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Recreational Carrying Capacity: An Annotated Bibliography

Compiled by
GEORGE H. STANKEY and DAVID W. LIME

INTERMOUNTAIN FOREST AND RANGE

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INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Forest Service
U. S. Department of Agriculture
Ogden, Utah 84401
Robert W. Harris, Director

Contents

Abstract

Recreational carrying capacity is a major management and research issue. An annotated bibliography including over 200 citations is presented, covering both the ecological and social dimensions of the capacity problem.

Introduction

This bibliography was prepared originally as an adjunct to a paper given by the compilers at The Forest Recreation Symposium held at the State University of New York, Syracuse, October 12-14, 1971. Our paper *"Carrying capacity: maintaining outdoor recreation quality"* focused on a discussion of what is meant by the concept of recreational carrying capacity, what is known about capacities in terms of how resources and experiences of visitors are affected by recreational use, and what alternative procedures the administrator can use to manage both resources and visitors for capacity.

The reader is urged to examine the references of literature citations found with many of the entries included in this bibliography for additional pertinent references. Ease in acquiring a copy of the reference was an important consideration in selecting entries. Theses and dissertations, as well as unpublished reports, generally have been excluded. However, some pertinent but unpublished papers have been included. Most of these can be obtained by contacting the authors of such unpublished material.

The contents of this bibliography are arranged into four parts. Each part is further subdivided into sections concerned with specific topics. Within these sections, entries are arranged alphabetically by author. Logically, many citations belong in more than one subsection. Consequently, each entry is cited in the first subsection of the bibliography where it appears. If pertinent in subsequent sections, it is identified by number only at the beginning of the section.

We see two especially important functions for this bibliography. First, it demonstrates the breadth and richness of the literature related to carrying capacity decisionmaking. It is doubtful if "cookbook" formulas for deciding whether recreational use should be controlled will ever be found; nevertheless, considerable data are at hand to help managers and administrators make intelligent decisions that will prevent unacceptable losses to either the resource complex or the recreationist's experience.

Unquestionably, however, we lack all the answers. Thus, we also feel this bibliography portrays some of the "blank spots" in our knowledge. For example, the interactions between recreationists and wildlife are poorly understood. Increasing pressures on the wildlife resource will require a broadened research attack on this area to forestall possible irreversible adverse impacts. Therefore, a careful examination of the literature cited in this bibliography should prove useful in designing future research.

The literature on carrying capacity is expanding rapidly which means that bibliographies such as this will quickly become dated. For example, a recent publication that we have not included in the following listing, but which is very pertinent to the subject, is the Conservation Foundation's report *National Parks for the Future*. The report discusses the concept of carrying capacity, its application to the National Parks, and suggests ways in which park quality might be maintained. The report can be obtained from the Conservation Foundation in Washington, D.C.

Concept of Carrying Capacity

Documentation of Need for More Recreation Space

1. Brower, David R.
   1956. Scenic resources for the future. Sierra Club Bull. 41(10):1-10.

   Summarizes the principal objectives of the Sierra Club's "Scenic Resources Review" proposed in 1956. In view of the anticipated demand of recreational opportunities during the next four decades, the author discusses the topics: what scenic resources remain in America; how much and what kinds of resources will we need by the year 2000; how can conflicting uses for the same resources be resolved; what should be the structural organization of the Review; and what responsibilities should be given to the various local, State, and national governments?

2. Cicchetti, Charles J., Joseph J. Seneca, and Paul Davidson
   1969. The demand and supply of outdoor recreation. Bureau Econ. Res. Rutgers-The State Univ., New Brunswick, N.J. 301 p.

   Study incorporated physical distance, socioeconomic variables, income, and supply indices to develop and estimate an econometric model of the recreation market. This is used to predict recreation users' responses to both demand and supply changes on an activity-by-activity basis.

3. Clawson, Marion
   1959. Our National Parks in the year 2000. Natl. Parks Mag. 33:142.

   By the year 2000, the population of the United States will be about 300 million. Moreover, the amount of discretionary income and leisure time will be increased, as will the mobility of individuals. These factors will interact to generate increasing demands on the National Parks; as a result, both the character of use and the type of recreational experience will change. The author proposes three lines of action to preserve the National Parks in perpetuity: (1) Develop ample opportunities for outdoor recreation in places other than National Parks; (2) develop programs to encourage people to *stay* in the Parks rather than just *come* to the Parks; and (3) attempt to reduce the numbers of casual visits to National Parks, perhaps by a sharp increase in entrance fees.

