretative efforts about the bear resource. Information was collected through the use of a survey conducted in the Tofte District of the Superior National Forest. The survey consisted of an in-person administered questionnaire and a series of daily observations in four study campgrounds. Results are discussed and the author looks at additions to the interpretive programs and ways the Forest Service can enlarge this study.



69. Manning, Robert E. 1985. Crowding norms in backcountry settings: A review and synthesis. *Journal of Leisure Research* 17(2):75-89.

The author reviews the conceptual and empirical literature that supports crowding in outdoor recreation as a normative concept. Several user studies of the Boundary Waters Canoe Area Wilderness are included in the review.

70. McAvoy, Leo H. 1981. *The recreational demand for development of harbors of refuge in western Lake Superior*. Research Report no. 4. St. Paul, MN: Minnesota Sea Grant Program. 35 pp.

The methods employed to determine demand were observations of current boating use and interviews with current boaters to obtain their opinions on the need for additional harbor facilities. The demand by the boaters interviewed was for small, protected harbors that provide ramp launch facilities, docks to tie up large and small boats, restroom facilities, and camping opportunities.

71. McAvoy, Leo H., and Roland Hamborg. 1984. Wilderness visitor knowledge of regulations: A comparison of visitor contact methods. *Journal of Interpretation* 9(1):1-10.

The article compares the effectiveness of wilderness visitor contact methods and examines visitors' knowledge of regulations within the Boundary Waters Canoe Area Wilderness. It is indicated that: 1) although inappropriate behavior was prevalent in the area, there was generally a high degree of regulation knowledge among sampled visitors; 2) Forest Service facilities and brochures elicited a higher degree of regulation knowledge from respondents than did other contact methods; and 3) long-time visitors scored significantly higher than short-time visitors on a test of their knowledge of regulations.

72. McCool, Stephen F. 1970. Dynamics of interpersonal interaction in the forest environment: An exploration of outfitter-camper relationships in the Boundary Waters Canoe Area. Ph.D. Dissertation. St. Paul, MN: University of Minnesota. 189 pp.

This 1968-69 study investigated (1) the influence of the outfitter on the camper's attitudes toward Boundary Waters Canoe Area (BWCA) management issues, and (2) the influence of the outfitter on the camper's compliance with BWCA littering regulations. For the collection of data, interviews were held over a two-year period with both outfitters and campers. Of the 38 firms which outfit parties into the BWCA, 20 were selected for intensive study. Interviews with 499 campers were conducted at 12 access points and one portage during the summers of 1968 and 1969. Study findings revealed: (1) personal referral was found to be the most important source of information about the BWCA for all groups; (2) the amount of equipment a group rents and its previous experience in the BWCA were found to be the best predictors of interaction; (3) between 75 and 85 percent of the campers interviewed opposed allowing public roads, underground shaft mining, and resorts and homes in the BWCA; and (4) outfitted groups who interacted with the outfitter on campsite cleanup were more likely to comply with littering regulations than noninteractors.

73. McCool, Stephen F., and Lawrence C. Merriam, Jr. 1970. *Factors associated with littering in the Boundary Waters Canoe Area*. Minnesota Forestry Research Note no. 218. St. Paul, MN: School of Forestry, University of Minnesota. 4 pp.

The report defines those variables most meaningfully related to sensitivity about litter and compliance with littering regulations, discusses the role of outfitters in communicating and reinforcing norms, and examines the need for managers to establish relations with nonoutfitted groups to gain compliance.

74. McCool, Stephen F., and Lawrence C. Merriam, Jr. 1970. *Travel method preference of BWCA campers*. Minnesota Forestry Research Note no. 219. St. Paul, MN: School of Forestry, University of Minnesota. 4 pp.

Probes the extent to which canoeists and motor boaters are satisfied with their method of travel. It also examines the reactions of people toward other travel methods and discusses future patterns of use and management implications.

75. McCool, Stephen F., and Lawrence C. Merriam, Jr. 1971. *Camper-outfitter interaction and the Boundary Waters Canoe Area, Superior National Forest, Minnesota*. Minnesota Forestry Research Note no. 225. St. Paul, MN: College of Forestry, University of Minnesota. 4 pp.

Focuses on describing the communication processes of outfitters and wilderness visitors. In particular, identifies visitors' information sources and levels of knowledge about the area and their attitudes on several important management policy issues.

76. McKinnell, Trudy, and Thomas A. Heberlein. 1987. *Increased use level and decreased crowding: Change over ten years at the Apostle Islands National Lakeshore*. Paper presented at the Rural Sociological Society Annual Meeting, August 12-15, University of Wisconsin-Madison. 26 pp.

This study compares recreational boaters of the Apostle Islands National lakeshore in Lake Superior in 1975 and 1985. The number of boater-nights doubled, but the 1985 boaters felt less crowded. The changing social and psychological characteristics accounted for only part of this change. Despite statistical controls, 1985 visitors were still less crowded. The full model did show that more contacts lead to more crowding and that younger people feel more crowded. The model also showed that those who preferred more contacts, had less experience or had no preference about the number of contacts felt less crowded. These findings were consistent with other studies of crowding in recreation settings.

77. Merriam, Lawrence C. 1986. *The Boundary Waters Canoe Area Wilderness (BWCAW) of Minnesota: Changes (1966-1986). Has the wilderness disappeared?* Station Bulletin AD-SB-2926. St. Paul, MN: Agricultural Experiment Station, University of Minnesota. 24 pp.

The author outlines past trends in Boundary Waters Canoe Area (BWCA) legislation, management concerns, recreational use, and other resource uses from 1966 to 1986. The BWCA has evolved over the years from a lightly-used region with mixed opportunities, to a popular publicized wilderness readily accessible to over half the population of the United States. The paper assesses the current status of the Canoe Area and whether or not wilderness values in the region are decreasing.

78. Merriam, Lawrence C., Jr., and Vilis Kurmis (eds.). 1981. *Voyageurs National Park, Minnesota: Research studies of a new park, its development, potential visitors, and plant communities, 1973-1980*. St. Paul, MN: College of Forestry, University of Minnesota. 15 pp.

The study presents basic inventory data on the development of the Voyageurs National Park, including vegetation, water quality, wildlife, and the cultural effects of development. The study also summarizes the studies of residents of various Minnesota communities and their opinions about the Park; and a major plant-community study done over a period of three years—from 1977 to 1979—concerning the vegetation of the Park.

79. Mid-Continent Surveys, Inc. 1980. *Chicago markets for BWCA vacations: A survey research study*. Report prepared for the Agricultural Extension Service, University of Minnesota. Minneapolis, MN: Mid-Continent Surveys, Inc. 48 pp.

This research study, completed in 1980, attempts to identify market segments in the Chicago area which have a high likelihood of vacationing in the Boundary Waters Canoe Area (BWCA) and/or the nearby area, and to recommend a marketing program for attracting these market segments to the BWCA area. The surveyed households had a median income in the \$25-35,000 range. The 750 respondents were not a representative cross-section of Chicago residents. They fell into the upper two-thirds income of the area, and at least one adult in the household had to have taken at least one or more 500-plus-mile vacation trip within the last 3 years. The survey recommends various estimates on the vacation needs (lodging, equipment, and so forth) of these market segments. Helps determine the BWCA's current image among these areas and attempts to identify media patterns for these market segments.

80. Mid-Continent Surveys, Inc. 1981. *Midwest markets for BWCA vacations: A survey research study*. Report prepared for the Agricultural Extension Service, University of Minnesota. Minneapolis, MN: Mid-Continent Surveys, Inc. 57 pp.

This research project, completed in the spring of 1981, identifies market segments in Des Moines, Springfield, Indianapolis, and Kansas City which have a high likelihood of vacationing in the Boundary Waters Canoe Area (BWCA) and/or the nearby area. It provides estimates of the vacation needs of the visitors, and determines the BWCA area's current image among those marketing segments. Through its survey of 250 scientifically sampled adults done jointly with the University of Minnesota Agricultural Extension Service, they identified the media patterns for these market segments and recommended a marketing program for attracting these markets to the BWCA area.

81. Miller, Delbert. 1972. *Wilderness campsites: Change, use, and users*. M.S. Paper, St. Paul, MN: University of Minnesota. 35 pp.

Based on findings from five years of research in the Boundary Waters Canoe Area of Minnesota, the study analyzed BWCA campsite change as it relates to visitor use. The study discusses the visitor's selection of and reaction to the study campsites. It was indicated that physical change on BWCA campsites was evaluated by monitoring the change in key site features, and visitor evaluation of BWCA sites was significantly affected by the visitors' travel means.

82. Mills, Allan S., L. C. Merriam, Jr., and C. E. Ramsey. 1975. *Campers and resorters in northern Minnesota: Some implications for Voyageurs National Park management*. Minnesota Forestry Research Notes no. 256. St. Paul, MN: College of Forestry, University of Minnesota. 4 pp.

A random probability sample of two groups of car campers were taken in the summer of 1973, one at Woodenfrog State Forest Campground bordering the south edge of Voyageurs Park and the other at Scenic State Park, situated about 110 miles south of the park locations. A selected judgement sample of resort guests was taken from the Voyageurs Park area at the same time. Both state campground areas in the sample have similar aesthetic characteristics, are located on lakes known for fishing, and have a number of facilities and activities available to users. The interview schedule included items concerning socio-economic information, activities in the respective areas, reasons for coming to that location, and in the case of campers, items on camping, attitudes and experiences with national parks, and development preferences.

83. Mills, Allan S., L. C. Merriam, Jr., and C. E. Ramsey. 1976. *Public opinion and park development*. Station Bulletin 516. St. Paul, MN: Agricultural Experiment Station, University of Minnesota. 11 pp.

The study tested the reliability and predictive validity of the Minnesota Scale used to assign discrete development preferences to campers in public park campgrounds in Minnesota. The survey was conducted with campers in several camping areas including Woodenfrog State Forest which is adjacent to Voyageurs National Park. Campers were analyzed in terms of: 1) priorities of park development preferences, and 2) comparisons of preferences between first-time and repeat campers and between rural and urban campers, and for types of camping equipment.

84. Nelson, Ernest E., and Jay M. Hughes. 1968. *Travel distance and joint visitation to the Boundary Waters Canoe Area and adjacent Canadian wilderness*. Minnesota Forestry Research Note no. 185. St. Paul, MN: School of Forestry, University of Minnesota. 4 pp.

Presents results of a study designed to quantify some of the distance-visitation relationships for the Boundary Waters Canoe Area and adjacent Quetico Provincial Park in Canada. In addition, it examines the "Northness Hypothesis" which states that there is a strong allure to the north woods and the more northern the area, the more attractive it becomes for some visitors.

85. Orning, George W. 1966. *Private pleasure boating in the national forests of Minnesota*. Research Note NC-15. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 4 pp.

An analysis of boating patterns in the mid-1960's suggested that if present boating trends continued in Minnesota's two National Forests, the lakes near the Boundary Waters Canoe Area would bear the brunt of the anticipated increased use in the Superior National Forest; on the Chippewa National Forest three large lakes were expected to receive the most growth.

86. Peterson, George L. 1971. *Motivations, perceptions, satisfactions and environmental dispositions of Boundary Waters Canoe Area users and managers*. Final Report. Evanston, IL: Department of Civil Engineering, The Technological Institute, Northwestern University. 264 pp.

This pilot study was concerned with objectives, perceptions, satisfactions, and environmental dispositions of users and managers in Minnesota's Boundary Waters Canoe Area (BWCA). The purpose of this research was to explore the application of elementary techniques of psychological measurement and statistics toward quantitative analysis. Particular emphasis was on (1) visitors' trip motives, (2) perception of the BWCA to satisfy user objectives, (3) desirability of area conditions that exist in this wilderness, (4) perception of the commonness of desired conditions in the area, and (5) feelings about the pleasantness of recreation activities that might be available in the canoe country.

87. Peterson, George L. 1974. A comparison of the sentiments and perceptions of wilderness managers and canoeists in the Boundary Waters Canoe Area. *Journal of Leisure Research* 6(3):194-206.

Examines objectives, perceptions, satisfactions, and environmental dispositions of users and managers in the Boundary Waters Canoe Area of the Superior National Forest. It compares the attitudes and perceptions measured in the field with attitudes and perceptions measured later by mailback questionnaires. This research also analyzes the biases introduced by the voluntary nature of the mail survey. The study is based on a limited sample of August canoeists from Cherokee-Long Island Lakes region and a small sample of foresters.

88. Peterson, George L. 1974. Evaluating the quality of the wilderness environment. *Environment and Behavior* 6(2):169-93.

This research made use of psychological inventories to measure aspirations for and perceptions of a spectrum of concrete details of the wilderness experience. Discusses the evaluation problem first, including an explanation of why the proposed approach is needed. This is followed by a theoretical explanation of the method itself. In the third section of the paper, the technique is applied to the Boundary Waters Canoe Area to illustrate how it works and the kinds of information it produces. In the final section the method and its illustrative results are summarized and evaluated.

89. Peterson, George L., Dorothy H. Anderson, and David W. Lime. 1982. Multiple-use site demand analysis: An application to the Boundary Waters Canoe Area Wilderness. *Journal of Leisure Research* 14(1):27-36.

A single site multiple use trip demand model is derived from a multiple site regional model based on utility maximizing choice theory. The model is applied to analyze and compare trips to the Boundary Waters Canoe Area Wilderness for several types of use. Travel cost elasticities of demand are compared and discussed.

90. Peterson, George L., and David W. Lime. 1973. Two sources of bias in the measurement of human response to the wilderness environment. *Journal of Leisure Research* 5(2):66-73.

This research examines two potential sources of bias in the measurement of human response to the wilderness environment: (1) substantial bias caused by differences between the situation in the wilderness and the situation at home and (2) voluntary response bias in mail surveys caused by differences between people who return mail questionnaires and people who do not. Results are based on research studies conducted on the Boundary Waters Canoe Area. Results show that such biases produce differences in degree, not in kind of response.

91. Peterson, George L., and David W. Lime. 1980. How does travel distance to the Boundary Waters influence use? *Naturalist* 31(4):22-27.

The authors analyze the distance traveled and money expended versus the recreational activity in the Boundary Waters Canoe Area. The study indicates visitors are willing to travel further and spend more money for water-based and overnight camping activities. In addition, the summarization of zip code data shows the Boundary Waters to be a national wilderness resource since nearly half of all visitor-days of use and trip expenditures occur outside Minnesota. The authors suggest that the data also could be used to direct information strategies to potential visitors.

92. Peterson, George L., Daniel J. Stynes, and J. Ross Arnold. 1985. The stability of a recreation demand model over time. *Journal of Leisure Research* 17(2):121-32.

Temporal stability of a simple recreation demand model, specified in terms of distance and population, is tested using a census of paddle canoe-camping trips to the Boundary Waters Canoe Area Wilderness for 1974-77, 1980, and 1981. The effect of population is stable over time, but the distance elasticity of demand changes, possibly indicating change in consumer tastes and preferences. The distribution of trips among origins is robust, and parameters based on 1974-77 data forecast 1980 and 1981 data as well as the 1980 and 1981 parameters. Increases in the overall level of participation cannot be explained by the model or by changes in its exogenous variables. Plausible causes of change, including specification error, are discussed and directions for future research are recommended.

93. Phelps, Carolyn, C., and David W. Lime. 1990. *Apostle Islands National Lakeshore 1989 sea-kayaker study*. Final report. St. Paul, MN: Department of Forest Resources and Park Service Cooperative Park Studies Unit, University of Minnesota. 8 pp. plus 49 tables and appendices.

The report documents a 1989 pilot study to monitor sea-kayak visitors' use patterns, socioeconomic characteristics, and opinions. Onsite observations and mailback questionnaires were used in this research. These methods seem appropriate, with modifications, for trend studies and for application in other studies of dispersed recreation.

94. Proescholdt, Kevin. 1984. *After the shouting stopped: Implementation of the Boundary Waters Canoe Area Wilderness Act*. Minneapolis, MN: Minnesota Audubon Council. 155 pp.

Documents and analyzes the implementation of the Boundary Waters Canoe Area Wilderness Act of 1978. Chapters include policy issues, historical analysis, legislative history, and subsequent implementation actions. Several chapters include research summaries of motorboat quotas, resort/outfitters financial assistance, snowmobile use, and general management of recreational opportunities.

95. Schmidt, Ross. 1973. The Boundary Waters Canoe Area: The paradox of use and preservation. *Geographical Survey* 2(1):11-16.

Discusses the overuse problems in the Boundary Waters Canoe Area and increasing attention paid by conservationists and government organizations following this issue. The conflict of various interest groups plays an important role in the future of the area. The author suggests eventual need to limit visitors to the area.

96. Schomaker, John H., and David W. Lime. 1986. Wilderness information specialists at portals: Information disseminators and gatherers. In *Proceedings from National Wilderness Research Conference: Current Research*, compiler R. C. Lucas, 249-53, July 23-26, 1985, Fort Collins, CO. General Technical Report INT-212. Ogden, UT: USDA Forest Service, Intermountain Research Station. 553 pp.

Points out appropriateness of consumer feedback in wilderness recreation, describes duties of contact people at wilderness entrances and types of information they can gather, and discusses usefulness of gathered information to managers and the requirements for successful conversational interviews.

97. Schomaker, Pamela J. 1990. Off-site visitor education in the Boundary Waters Canoe Area Wilderness: The BWCAW User Education Program. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 142-47. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

In the Boundary Waters Canoe Area Wilderness (BWCAW), managers have developed a number of visitor education methods, including an off-site program entitled the BWCAW User Education Program. The paper evaluates this program and makes suggestions for development of similar off-site visitor education programs in other wilderness settings.