4. Clawson, Marion
1958. Statistics on outdoor recreation. 165 p. Wash., D.C.:Resources for the Future, Inc.

Combines available statistics on public outdoor recreation as of the mid-1950's. Some economic and social analyses of the interrelationships of these and other statistics are made. A plea is made for more sophisticated data collection in the future that will permit more refined and useful analyses.

5. Clawson, Marion
1959. The crisis in outdoor recreation. Am. For: Part I, 65(3):22-31, 40-41; Part II, 65(4):28-35, 61-62.

Outlines the historical growth in recreation. The supply and demand for recreation opportunities in the future are discussed. Four basic components of demand are examined: (1) population; (2) buying power; (3) leisure time; and (4) mobility. Supply is defined in terms of user-oriented sites, resource-based sites, and intermediate areas. The roles of public and private suppliers are discussed. Future problems, such as overuse and other resource demands, are considered.

6. Clawson, Marion
1967. The Federal lands since 1956: recent trends in use and management. 113 p. Baltimore:Johns Hopkins Press for Resources for the Future, Inc.

Updates the 1957 RFF study by Clawson and Held "The Federal lands: their use and management." An analysis is made of changes since 1956. Estimations of use, expenditures, and receipts data are made for 1980. Discusses the extent to which 1957 projections and estimations were fulfilled.

7. Clawson, Marion, and Burnell Held
1957. The Federal lands: their use and management. 501 p. Lincoln:Univ. Nebr. Press for Resources for the Future, Inc.

Reviews changes in Federal land use. Historical forces bringing about these changes are discussed, and implications for future management are outlined. Governmental land management practices are critically reviewed and ways are offered in which management could be improved.

8. Clawson, Marion, R. Burnell Held, and C. H. Stoddard
1960. Land for the future. 672 p. Baltimore:Johns Hopkins Press for Resources for the Future, Inc.

Examines the historical changes in land use in the United States and how these uses might change by the year 2000. The authors initially examine the changing patterns of land use in broad perspective and then undertake a topical analysis, focused on important land uses. Recreation forms a major portion of their discussion. Finally, problems in reconciling the competing demands are outlined as are possible solutions.

9. David, E. J. L.
1969. The exploding demand for recreational property. Land Econ. 45(2):206-217.

Presents results of a study of riparian property values around 60 artificial lakes in Wisconsin. Traces increases in per-acre values over a 10-year period (1952-1962). The increasing value of land is related to the economic impact on other sectors of the economy. The implications increasing property values will have for amenities of lakes are described. Shoreline zoning and water quality improvement are briefly discussed.

10. James, George A., and Thomas H. Ripley
1963. Overuse: a threat to our developed recreation areas. Am. Recreation J. 4(3):5-6.

Pleads for more research to determine factors influencing the deterioration of intensively used recreation sites and what can be done to rehabilitate worn areas. Findings of a 1961 study of 42 developed camping and picnicking areas in North Carolina and Tennessee are presented. The focus is on the effects of heavy use in terms of changes in the depth of upper soil layers, the amount of bare ground, the level of erosion, and changes in exposure of tree roots. The tolerability of selected species to intensive use also is reported.

11. Johnson, Warren A.
1967. Over-use of the National Parks. Natl. Parks Mag. 41(241):4-7.

Increasing levels of use as well as visitor objectives that conflict with management objectives threaten the National Parks. Discusses two trends that might offer some hope: (1) Rapidly expanding technology of transportation; and (2) increase in day use. The ultimate need to consider population control is recognized.

12. Lucas, Robert C.
1971. Hikers and other trail users. For. Recreation Symp. Proc., Northeast Forest Exp. Stn., Upper Darby, Pa., p. 113-122.

Reports on the status of recreational opportunities for trail users. Trends in the provision of trails are discussed. Trail use is described and future demands for trail-based recreation are cited. Research on attitudes of hikers is reviewed. Management implications are suggested. Pleads for more sociological and biological research in this area of recreation.

13. Lykes, Ira B.
1969. Planning for tomorrow's needs. Better Camping 10(7):26-32.

Considers the growth in camping use of the National Parks. Outlines the objectives of the Park Service and describes the approximate ratio of wilderness acreage to developed recreation areas within the Parks. The importance of understanding visitor motivations is discussed. Diversity in camping opportunities is also stressed.