98. Searle, R. Newell. 1977. *Saving Quetico-Superior: A land set apart*. St. Paul, MN: Minnesota Historical Society Press. 275 pp.

This book describes the history of the Quetico-Superior country and the move to protect the area as a wilderness. Within the historical account, numerous research projects on user characteristics and use patterns are mentioned.

99. Shelby, Bo, Jerry J. Vaske, and Thomas A. Heberlein. 1989. Comparative analysis of crowding in multiple locations: Results from fifteen years of research. *Leisure Sciences* 11(4):269-91.

Crowding is one of the most frequently studied phenomena in the outdoor recreation literature, but almost all the research focuses on single populations or settings and individual-level analysis. The present study uses comparative analysis of aggregate data to explore questions that single studies cannot answer. Data comes from more than 17,000 individuals in 35 studies of 59 different settings or activities, including the Boundary Waters Canoe Area Wilderness, Apostle Islands National Lakeshore, and the Brule River in northern Wisconsin.

100. Stankey, George H. 1971. The perception of wilderness recreation carrying capacity: A geographic study in natural resources management. Ph.D. Dissertation. East Lansing, MI: Michigan State University. 351 pp.

This dissertation investigates the question of carrying capacity in wilderness settings. The study was conducted in four national forest wilderness areas, including the Boundary Waters Canoe Area. A survey attempted to define visitor parameters of carrying capacity and possible management techniques to control carrying capacity. The four aspects of carrying capacity included in the study are level of use, type of use, location of encounters, and depreciative user behavior. Twelve potential management techniques are identified and a probabilistic model for estimating carrying capacity is outlined.

101. Stankey, George H. 1971. Wilderness: Carrying capacity and quality. *Naturalist* 22(3):7-13.

This study, undertaken in four different wilderness areas in 1969, was concerned with visitors' attitudes towards: (1) levels of use; (2) types of use; (3) location of encounters with others and the timing of those encounters; and (4) the effects of inappropriate behavior, specifically littering and campsite wear and tear. The study was conducted in the Bob Marshall Wilderness in Montana, the Bridger Wilderness in Wyoming, the High Uintas Primitive Area in Utah, and the Boundary Waters Canoe Area (BWCA) in Minnesota. It was found that a high quality experience was characterized by very few encounters in an environment where man's evidence was minimal and camping locations that afforded the visitor complete solitude. In the BWCA, this would include no encounters with outboard motors. Conversely, it was found that a low quality experience involved numerous encounters with large parties, an inability to locate an isolated camp, and where one continually encountered evidence of man's presence.

102. Stankey, George H. 1973. *Visitor perception of wilderness recreation carrying capacity*. Research Paper INT-142. Ogden, UT: Intermountain Forestry and Range Experiment Station, USDA Forest Service. 61 pp.

The paper presents results of a study of wilderness users in the Bob Marshall, Bridger, High Uintas, and the Boundary Waters Canoe Area (BWCA) to determine their perception of and reaction to problems such as crowding, littering, and conflicts between user groups, and to management actions to alleviate such problems. Suggested management actions include: (1) limit party size; (2) restrict motor use in the BWCA; (3) encourage "off-season" use; and (4) zoning.

103. Stankey, George H., Robert C. Lucas, and David W. Lime. 1976. Crowding in parks and wilderness. *Design and Environment* (Fall):38-41.

The article discusses the increased recreational use of designated wilderness areas such as the John Muir Wilderness in California and the Boundary Waters Canoe Area in Minnesota and the difficulty of wilderness management with problems of overuse. It presents the pattern of use and use-density in some individual wilderness areas and how such information can aid management decisions. Finally, it proposes some solutions for spreading use more evenly (e.g., information for visitors to disperse use and increases in the supply of classified wilderness and related primitive environments).

104. Stone, Gregory P., and Marvin J. Taves. 1956. Research into the human element in wilderness use. In *Proceedings Society of American Foresters Meeting*, 26-32, Oct. 15-17, Memphis, TN.

The paper presents a view of man in the wilderness and an agenda for research problems that concern sociology. The sample is based on the accessibility of users for interviews and questionnaires in the Quetico-Superior area. The authors summarize the data in terms of user characteristics, trip planning, imagery of the wilderness, and sociology of camping.

105. Taves, Marvin, William Hathaway, and Gordon Bultena. 1960. *Canoe country vacationers*. Miscellaneous Report 39. St. Paul, MN: Agricultural Experiment Station, University of Minnesota. 28 pp.

The field study was conducted in the Quetico-Superior during the summer of 1958 and one of the very earliest visitor use studies in the region. Campers and canoeists were interviewed in campgrounds adjacent to the Boundary Waters Canoe Area and on canoe routes. The study focused on user characteristics, preparation for the trip, and user attitudes toward the area, management, facilities, and other users.

106. Taves, Marvin, and James T. Morgan. 1960. Canoe country camping--who? where? why? *Minnesota Farm and Home Science* 17(3):3,20.

The article highlights the results of a 1958 survey of Superior National Forest users who were either wilderness canoers or campers in established campgrounds near the wilderness. The report summarizes 383 users' views on wilderness management and attractions as well as documents user characteristics.

107. Vickery, Jim dale. 1989. We the visitor: Part I. *The Boundary Waters Journal* 2(4):23-29.

This article explores recreational use and visitation in the Boundary Waters Canoe Area Wilderness (BWCAW) from the early 1920's until 1987. A summary of the management history of the area as well as a summary of the results of a wide variety of research studies concerning use and visitation in BWCAW are presented.

108. Vickery, Jim dale. 1989. We the visitor: Part II. *The Boundary Waters Journal* 3(2):66-70.

This article continues (a continuation of Part I, "We the visitor," Spring 1989, *The Boundary Waters Journal*) to explore use and visitation in the Boundary Waters Canoe Area Wilderness (BWCAW). Use and visitation figures for the BWCAW are updated from 1987 to 1988. A summary of current, ongoing research projects and potential management implications follows.

109. Wildland Research Center, University of California. 1962. *Wilderness and recreation--a report on resources, values and problems*. Review Commission Study Report 3. Washington, D.C.: Outdoor Recreation Resources. 352 pp.

Personal interviews were conducted during July and August, 1960, with 491 respondents in seven wilderness areas (including the Boundary Waters Canoe Area). This research was initiated in an attempt to gain systematic knowledge of wilderness users and wilderness use on a multi-area basis covering a broad range of topics. Examines factors which influence how people use and react to wilderness settings.

110. Wilson, Fergus. 1977. Quetico Provincial Park. *Naturalist* 28(4):12-15.

The article describes the reasons for a Visitor Distribution Program in Ontario's Quetico Provincial Park. The program is the first visitor regulation system implemented in this Ontario wilderness and is directed at mitigating visitor impacts such as overused campsites, large parties, and congested routes. The program was established with built-in monitoring mechanisms to assess the success of the program.

## SECTION 2

### Investigations of Environmental Impacts

(see also 8, 18, 19, 38, 51, 81)

111. Barton, Michael A. 1969. Water pollution in remote recreational areas. *Journal of Soil and Water Conservation* 24(4):132-34.

The concentrated use of remote recreation areas, such as Minnesota's Boundary Waters Canoe Area, threatens water quality. Solid wastes, enriched waters from adjacent municipalities, human waste, gasoline from outboard engines, and insecticides all contribute to a potentially serious pollution problem. Natural inputs, such as sedimentation, also must be considered. A system is proposed for monitoring selected constituents (e.g., phosphorus and fecal coliform).

112. Barton, Michael A. 1969. Waters of the canoe country. *Naturalist* 20(1):42-47.

This article speaks on the water quality of the Boundary Waters Canoe Area and its inherent attractiveness to the visitors of that wilderness. A study conducted in 1969 is summarized that describes the many factors involved that produce such pristine waters and how these waters are now being contaminated by nutrient disposal. Sampling points were established at 51 locations within the Wilderness. Stations were selected to represent areas of little visitor use, areas of heavy visitor use, downstream locations from external nutrient sources and discharge from the area. Volume of flow measurements were made to determine total chemical discharge rather than just concentration. Natural change to the area's water quality cannot be prevented, but the impact of mankind can be minimized.

113. Cole, David N., and Jeffrey L. Marion. 1986. Wilderness campsite impacts: Changes over time. In *Proceedings of the National Wilderness Research Conference*, compiler R. C. Lucas, 144-51. General Technical Report INT-212. Ogden, UT: USDA Forest Service. 553 pp.

How wilderness campsite impacts change over time was the object of both a 5-year longitudinal study in the Eagle Cap Wilderness, Oregon, and a cross-sectional study in the Boundary Waters Canoe Area, Minnesota. Conclusions from the two studies generally support each other. The major types of impact that increase substantially after the first few years a site is used are campsite area, tree damage, loss of organic horizons, exposed mineral soil, and perhaps bulk density. Even with these types of impact, most changes appear to occur within the first 5 to 10 years after a site is developed. Suggestions for minimizing long-term campsite deterioration are offered.