14. McKane, John G.
1960. The crisis in recreation space. The Conserv. Volunteer 23(137):46-49.

Presents brief viewpoints from national, State, and local agencies, independent organizations, and individuals focusing on the growing demand for recreation space. Also cites examples of successful programs and still unsolved problems experienced in attempting to solve these demands.

15. National League of Cities
1968. Recreation in the Nation's cities: problems and approaches. 56 p., Bur. Outdoor Recreation, Wash., D.C.

Location of park and recreation facilities is a primary factor affecting the success of recreation programs. However, optimum utilization of potential recreation resources has not been achieved, for which lack of communication among city, county, and private agencies is cited as a major contributing factor. Little positive planning has been done to meet the needs of persons in slum neighborhoods. Attention should focus on what people want, not what recreation departments believe best.

16. Nelson, J. G., and R. C. Scace (eds.)
1968. The Canadian National Parks: today and tomorrow. Proc. Conf. held at Calgary, Alberta, 2 vols. 1,027 p.

A collection of over 40 papers discussing the extent and use of National Parks in other countries of the world as well as in Canada--their value, research needs, and, in some, the relationship of the National Parks to other recreational opportunities.

17. Ogburn, Charles, Jr.
1970. Population and resources: the coming collision. The Popul. Bull. XXVI(2):3-36.

Examines the increasing world consumption of minerals, energy resources, and food, and their consequences (rise in pollution and other forms of environmental degradation). Argues that population control would provide an opportunity for the development of more deliberate and conservative policies with regard to resource utilization.

18. Outdoor Recreation Resources Review Commission (ORRRC)
1962. Hunting in the United States--its present and future role. Study Rep. 6, 180 p., Wash., D.C.:Gov. Print. Off.

Examines forces affecting game supply and summarizes a State-by-State survey of factors influencing hunting in the 48 contiguous States--wildlife regulations, limitation of hunting access, public hunting areas, fee hunting, and shooting preserves. The significance of land-use trends and Federal land-use programs as they affect game supply is evaluated. Problems affecting State game agencies are analyzed and suggested solutions are offered.

19. ORRRC
1962. Potential new sites for outdoor recreation in the Northeast. Study Rep. 8, 170 p. Wash., D.C.:Gov. Print. Off.

Presents the findings of a study designed to determine the existence of potential recreation sites of 30 acres or more currently in private ownership located in the 10 densely populated northeastern States. The location of sites is based upon an analysis of aerial photographs. Site potential is determined according to land type, recreation suitability, and proximity to major metropolitan concentrations. Case studies carried out in New Hampshire, Pennsylvania, and Connecticut are utilized to illustrate ownership patterns, problems, history of land transfer, current land use, and availability for public purchase. Describes procedures used by and available to State agencies for land acquisition and development.

20. ORRRC
1962. Projections to the years 1976 and 2000: economic growth, population, labor force and leisure, and transportation. Study Rep. 23, 510 p. Wash., D.C.:Gov. Print. Off.

Contains a set of four fundamental studies that project the size, distribution, income, leisure, and mobility of the American population to 1976 and 2000. In addition to national aggregates, attention is directed to regional and State characteristics.

21. ORRRC
1962. Prospective demand for outdoor recreation. Study Rep. 26, 150 p. Wash., D.C.:Gov. Print. Off.

Measures the needs and preferences of the American people for a number of outdoor recreation activities. This comprehensive analysis is based on data obtained from the National Recreation Survey, the Commission inventory, the metropolitan studies, and the essays concerned with trends and patterns of American life (ORRRC Study Rep. 22).

22. ORRRC
1962. Sport fishing--today and tomorrow. Study Rep. 7, 130 p. Wash., D.C.: Gov. Print. Off.

Presents an appraisal of fishing as a form of recreation in the United States and includes a State-by-State survey of the problems of supply, status of fishing waters, and management policies and responsibilities. Covers present and future supply of both warm- and cold-water fish and makes projections of the status of sport fishing in the years ahead. Summarizes the future prospects by regions.

23. ORRRC
1962. The future of outdoor recreation in metropolitan regions of the United States. Study Rep. 21 (3 vols.), 640 p. Wash., D.C.:Gov. Printing Off.