114. Frissell, Sidney S. 1978. Judging recreation impacts on wilderness campsites. *Journal of Forestry* 76:481-83.

The paper describes a classification scheme based on a rating of the degree of human-caused change on wilderness campsites. The criteria include visual indicators and patterns of site change. A section on management application is also included.

115. King, John G. 1971. The effects of recreational use on water quality in the vicinity of campsites in the Boundary Waters Canoe Area. Masters Thesis. St. Paul, MN: University of Minnesota. 107 pp.

This study evaluated a few of the chemical parameters of water quality in two lake systems in the Boundary Waters Canoe Area—the Moose Lake chain of lakes and Isabella Lake and River. Sampling was conducted at campsites and at established controls. Data revealed that the recreational use of these lakes is affecting certain water quality parameters, especially the population of coliform bacteria. At the same time, it was indicated that the effect on the lakes is small. However, oligotrophic lakes quickly respond to only small changes in nutrient levels.

116. King, John G., and Arnett C. Mace, Jr. 1972. Can we keep our canoe country waters clean? *Minnesota Volunteer* 35(205):57-61.

The article presents a summary of the impacts of visitor use in the Boundary Waters Canoe Area (BWCA). The article points out that most visitors confine themselves to water-based activities and have an impact on the water quality in the BWCA. Some water quality parameters are discussed as well as suggestions for future monitoring of water quality.

117. King, John G., and Arnett C. Mace Jr. 1974. Effects of recreation on water quality. *Journal of Water Pollution Control* 46(11):2453-59.

A study was initiated in 1970 to determine if wilderness campsite use within the Boundary Waters Canoe Area (BWCA) was noticeably affecting the quality of nearby water. The two areas chosen were the Moose Lake chain of lakes and the Lake Isabella area. Each campsite was sampled twice during the summer. Results show that the recreational use of these campsites seems to affect the total coliform bacteria populations and the available phosphate concentrations in the vicinity. Because of the rapid growth in visitation to the BWCA, this article suggests periodic monitoring of the quality of the lakes.

118. Legg, Michael H., and Gary Schneider. 1977. Soil deterioration on campsites: Northern forest types. *Soil Science Society of America Journal* 41:437-41.

Camping use and soil deterioration were monitored on 12 backcountry campsites in the western Upper Peninsula of Michigan during their third and fourth camping seasons. Sites were chosen on previously undistributed Gogebic fine sandy loam under mature northern forest cover. Percentage of litter cover, soil macropore space and depth to A2 horizon decreased, and soil bulk density increased with time during both use seasons. Deterioration increased greatly on all campsites with intensity of use. Except for depth to A2 horizon, measured parameters recovered partially over winter, but recovery was less than deterioration during the previous summer.

119. Marion, Jeffrey L. 1984. Ecological changes resulting from recreational use: A study of backcountry campsites in the Boundary Waters Canoe Area, Minnesota. Ph.D. Dissertation. St. Paul, MN: University of Minnesota. 279 pp.

This study examines the ecological changes which have occurred on 96 Boundary Waters Canoe Area Wilderness campsites. Biophysical measurements were taken on both campsites and adjacent environmentally similar but undisturbed control sites. Differences between campsite and control measures were compared in an effort to: 1) identify and measure the extent of vegetative, soil, and physical site changes, 2) evaluate and relate differences in the extent of these changes to important influential factors, 3) assess the relative recreational durability of vegetation and soil types, and 4) evaluate management-oriented impact assessment and monitoring systems.

120. Marion, Jeffrey L. 1986. Campsite impact assessment systems: Application, evaluation, and development. In *Proceedings of the 1984 Natural River Recreation Symposium*, eds. J. S. Popadic, D. I. Butterfield, D. H. Anderson, and M. R. Popadic, 561-73, Oct. 31-Nov. 3, 1984. Baton Rouge, LA: Louisiana State University, School of Landscape Architecture. 740 pp.

The report reviews campsite impact assessment systems, evaluates the effectiveness and accuracy of two widely-used systems on campsites in the Boundary Waters Canoe Area Wilderness, and outlines procedures for the development of flexible area-specific impact assessment systems.

121. Marion, Jeffrey L., and Lawrence C. Merriam. 1985. Predictability of recreational impact on soils. *Soil Science Society of America Journal* 49(3):751-53.

Biophysical measurements were taken on 96 paired campsites and controls in the Boundary Waters Canoe Area Wilderness of northeastern Minnesota. Multiple regression analysis was used to identify and evaluate factors affecting changes in bulk density, organic horizon thickness, and exposed soil associated with campsite use. The best predictors of change in bulk density were campsite age, mineral soil organic content, organic horizon thickness, and offsite bulk density. Level of use and campsite age were the best predictors of amount of exposed soil. Bulk density and exposed soil continued to increase with campsite age, even though all sites included in the study were >5 years in age. Other studies have not found this relationship. This information can be used to assist managers in selecting recreation site locations and appropriate site management techniques.

122. Marion, Jeffrey L., and Lawrence C. Merriam. 1985. *Recreational impacts on well-established campsites in the Boundary Waters Canoe Area Wilderness*. Station Bulletin AD-SB-2502. St. Paul, MN: Agricultural Experiment Station, University of Minnesota. 15 pp.

This study examined recreationally related changes on 96 well-established campsites in the Boundary Waters Canoe Area Wilderness. Biophysical measurements taken on campsites and adjacent environmentally similar but undisturbed control sites were compared in an effort to identify and assess the extent of vegetative, soil, and physical site changes. The authors found a number of important biophysical impacts resulting from recreational use of these campsites. In terms of an ideal wilderness, all of these changes are significant because they represent deviations from natural conditions. Many biophysical changes occur even at low use levels and are inevitable if use is to be accommodated. Increasing wilderness recreational pressures in the future will require managers to deal with the resulting changes. Improved site selection criteria, and limited resource manipulation in the form of rehabilitation programs may also aid in minimizing recreational impacts and restoring existing sites.

123. Marion, Jeffrey L., and Toivo Sober. 1987. Environmental impact management in the Boundary Waters Canoe Area Wilderness. *Northern Journal of Applied Forestry* 4(1):7-10.

Increases in wilderness and backcountry recreational use have resulted in significant environmental impacts that are requiring more intensive visitor and resource management by the managing agencies. Resource impacts in the nation's most highly used wilderness, the Boundary Waters Canoe Area, have been reduced through the implementation of a designated site camping policy in the early 1970s. The number and location of sites are matched to visitor numbers and use patterns by a travel model developed from visitor trip records. Recently, a campsite rehabilitation program has been extended to campsites currently in use in an effort to restore natural conditions and prevent impacts from reaching unacceptable levels. This has been accomplished through the use of native materials and plant species to reduce both the area and the extent of impact at each campsite.

124. McCool, Stephen F., Lawrence C. Merriam, Jr., and Charles T. Cushwa. 1969. *The condition of wilderness campsites in the Boundary Waters Canoe Area*. Minnesota Forestry Research Note no. 202. St. Paul, MN: School of Forestry, University of Minnesota. 4 pp.

Campsites on islands and major travel routes were more deteriorated than mainland or off route sites. Intensity of use was thought to be as important as physical characteristics in the rate of deterioration of wilderness campsites.

125. McIntyre, Judith Muriel Watland. 1975. *Biology and behavior of the common loon (Gavia imer) with reference to its adaptability in man-altered environment*. Ph.D. Dissertation. Minneapolis, MN: University of Minnesota. 230 pp.

Life history of the common loon includes a small clutch size, a long period of parental care, onset of first breeding after the second year, and a long life span. Consequently, loons are subject to the potential hazards of a wide range of toxic chemicals and increased human recreational use of lakes because of their aquatic habits and conflicts with humans for prime habitat. Loons were studied in several locations, including northeastern Minnesota, to assess their ability of adapting to environmental changes.

126. Merriam, Lawrence C., Jr., Kent Goeckermann, James A. Bloemendal, and Terrance M. Costello. 1971. *A progress report on the condition of newly established campsites in the Boundary Waters Canoe Area*. Minnesota Forestry Research Note no. 232. St. Paul, MN: College of Forestry, University of Minnesota. 4 pp.

This study focuses on visitor use impact on campsites in the Boundary Waters Canoe Area. The study is unique because it deals with campsites created in 1968 and is able to study the use impacts from the creation of the campsites. The measurements focused on visitor use effects upon varying vegetation and soil types, varying locations, slopes and aspects.

127. Merriam, Lawrence C., and R. F. Peterson. 1983. *Impact of 15 years of use on some campsites in the BWCA*. Minnesota Forestry Research Note no. 282. St. Paul, MN: College of Forestry, University of Minnesota. 4 pp.

This report summarizes the results of a re-study of eight campsites in the Boundary Waters Canoe Area. The study measures the change of soil compaction, bare soil area not vegetated, number of dead trees, and total site size. The authors concluded that birch-aspen sites were impacted the most and the red pine and spruce sites the least.



128. Merriam, Lawrence C., Jr., R. F. Peterson, and Timothy B. Knopp. 1980. Changes in the Boundary Waters camping places. *Naturalist* 31(4):28-31.

Discusses results of research in Minnesota's Boundary Waters Canoe Area Wilderness from 1966 to 1980 to evaluate the impact of recreational use on designated campsites.

129. Merriam, Lawrence C., Jr., and Charles K. Smith. 1974. Visitor impact on newly developed campsites in the Boundary Waters Canoe Area. *Journal of Forestry* 72(10):627-30.

The impact of visitor use on newly developed campsites throughout the Boundary Waters Canoe Area tended to level off after the first two years. Visitor registration provided nearly complete use data, and the effects on soil, water quality, vegetation and site size were measured and mapped. Physical measurements were combined into an impact-stage rating system by cover types. Management implications of the results are discussed.

130. Merriam, Lawrence C., Jr., and Charles K. Smith. 1975. *Newly established campsites in the Boundary Waters Canoe Area: Restudy of selected sites*. Minnesota Forestry Research Note no. 254. St. Paul, MN: College of Forestry, University of Minnesota. 4 pp.

This paper reports remeasurements taken on five campsites, two years after the study reported in Merriam and others. No marked changes over the two years were noted, although some sites continued to deteriorate slowly while others improved. As the authors state, however, "The sample size was too small to make any real inferences." The possibility of using shrubs to prevent site expansion and wood chip mulch to reduce compaction is mentioned.

131. Merriam, Lawrence C., Jr., Charles K. Smith, Delbert E. Miller, Ching Tao Huang, J. C. Tappeiner, Kent Goeckermann, James A. Bloemendal, and Terrance M. Costello. 1973. *Newly developed campsites in the Boundary Waters Canoe Area: A study of 5 year's use*. Minnesota Agricultural Experiment Station Bulletin 511. St. Paul, MN: Agricultural Experiment Station, University of Minnesota. 27 pp.

Thirty-three wilderness campsites developed in the Boundary Waters Canoe Area during 1967 by the Forest Service were studied for five years (1968-1972) to determine the impact of visitor use. The effects on soils, vegetation, and site size were measured twice each year. Impacts were most severe in aspen-birch cover types and least severe in the white-cedar type. Impacts leveled off before the end of five years. Implications for wilderness management are also discussed.

132. Nichols, Dale S., Don Prettyman, and Mary Gross. 1983. Movement of bacteria and nutrients from pit latrines in the Boundary Waters Canoe Area Wilderness. *Water, Air, and Soil Pollution* (20):171-80.

The authors studied the movement of fecal bacteria, nitrogen, and phosphorous from pit latrines into nearby water sources in the Boundary Waters Canoe Area and also studied the effectiveness of peat latrine liners in reducing this movement. From the results obtained during the research, the authors make suggestions for further management of pit latrines.

133. Wingate, Paul J. 1990. Wilderness area fisheries management. In *Managing American's Enduring Wilderness Resource*, ed. D. W. Lime, 353-56. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

Fishing is an integral part of multiple use within the Boundary Waters Canoe Area Wilderness. The loss (or decline) of these fisheries would severely diminish the value and quality of the wilderness experience to this area. To maintain this wilderness experience, it is necessary for the Minnesota Department of Natural Resources to adequately sample these aquatic communities as well as implement necessary management programs without restrictions.

134. Wolter, John C. 1970. Water quality within the Boundary Waters Canoe Area. In *Proceedings, The Quetico-Superior Foundation: 1970 Institute on the Boundary Water Canoe Area*, 28-34, Oct. 16, Duluth, MN. Minneapolis, MN: Quetico-superior Foundation. 87 pp.

The paper summarizes some of the primary recreational impacts on water quality within the Boundary Waters Canoe Area. Sources of contamination, water quality parameters, and potential management solutions for minimizing water pollution are discussed.

## SECTION 3

### Investigations of Tourism and Economic Development

(see also 8, 9, 10, 11, 12, 35, 36, 51, 79, 80, 82, 83)

135. Agricultural Extension Service, University of Minnesota and Design Consortium, Inc. 1981. *Recreational concepts for northeastern Minnesota*. St. Paul, MN: Agricultural Extension Service, University of Minnesota. 59 pp.

The purpose of the 1981 project was to record, organize, and expand on some of the ideas which northeastern Minnesota tourism operators and other local citizens would like to implement to stimulate tourism. The study area included Cook, Crane Lake, Ely, Grand Marais, Soudan and Tower, plus the surrounding rural landscape in northeast Minnesota. A series of public discussions produced the ideas, projects, and scenarios presented. The three main topics discussed were trail systems, historical tours, information access, and image building. Both graphic and written presentations suggested ways in which these concepts could become reality. Also highlighted and promoted within this study are the communities' individual endowments and how best to promote them.

136. Ballman, Gary, Uel Blank, and L. R. Simonson. 1990. Meshing high quality wilderness maintenance with a viable tourism economy. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 646-50. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

This paper reports a three-year study/education/action project conducted in the later 1970's in the Boundary Waters Canoe Area Wilderness (BWCAW) by the University of Minnesota. The project assisted the communities adjacent to the BWCAW in developing a viable tourism industry while maintaining the high-level wilderness qualities of this unique lakeland wilderness.

137. Ballman, Gary. 1981. Northeastern Minnesota resorts expand--a new industry trend? *Minnesota Tourist Travel Notes* 18(1):3-6.

The article discusses recent expansions in facilities and services that have been made by some resort owners located near the Boundary Waters Canoe Area. Much of this construction was aided by financial assistance from the U.S. Forest Service through provisions contained in the BWCA Wilderness Act. The author suggests results of these efforts seem to be a general upgrading of tourist facilities in northeastern Minnesota.

138. Ballman, Gary, James Burke, Richard Korte, and Uel Blank. 1982. "Real" conversion rates of regional advertising programs: Working from gross to net rates. In *Proceedings of the Thirteenth Annual Conference of the Travel and Tourism Research Association, June 13-16, Florida*. 26 pp.

The paper discusses the nature of conversion studies and the interpretational, methodological, and theoretical problems associated with such studies. The second portion of the paper is devoted to a marketing program incorporating conversion study techniques. The marketing program was developed for the Minnesota Arrowhead Association who sought a needs assessment of their region. The object of the assessment was to develop an advertising campaign for "Minnesota's Border Country" to maintain and reassure traditional clientele and to simultaneously tap undeveloped tourism markets.

139. Ballman, Gary. 1984. *Tourism as an economic stimulus in northeast Minnesota*. (A Northeast Minnesota Task Force publication). St. Paul, MN: Minnesota Agricultural Extension Service, University of Minnesota. 10 pp.

This report examines some of the economic problems facing northeastern Minnesota. Specifically, it examines the current economic conditions of the region, potential development alternatives, and some of the research conducted by the University of Minnesota and how this work might aid future development strategies.

140. Ballman, Gary, Jim Burke, Uel Blank, and Dick Korte. 1984. Toward higher quality conversion studies: Refining the numbers game. *Journal of Travel Research* 22(4):28-33.

The article focuses on how to accurately determine the costs and returns of tourism advertising campaigns, examines traditional procedures of conversion studies, and suggests guidelines for improved methodology and interpretation. One of the examples for applying quality conversion studies is "Minnesota's Border Country" in northeastern Minnesota.

141. Blank, Uel, Lawrence Simonson, Gary Ballman, James Burke, Richard Korte, and Arnie Heikkila. 1983. *Contributing to tourism industry vitality of a natural resource based region through educational/technical assistance*. Staff Paper Series P83-20. St. Paul, MN: Department of Agricultural and Applied Economics, University of Minnesota. 88 pp.

This report gives a comprehensive overview of a three-year extension education program designed to provide educational/technical assistance to the tourism industry serving the Boundary Waters Canoe Area in northeastern Minnesota. The project was conducted in close cooperation with the U.S. Forest Service which covered the period between September 1979 and September 1982.

142. Blank, Uel, Helen Jensen, and Susan Wagenhals. 1975. *Minnesota's lodging industry: Statistics and characteristics*. Extension Bulletin 386. St. Paul, MN: Agricultural Extension Service, University of Minnesota. 43 p.

This report presents the first comprehensive data on the lodging industry in Minnesota, including northeastern Minnesota. It highlights basic information on lodging establishment by types, capacities, and geographic distribution. Limited trend data as well as industry organization and services also are presented. Some insights into lodging firms' relationships with the economic structure of Minnesota and its natural resources also are included.

143. Gunderson, Jeffrey. 1988. *1987-88 charter fishing study: Minnesota waters of Lake Superior*. Research Report 27. Duluth, MN: Minnesota Sea Grant Extension Program, University of Minnesota-Duluth. 38 pp.

Information was collected regarding: (1) economic impact of charter fishing, (2) customer characterization, and (3) business profile of the charter boats. While the focus of the study is on the Minnesota charter boat industry along the north shore of Lake Superior, some results describe charter operations on Lake Superior for Wisconsin and Michigan as well as Minnesota.