Describes the general characteristics of outdoor recreation activities and particular problems of metropolitan residents, including the problem of access. Contrasts present and future outdoor recreation opportunities against the backdrop of expanding urbanization. Contains separate studies of five selected metropolitan regions: (1) New York, New Jersey, Philadelphia; (2) St. Louis; (3) Atlanta; (4) Chicago; and (5) Los Angeles. The central topic in each study is an analysis of the supply and demand aspects of outdoor recreation. In each, central problems are identified and possible solutions suggested.

24. ORRRC
1962. Wilderness and recreation--a report on resources, values, and problems. Study Rep. 3, 352 p. Wash., D.C.:Gov. Print. Off.

Contains an inventory of 64 areas, encompassing approximately 28 million acres. Discusses traditional concepts of wilderness, various approaches to its economic evaluation, and basic legal and administrative considerations and problems involved in wilderness preservation. An evaluation is made of the commercial potential of existing wilderness areas--timber, grazing, water, and mineral resources. An analysis of social and economic characteristics of wilderness users is based upon a sample survey carried out in three specified areas.

25. Rockefeller, Lawrence
1962. The future of outdoor recreation. J. For. 60(8):521-524.

Meeting the recreation demands and needs of the future can only be done by developing a mixture of opportunities. The "dollars and acres" approach of setting goals is criticized, in part because it can become an end in itself, ignoring the needs of people over a long time span. Illustrations are provided demonstrating how a mixture of opportunities in both forest lands and on lands around metropolitan areas can best provide benefits to the public as well as garner support from the public.

26. Siecker, John
1951. The future of forest recreation. J. For. 49(7):503-506.

Speculates on the changes and developments that might take place in forest recreation by the year 2000. A definition of wilderness carrying capacity is presented. The effects on a recreation area of overcrowding are considered--both the ecological impacts and the loss in quality of visitor experiences. Possible methods for rationing visitor travel in an area and regulating use also are described.

27. Strong, Ann Louise
1963. Preserving urban open space. Urban Renewal Adm., Housing and Home Finance Agency. 36 p., illus. Wash., D.C.:Gov. Print. Off.

Describes the increasing pressures on urban open space. Outlines methods of controlling or regulating developments for various levels of government. Gives some new strategies, such as compensable regulations and new taxing policies, for preserving open space.

28. Tyndal, James H.
1949. Forestry in a great metropolitan area. J. For. 47(1):29-35.

Describes the pressures and demands placed on The Cook County Forest Preserve District in Illinois. Outlines managerial efforts to provide a sustained yield of recreation. Defines (a) the capacity of picnic areas and (b) recreational forestry.

29. Udall, Stewart
1961. National Parks for the future. The Atl. Mon. 207(6):81-84.

A popularized description of factors that have resulted in the deterioration of many National Parks. Reviews the progress and direction of Mission 66. Presents some ideas as to how future management might meet the challenge of providing quality opportunities for more people.

30. U.S. Department of the Interior
1970. Islands of America. 95 p. Wash., D.C.:Gov. Print. Off.

Presents an inventory of all American islands 10 acres or larger. Includes resource and ownership data on over 26,000 islands. Presents data for some islands having exceptional potential for public recreation.

31. U.S. Department of the Interior
1968. Man and nature in the city. 92 p. Wash., D.C.:Gov. Print. Off.

Provides a collection of papers with discussions on the relationship of man to nature in the city environment. Topics include the value of natural environments for youth and the ghetto dweller.

32. U.S. Department of the Interior
1967. Recreation land price escalation. 33 p. Wash., D.C.:Gov. Print. Off.

Examines escalating land prices for acquisition of recreational lands at the Federal, State, and local levels in terms of general land price trends. Discusses the inadequacy of the Land and Water Conservation Fund to acquire lands in existing, newly authorized, and proposed Federal recreation areas. Anticipated revenues from current income sources are analyzed in the light of past experience. Additional sources of funding are explored and estimated.

33. U.S. Department of the Interior
1966. Trails for America: report on the Nationwide Trail Study. 155 p. Wash., D.C.:Gov. Print. Off.

Describes the supply and demand situation of recreational trails. A National Scenic Trail System is discussed and proposed areas are given. Outlines the role of Federal and State agencies in supplying trails and stresses the opportunity for trail development in urban areas.

34. U.S. Public Land Law Review Commission
1970. One third of the Nation's land. 342 p. Wash., D.C.:Gov. Print. Off.

Presents recommendations for policy guidelines for the retention and management or disposition of 725 million acres of Federal lands. In chapter 12, *"Outdoor recreation,"* attention is given to the need for preserving both natural conditions and visitor experiences in particularly valuable recreation environments. The need to regulate use pressures on the public lands and some methods for rationing use are also discussed (also see chapter 17, *"Trespass and disputed title"*).

35. U.S. Senate Select Committee on National Water Resources
1960. Water resources activities in the United States; water recreation needs in the United States, 1960-2000. Comm. Print 17, 86th Congr. 2d sess. Wash., D.C.:Gov. Print. Off.

Covers such topics as the rapidly increasing use of water-based areas, problems of intensive use and crowding, planning for additional areas, public water supply legislation, and inadequate criteria for estimating future water-based recreation needs. Contains 17 recommendations by the National Park Service regarding Federal objectives for water-related recreation areas. An Appendix contains recommendations for general policy by the Committee.

36. Zahniser, Howard
1955. The need for wilderness areas. Natl. Parks Mag. 29(123):161-166.

Identifies major values associated with having wilderness areas--including opportunities for solitude, conditions for enhancing physical hardiness and personality development, scenic beauty and esthetics, education, and scientific study. Pleads for the establishment of a national wilderness preservation system.

Definitions of Recreational Carrying Capacity

(*Also see reference numbers 16, 26, 28*)

37. Anderson, Kenneth R.
1959. A user-resource recreation planning method. 80 p. Natl. Advis. Counc. on Reg. Recreation Planning, Hidden Valley, Loomis, Calif.

Proposes a practical and comprehensive means of estimating the present and future recreation requirements of users and the recreation potential of natural and manmade sources. Planning guides are employed to relate these recreation requirements to the available resources.

38. Chubb, Michael
1964. Outdoor recreation land capacity: concepts, usage, and definitions. Unpubl. M.S. thesis, Dep. Resour. Dev. Mich. State Univ., East Lansing.

Presents a comprehensive review of State, Federal, and regional capacity standards, accompanied by a critical analysis. Offers two sets of carrying capacity definitions. Outlines factors affecting capacity calculations.

39. Chubb, Michael, and Peter Ashton
1969. Park and recreation standards research: the creation of environmental quality controls for recreation. 76 p. Report to the Natl. Recreation and Park Assoc. Tech. Rep. 5. Recreation Res. and Planning Unit, Mich. State Univ., East Lansing.

Discusses the factors influencing the recreational capacity of a site, both physical and psychological; reviews past efforts to define carrying capacity; and proposes a set of uniform definitions for carrying capacity. Presents a case study involving how such definitions apply to boating.

40. Clawson, Marion, and Jack L. Knetsch
1966. Economics of outdoor recreation. 328 p. Baltimore:Johns Hopkins Press for Resources for the Future, Inc.

Directed primarily toward recreation administrators, planners, and students in these fields, policy issues are raised and methods of analyzing such policies are presented. Among other topics discussed are the various elements of demand; supply considerations and recreation quality; the economic values of recreation and its claim on resources; the effect of recreational development on local economies; cost and investment considerations; and assigning prices and methods of financing public facilities.

41. Ditton, Robert B.
1969. The identification and critical analysis of selected literature dealing with the recreational aspects of water resources use, planning, and development. Res. Rep. 23, 293 p. Urbana:Univ. Ill. Water Resour. Cent.

Describes how over one thousand articles and publications were identified, documented, and classified according to keyword descriptors. A computerized bibliographic retrieval routine was developed to enable an investigator to receive relevant bibliographic notations. Using this retrieval system to assemble bibliographies by topic, this project surveyed and analyzed research findings and their implications for water recreation planning and development. The critical analysis of pertinent literature is organized within five broad areas: (1) The water resource; (2) water resource recreation planning; (3) user-resource planning considerations; (4) factors inhibiting the recreational use of water resources; and (5) maintaining water quality for recreational use. An interdisciplinary water recreation planning and development bibliography is included.

42. Frissell, Sidney S., Jr., and George H. Stankey
1972. Wilderness environmental quality: search for social and ecological harmony. Paper presented at Annu. Meet., Soc. Am. For., Hot Springs, Ark., Oct. 4.