144. Hansen, William F. 1983. Bird of paradox--doing business in the wilderness. *Naturalist* 34(3):22-28.

With growth in wilderness visitation, wildland managers will increasingly seek cooperation with business communities adjacent to wilderness. Cooperation can exist in many forms, but efforts are especially needed to cooperatively develop wilderness user education programs. Efforts are particularly needed to instruct visitors in the rudiments of minimum-impact camping.

145. Hansen, William. 1990. Things that work: Practical partnerships in wilderness management. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 239-42. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

Wilderness managers should consider partnerships with the commercial sector and others as an important and viable tool to aid wildland planning and management. The article emphasizes that many partnerships have been successfully achieved (including examples in Minnesota's Boundary Waters Canoe Area Wilderness) and that further research and communication are needed to quantify the existing and potential benefits of partnerships in wilderness management.

146. Heikkila, Arnold J. 1982. New visitor centers--Cook, Tower, and Grand Marais. Agricultural Extension Service, University of Minnesota. *Minnesota Tourism Travel Notes* 19(1):2.

The article provides information concerning the opening of three visitors' centers located in three respective communities on the perimeter of the Boundary Waters Canoe Area Wilderness. The communities of Cook, Tower, and Grand Marais and the roles and functions of their respective new visitor centers are discussed.

147. Minnesota Department of Natural Resources. 1985. *Recreation development opportunities: Edge-of-the-wilderness area*. St. Paul, MN: Minnesota Department of Natural Resources Office of Planning. 124 pp.

This report was prepared to address a need for comprehensive information on recreation development opportunities on lands and waters administered by the Minnesota Department of Natural Resources (DNR) and other public land management agencies in northeastern Minnesota. It is not intended to be a plan for recreation development, but to present recreation development ideas and to compile information to help evaluate ideas. Interviews and brainstorming sessions with DNR, USDA Forest Service, and USDI-National Park Service employees generated a list of recreation development ideas. Available information on recreation management, trends, and economic impacts from within the DNR and other sources was synthesized. The report describes the study area, development ideas, existing recreation facilities, recreation use patterns and expenditures, and provides a summary and conclusions.

148. Plass, Karen, Scott Chase, Burnell C. Fischer, John McKinney, John Schwartz, Fred Snyder, and David G. White. 1989. *The 1987 Great Lakes charter sailing industry*. Research Report 29. Duluth, MN: Minnesota Sea Grant Extension Program, University of Minnesota-Duluth. 28 pp.

An impressive charter sailing and charter sailing instruction industry has developed on the five Great Lakes during the past two decades. While this report presents results of a survey conducted on all the lakes in 1987, the data is presented for the individual lakes as well. Lake Superior had the most charter sailboats in the fleet. Estimates of boating use and economic impacts of the industry are presented.

149. Schatz, Edward Curtis. 1990. Cooperation between recreation resource managers and private sector businesses: Use of a modified transactive planning process to promote cooperation and improved communication between BWCAW managers and cooperative permit writers. Ph.D. Dissertation. Minneapolis, MN: University of Minnesota. 265 pp.

This study tests and evaluates a modified transactive planning process intended to promote cooperation in recreation resource management between public managers and private sector businesses. Evaluation of this four-stage process is based on quantitative survey and qualitative data. The study, conducted in Minnesota's Boundary Waters Canoe Area Wilderness, indicates managers and private businesses share many of the same management goals and concerns and agree they can and should address these concerns cooperatively.

150. Sem, John. 1990. The Edge-of-the-Wilderness Program: A community and government agency public participation process. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 622-28. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

This paper describes the Edge-of-the-Wilderness Program, a program designed to help public and private sectors cooperatively develop a common development and implementation plan concerning tourism. The results of applying the program to communities adjacent to Minnesota's Boundary Waters Canoe Area Wilderness are discussed.

151. Simonson, Lawrence. 1982. Package tours in your future? Agricultural Extension Service, University of Minnesota. *Minnesota Tourism Travel Notes* 19(1):5-6.

The article describes the use of a package tour program by the Boundary Waters Canoe Area Technical Assistance Program. The assistance program includes help in the assembling of tourist packages, familiarization tours of the area for travel agents and writers, advertising the program, and a slide/tape presentation.

152. Soderberg, Barbara A. 1988. Partnerships in interpretation of the Superior National Forest. In *Proceedings of the Fourth Society of American Foresters Region V Conference: Managing North Central Forests for Non-Timber Values*, ed. James E. Johnson, 95-101, Nov. 29-Dec. 1, Duluth, MN. SAF Publication 88-04. Bethesda, MD: Society of American Foresters. 156 pp. (A modified version of this paper appears in *Proceedings of the National Extension Workshop: Using Tourism and Travel as a Community Tourism and Travel as a Community and Rural Revitalization Strategy*, ed. John Sem, 180-87, May 10-12, Minneapolis, MN. St. Paul, MN: Minnesota Extension Service, University of Minnesota. 215 pp.)

The Resort Naturalist Program, conceived in 1984 on the Superior National Forest, is a unique partnership between the public and private sector. The Forest Service, area resorts, and interpreters cooperate to enhance visitors experiences while informing them about natural resource management.

153. University of Wisconsin. 1973. *Upper Great Lakes regional recreation planning study--Part 1A: Environmental considerations--Minnesota*. Madison, WI: Institute for Environmental Studies, University of Wisconsin-Madison and Recreation Resources Center, University of Wisconsin-Extension. 36 p.

Focuses on the Minnesota land, which, both at the present time and in the future, will receive the greatest impact from visitors to the Boundary Waters Canoe Area and the Isle Royale and Voyageurs National Parks. Emphasizes that the user impact on the environment must be more carefully regulated and controlled. Reports three subjects: 1) private land in the impact area, 2) management of public land in the impact area, and 3) existing facilities in the impact area.

154. Wood, Thomas J. 1986. *An assessment of tourism marketing programs in greater Ely, Minnesota*. Working Paper no. 86-12. Duluth, MN: Bureau of Business and Economic Research, University of Minnesota-Duluth. 30 pp.

The purpose of this assessment was not only to document the current status of tourism marketing in the Ely area, but more importantly to be part of the process to develop a sound marketing strategy for the area. Specifically, the assessment was designed to: 1) understand the current status of the lodging industry, 2) identify the area's product image, 3) examine past and present promotional efforts, 4) determine target market objectives, and 5) discuss potential market strategies.



## SECTION 4

### Investigations of Wildland Recreation Resource Management

(see also 3, 4, 5, 7, 8, 14, 18, 19, 21, 24, 25, 27, 28, 29, 30, 31, 33, 34, 35, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 58, 60, 62, 63, 65, 68, 72, 73, 75, 76, 78, 82, 83, 87, 94, 95, 96, 97, 98, 100, 101, 102, 103, 105, 109, 110, 111, 113, 114, 115, 117, 119, 120, 122, 123, 128, 129, 130, 131, 132, 133, 134, 136, 141, 145, 146, 149, 150, 151, 152, 153)

155. Anderson, Charles G. 1983. BWCA--a myriad of cooperation. *Naturalist* 34(3):29-31.

The author reviews past social science in Minnesota's Boundary Waters Canoe Area Wilderness and Quetico Provincial Park and how this research has aided wilderness resource management decision-making in the Forest Service. Also reviewed are some of the cooperative partnerships between the Superior National Forest and the Minnesota Department of Natural Resources.

156. Backes, David J. 1983. The air ban: Sigurd F. Olson and the fight to ban airplanes from the roadless area of Minnesota's Superior National Forest. M.S. Thesis. Madison, WI: University of Wisconsin-Madison. 193 pp.

This study documents the battle to ban airplanes from the roadless area of Minnesota's Superior National Forest and the role of Sigurd F. Olson in developing local support for such a move. The thesis covers the fight for control of Ely, the national conservation campaign, Sigurd F. Olson local and national efforts, and the involvement of federal agencies.

157. Blank, Uel. 1982. Insurmountable opportunities. *Minnesota Tourist Travel Notes* 19(1):3-4.

This article discusses the management of northern Minnesota's recreational resources and the various entities involved and concerned with the process and outcomes. The article classifies the interested parties as recreational users and recreational demand, environmentalists, area residents, and local communities and resource managing agencies. There is also a short section on analyzing future management directions.

158. Buchanan, Dean. 1970. Management measures for the BWCA. In *Proceedings, The Quetico-Superior Foundation: Institute on the Boundary Water Canoe Area*, 35-39, Oct. 16, Brookdale Center, MN. Minneapolis, MN: Quetico-Superior Foundation. 87 pp.

The report summarizes an administrative pilot project covering 15 percent of the Boundary Waters Canoe Area comprised of the Moose Lake contiguous waterway, the Lake One route and Pipestone Bay of Basswood Lake. The project was undertaken to determine the use of campsites and the impact upon the resource. From this pilot project management actions were derived.

159. deBettencourt, James S., George L. Peterson and Pai Kang Wang. 1978. Managing wilderness travel: A Markov-based linear programming model. *Environment and Planning A* 10:71-79.

Overnight travel by watercraft in the Boundary Water Canoe Area is described as a discrete parameter Markov chain. A simple normative model is constructed of the system as a steady state process in terms of constant daily entry rates and expected daily populations in interior zones. By means of linear programming, and given constraints on entry rates and zone average daily populations, optimal entry quotas are determined for each of 33 entry points. The quotas derived provided the basis for an actual control program implemented in 1976. Information pertaining to the validity of the application is presented and the use of the model in policy formulation is described.

160. Evans, T. Jeffery. 1990. Minnesota's Boundary Waters Wilderness: Time for a new name and philosophy. *Journal of the Minnesota Academy of Science*, 55(2):13-15.

The author addresses many of the problems facing the Boundary Waters Canoe Area Wilderness today, including crowding, fire suppression, military overflights, mining pollution, acid rain, forest fragmentation, and the greenhouse effect. It is suggested that scientific research will play an important role in solving these problems. However, the author believes most of the solutions will be found in a philosophy which answers: (1) what is a wilderness?, (2) how is a wilderness to be managed?, and (3) what costs are we willing to pay to protect such a wilderness?

161. Gilbert, Gorman C., and George L. Peterson. 1972. Markov renewal model of linked trip travel behavior. *Transportation Engineering Journal ASCE* 98(TE3):691-704.

Previous models have been used in attempts to examine the linkages among activities in an urban area. Many of these models have used Markov chain theory, focusing upon linked trips made among activities. However, the lack of time-dependence in such models has necessitated a nontemporal view of such trips. A Markov renewal model, however, includes this time dimension and, thus, can represent the time spent at each destination of a linked trip. This paper presents the mathematical development of Markov renewal theory and its application to urban travel modeling.

162. Gilbert, Gorman C. 1972. The use of Markov renewal theory in planning analysis: An application to the Boundary Waters Canoe Area. Ph.D. Dissertation. Evanston, IL: Northwestern University. 160 pp.

In this dissertation a travel model is developed for the Boundary Waters Canoe Area (BWCA). In all, the function of the report is to develop a travel model which is practical and which can be useful as a tool in BWCA wilderness management. The travel model makes use of Markov renewal theory to describe BWCA travel and predict various travel patterns.

163. Gilbert, Gorman C., George L. Peterson, and David W. Lime. 1972. Toward a model of travel behavior in the Boundary Waters Canoe Area. *Environment and Behavior*, 4(2):131-57.

This paper focuses on the general overuse problem that exists in Minnesota's Boundary Waters Canoe Area and stresses the importance of determining social and ecological carrying capacities to prevent negative impacts of overuse. It is proposed that once capacities are recommended, a predictive model can be used to evaluate the impacts of alternative use control measures. Possible regulator and manipulative use control techniques are identified. It is suggested that Markov renewable theory is a promising tool in predicting user distributions in dispersed recreation areas.

164. Hellerstein, Daniel M. 1989. The use of count data models in travel cost analysis: An application to the Boundary Waters Canoe Area. Ph.D. Dissertation. Yale University.

This dissertation applies recent advances in count data model estimation to the travel cost technique. The Poisson and the Negative Binomial models are introduced and compared to continuous analogues. Robust estimation procedures for these count data are then investigated. The exploitation of time-varying data, both to examine trends in trip demand and to control unobservables, is explored in conjunction with count models. Multiple-year permit data from the Boundary Waters Canoe Area in Minnesota are examined.

165. Knopp, Timothy B., and Michael D. Bruder. 1982. Space perception as a factor in land use decision making. *Environmental Management* 6(3):193-98.

Land use decisions involve the allocation of space to competing demands. Space is perceived subjectively, particularly in respect to recreational use. Five Minnesota groups involved in decision making processes were questioned as to how they perceived space. This paper summarizes the results of the study and concludes that the importance of space perception is dependent on the type of process in decision making; in particular whether the process is incremental or comprehensive. The Boundary Waters Canoe Area Wilderness was used as an indicator of how management perceives wilderness space.

166. Knopp, Timothy B., and Michael D. Bruder. 1985. The language of land use. *Northern Journal of Applied Forestry* 2(1):9-11.

This study attempts to gain a better understanding of what people mean when they use certain words in the land-use decision making process. Land-use terms are characteristically vague and ambiguous. Boundary Waters Canoe Area management illustrates some of the many problems inherent to the land-use decision making process when those involved do not share a common language. It is hoped that results of this research will permit a better understanding of what others are saying, promote more effective educational programs, and refine the language of land use.

167. Lais, Gregory J., W. Kay Ellis, and John H. Galland. 1990. Access to wilderness by people with disabilities. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 243-49. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

This paper explores some of the common issues involving the apparent contradiction between preservation of wilderness and access to it by persons with disabilities. The authors maintain that by engaging in calm, creative, and flexible problem solving, we can easily provide access and preserve wilderness integrity.

168. Lime, David W. 1970. Research for determining use capacities of the Boundary Waters Canoe Area. *Naturalist* 21(4):9-13.

The paper discusses the kinds of information needed to estimate carrying capacities of the Boundary Waters Canoe Area and describes one study currently underway to measure both travel patterns of visitors and their attitudes about crowding.

169. Lime, David W., and Roland G. Buchman. 1974. Putting wilderness permit information to work. *Journal of Forestry* 72(10):622-26.

Visitor use information from wilderness permits has important uses for both managers and public. Basic summaries allow managers to (a) understand trends or change in use, (b) determine where and when the regulation of visitors may or may not be needed, (c) select locations for public meetings and distribute news releases, and (d) plan daily work schedules. Summaries of use can help visitors better plan their visit by informing them about various temporal and spatial aspects of use. The advantages for managers to consider an online computerized system in their planning to analyze day-to-day use patterns also is discussed.

170. Lucas, Robert C. 1963. Bias in estimating recreationists' length of stay from sample interviews. *Journal of Forestry* 61(12):912-15.

Estimating recreational use of relatively unsupervised areas objectively depends upon sampling. Most land managers count visitors and then multiply by an estimate of length of stay to obtain person-days of use. Estimates of length of stay from on-site samples are biased upwards, however, because the probability of a visitor falling in the sample is a function of length of stay. This previously unrecognized bias is large, but a sample weighting procedure removes its effect. A survey of use on the Boundary Waters Canoe Area is examined.

171. Lucas, Robert C. 1965. A new research program for the Boundary Waters Canoe Area. *Naturalist* 16(4):8-15.

During the mid-1960's, the Forest Service's North Central Forest Experiment Station planned a substantially enlarged program of research in the Boundary Waters Canoe Area. The program called for expanded ecological research on the wilderness resource and studies of wilderness users.

172. Lucas, Robert C. 1966. The contributions of environmental research to wilderness policy decisions. *Journal of Social Issues* 22(4):116-26.

Increasing interest in wilderness recreation leads to controversy over management and use of wilderness settings. Social research, such as on visitor management, is needed to help formulate future wilderness policy.

173. Lucas, Robert C. 1966. Park land use policies. In *Proceedings from the 5th Federal-Provincial Parks Conference*, 60-63, Sept. 19-23, Winnipeg, Manitoba.

This paper presents a quick review of the policy evolution in the Boundary Waters Canoe Area (BWCA), some past research, and research plans useful in considering land use policy in Canadian Provincial Parks. Quetico Provincial Park and the BWCA are thought of as a linked pair and past federal policy regarding the BWCA is useful for planning future Quetico management strategies.

174. Merriam, Lawrence C., Jr. 1970. Campsites and campers in the Boundary Waters Canoe Area. In *Proceedings, The Quetico-Superior Foundation: Institute on the Boundary Waters Canoe Area*, 74-76, Oct. 16, Brookdale Center, MN. Minneapolis, MN: Quetico-Superior Foundation. 87 pp.

The paper summarizes campsite research conducted between 1966 and 1973. Research included investigations of (1) campsite supply-demand relationships, (2) campsite conditions, (3) the form and rate of deterioration of newly-established campsites, and (4) campers and outfitters of the Boundary Waters Canoe Area, their attitudes and interactions.

175. Minnesota Department of Natural Resources. 1978. *North shore recreation study*. St. Paul, MN: Office of Planning and Research and the Division of Parks and Recreation, Minnesota Department of Natural Resources. 138 pp.

The study was designed to evaluate the recreation potentials of private and public lands on the North Shore, recommend recreational uses for those lands, and suggest ways to coordinate the various recreational activities as an interrelated system. The report summarizes major recommendations and issues which pertain to interagency coordination: accessibility of recreation areas, rest areas, forests, rivers and lakes, and wildlife management.

176. Morgan, James T. 1970. User capacities of the BWCA. In *Proceedings, The Quetico-Superior Foundation, Institute on the Boundary Water Canoe Area*, 82-84, Oct. 16, Brookdale Center, MN. Minneapolis, MN: Quetico-Superior Foundation. 87 pp.

Visitor "capacity" of the Boundary Waters Canoe Area is the number of people on a lake at any one time that can enjoy the environment without damaging it. Estimating capacity requires studies of resource use tolerance, visitor use patterns, and visitor perceptions and satisfactions.

177. Nassauer, Joan Iverson. 1990. Using image capture technology to generate wilderness management solutions. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 553-62. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

The purpose of this paper is to examine how the capability of image capture technology (ICT) to produce highly believable landscape simulations can be used to generate wilderness management solutions. Several examples from the University of Minnesota Landscape Simulation Laboratory are described, including a study in the Boundary Waters Canoe Area Wilderness to assess wilderness visitors' and managers' perceptions of resource impacts in backcountry campsites.

178. Peterson, George L. 1977. The computer takes a canoe trip. *Naturalist* 28(4):9-11.

Discusses a mathematical computer model that describes the travel process in the Boundary Waters Canoe Area and Quetico Provincial Park. The article describes a "forward-seeking" (trial and error) and a "backward-seeking" (linear programming) model. The use of these computer models to aid in developing an entry point quota system also is discussed.

179. Peterson, George L. 1981. *The BWCA visitor distribution model. Final report.* Evanston, IL: The Technological Institute, Department of Civil Engineering, Northwestern University. 101 pp.

The report describes a visitor distribution model that addresses several management and carrying capacity problems found in the Boundary Waters Canoe Area. The management problems include user conflict, unevenness among entry points, and uneven distribution over time. The carrying capacity parameters are: (1) limited number of acceptable campsites and (2) official carrying capacity restraints. The report includes an analysis of a travel model, validating and collecting data, and operational programs and procedures for the model. A final chapter is devoted to methodological and philosophical questions raised by the study.

180. Peterson, George L., and James S. deBettencourt. 1979. Flow-metering of wilderness travel in the Quetico-Superior: New finds and research needs. *Modeling and Simulation* 10(3):1335-40.

Recreational travel congestion in the Quetico-Superior wilderness area is being controlled by means of "flow-metering" at points of entry. Entry point quotas are derived from a Markov-based linear programming model. The management problem and model are described. Empirical results pertaining to validity and bias are presented, and further research needs are suggested.

181. Peterson, George L., James S. deBettencourt, and Pai Kang Wang. 1977. A Markov-based linear programming model of travel in the Boundary Waters Canoe Area. In *Proceedings, River Recreation Management and Research Symposium*, 342-50. General Technical Report NC-28. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 455 pp.

Describes and illustrates a Markov-based linear programming method used to predict and analyze visitor travel in the Boundary Waters Canoe Area so management can control the rate of entry of travellers into the area.

182. Peterson, George L., and Gorman Gilbert. 1971. Application of Markov renewal theory to travel behavior in the Boundary Waters Canoe Area. In *Proceedings IEEE Fall Conference*, 316-20, Chicago, IL.

This paper is concerned specifically with the problem of preventing overuse by recreationists in the Boundary Waters Canoe Area. Analysis of the problem leads to numerous alternative regulations or actions. Because the primary use is wilderness travel by canoe, the need is for a travel behavior model. The paper suggests a conceptual and mathematical strategy for modelling camp migration and discusses problems of operationalizing the model.

183. Peterson, George L., and David W. Lime. 1980. Recreation policy analysis in wilderness management: A case study of the Quetico-Superior. In *Proceedings, 3rd Annual Applied Geography Conference*, eds. J. W. Frazier and B. J. Epstein, 4-13, Binghamton, NY. Syracuse, NY: Department of Geography, SUNY. 325 pp.

Describes (1) growing demand for wildland environments and resulting concerns by administrators, (2) research activities between 1970 and 1977 to predict visitor travel, (3) implementation of a rationing system to limit visitor access based on this research, and (4) potential of such mathematical models to assist administrators of other recreation environments in developing use distribution programs.

184. Peterson, George L., and David W. Lime. 1983. A research-management partnership grows in Minnesota's canoe country. *Naturalist* 34(3):5-11.

Briefly reviews history of research and technology transfer in the Boundary Waters Canoe Area during the past several decades. Explores the potential for using wilderness permit data in new programs of research. Outlines new directions in research in response to changing information needs of wilderness managers.



185. Proescholdt, Kevin. 1990. Integrated land management in the Quetico-Superior ecosystem. In *Managing America's Enduring Wilderness Resource*, ed. D. W. Lime, 500-06. St. Paul, MN: Tourism Center, Minnesota Extension Service and Minnesota Agricultural Experiment Station, University of Minnesota. 706 pp.

The international Quetico-Superior ecosystem in northeastern Minnesota and southwestern Ontario provides an excellent example of integrated management including both designated wilderness and nonwilderness lands. This paper addresses lessons learned from the past 60 years of management in the Quetico-Superior ecosystem. It includes discussion of the growth in recreation visitation and conflicts between motorized and nonmotorized boating.

186. Rupp, Craig W. 1970. Boundary Waters Canoe Area management. *Naturalist* 21(4):3-7.

The article discusses the role the Forest Service has in managing the Boundary Waters Canoe Area. He states that the Forest Service is managing a wilderness resource and not individual resources, uses, or activities such as visitors, watersheds and water quality, vegetation, recreation, wildlife, or minerals. The individual elements are to be managed for the sake of the whole. It discusses the various management techniques used when managing water quality, vegetation, visitors, and wildlife.

187. Soderberg, Barbara A. 1987. *Canoes, computers, and cooperation or high tech tranquility in Minnesota's Boundary Waters Canoe Area Wilderness*. Paper presented at the World Wilderness Congress, September 12-18, Estes Park, CO. 9 pp.

The paper focuses on the level of visitor use in the Boundary Waters Canoe Area Wilderness and the management responses by Ontario's Quetico Provincial Park, Superior National Forest, and Voyageur's National Park to address these increases. The management strategies highlighted include a visitor distribution program, rules and regulations, user education, and partnerships with local commercial interests.

188. Soderberg, Barbara Wagoner. 1983. Spirit of volunteerism. *Naturalist*, 34(3):12-19.

In partial response to substantial wilderness use, reduced budgets, personnel constraints, and much work to be accomplished in the Boundary Waters Canoe Area Wilderness, the Forest Service has sought the able assistance of volunteers. In addition to helping with a variety of wilderness management activities, the volunteer program has brought greater public understanding, support, and appreciation for wilderness policies and programs. Increasingly, wildland managers nationwide are seeking these and other partnerships.

189. Stinchfield, Joe. 1989. *An underwater state park feasibility study: An assessment of opportunities to enhance diving on the north shore of Lake Superior*. St. Paul, MN: Minnesota Department of Natural Resources, Office of Planning and Division of Parks and Recreation. 43 pp.

This study explored the need for and feasibility of providing an underwater state park and other support facilities to meet the needs of divers along the north shore of Lake Superior. The study provided information from a nonscientific sample of Minnesota divers (about 40 people) on the demand for underwater recreation opportunities and support facilities.

190. Thompson, James S. 1979. A simulation technique for analyzing control strategies on travel systems that are characterized by zonal transitions in a discrete time frame: With an application to the Quetico Provincial Park, Canada. MS Thesis. Evanston, IL: Northwestern University. 37 pp.

This thesis focuses on developing a strategy to explore movements of visitors within a particular area or zone in Quetico Provincial Park. The research explores the use of a glorified bookkeeping simulation to track visitors as they move within the park. Chapters are devoted to Markov based linear programming models, a description of the simulation, and the results obtained.

191. Thompson, James S., George L. Peterson, and Mark Turnquist. 1984. Simulation analysis of the stochastic behavior of a discrete time migration process. In *Proceedings of the 15th Annual Modeling and Simulations Conference*, 1303-08, April 19-20, University of Pittsburgh, Pittsburgh, PA. Park, NC: Instrument Society of America Research Triangle.

A simulation is developed to help analyze and predict congestion areas and patterns in the Quetico Provincial Park. The management problem and simulation is described in the paper as well as other applications.

192. USDA Forest Service. 1967. *Boundary Waters Canoe Area research symposium*. St. Paul, MN: North Central Forest Experiment Station, USDA Forest Service. 48 pp.

This proceedings of a meeting to discuss research in the Boundary Waters Canoe Area includes a section devoted to recreation use projects. Several brief summaries discuss past and present research focusing on visitor use questions. At the same time, the proceedings identifies many gaps in research needed to help manage this unique region.

193. Wang, Pai Kang. 1976. Travel behavior analysis and user management in the Boundary Waters Canoe Area: An application of Markov theory and linear programming. Ph.D. Dissertation. Evanston, IL: Northwestern University. 168 pp.

Based on a data set of 5,000 travel diaries of Boundary Waters Canoe Area (BWCA) campers, a Markov chain model of travel behavior is developed and proven to be capable of predicting and describing the travel process in the BWCA. Using the Markov chain, a backward-seeking model is developed and used to evaluate various control policies. Also, seasonal travel behaviors are compared, alternative policies are generated from the model, and the possible extension of this model to similar problems in this field are discussed.

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