Presents a conceptual model of carrying capacity that defines needed input, illustrates the interrelationship between the various components, and provides insight on how the limiting constraint on capacity decisions for any given situation could be determined. Quantitative measures of changes in the physical regime and visitor experience levels that accompany increased use are stressed. For example, in one area, reduced water quality might represent the decision

criteria whereby managers would elect to restrict use; in a second area, declining aggregate social utility might occur before unacceptable change is noted in any physical parameter. This "minimum-value" concept of carrying capacity allows equal consideration of ecological and social factors and will provide managers a sounder basis for difficult rationing decisions in wilderness.

43. Held, R. Burnell, Stanley Brickler, and Arthur T. Wilcox
1969. A study to develop practical techniques for determining the carrying capacity of natural areas in the National Park System. 47 p. Natl. Park Serv. and the Cent. for Res. and Educ., Colo. State Univ.

Proposes a methodology to maximize utility of National Parks, recognizing the dual problem of preserving the Parks and providing for their use and enjoyment. Calls for continuing studies of the relationship between changes in the physical environment and visitor satisfaction and increasing numbers of users. Suggests the use of "ration cards" as a technique to produce more desirable use distributions.

44. LaPage, Wilbur
1963. Some sociological aspects of forest recreation. J. For. 61(1):32-36.

Presents a philosophical treatment of management problems and research needs into motivations for, and patterns of, recreational use of forest lands. Suggests the development of a measure of recreational productivity, based upon consumer satisfaction, to be used as one element in the analysis of recreational land carrying capacities and associated problems.

45. Lime, David W.
1970. Research for determining use capacities of the Boundary Waters Canoe Area. Naturalist 21(4):8-13.

Focuses on the kinds of research information needed (both biological and sociological) to estimate capacities of dispersed recreation areas. Discusses a study now underway to measure both travel patterns of visitors and their attitudes about crowding.

46. Lime, David W., and George H. Stankey
1971. Carrying capacity: maintaining outdoor recreation quality. P. 174-184, in: For. Recreation Symp. Proc., Northeast For. Exp. Stn., Upper Darby, Pa.

Discusses (a) what is meant by the concept of recreational carrying capacity, (b) what is known about capacities in terms of both how resources and experiences of visitors are affected by recreational use, and (c) what alternative procedures the administrator can use to manage both resources and visitors for capacity.

47. Lucas, Robert C.
1964. The recreational capacity of the Quetico-Superior area. USDA For. Serv. Res. Pap. LS-15, Lake States For. Exp. Stn., St. Paul, Minn. 34 p., illus.

More people visit the Quetico-Superior wilderness each year, raising the question of recreational capacity. 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 indicates 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 presented.

48. Oi, Michio
1970. Carrying capacity of National Parks in Japan. Park and Recreation Trends 6(2):21-24.

Describes and lists reasons for increasing use of National Parks in Japan. An outline of some of the steps in determining carrying capacities for Japanese National Parks is presented. Both the physical capacity of an area as well as the psychological element of use are considered in this outline.

49. ORRRC
1962. The quality of outdoor recreation: as evidenced by user satisfaction. Study rep. 5, 95 p. Wash., D.C.:Gov. Print. Off.

Presents the findings of a study designed to test the value of user satisfaction as a measure of area quality, based upon user surveys of 24 recreation areas. Data are summarized and evaluated in terms of socioeconomic characteristics and visitor activities. Field appraisals of various elements that affect quality--facilities, physical characteristics, cleanliness, degree of congestion--of each site were used to provide a framework for relating and assessing the survey findings. Analyzes the validity of employing expressions of user satisfaction as a measure of area quality, and discusses the resulting implications.

50. Stankey, George H.
Visitor perception of wilderness recreation carrying capacity. USDA For. Serv. Res. Pap. (in prep.). Intermt. For. and Range Exp. Stn., Ogden, Utah.

The concept of carrying capacity is examined and a general model of the capacity evaluation process is outlined. The effects of several use parameters on capacity perception are examined and attitudes toward various rationing devices are probed. The use distribution in four study areas is discussed and maps of "crowded" zones are developed. Several management techniques to increase capacity are discussed.

51. U.S. Department of the Interior
1967. Outdoor recreation space standards. 67 p. Wash., D.C.:Gov. Print. Off.

Describes outdoor recreation space standards for a variety of recreational opportunities developed by various governmental agencies and recreational planners. Includes a bibliography of over 130 sources.

52. U.S. Forest Service
1959. The National Forest outdoor recreation resources review work plan. 123 p. (mimeo.), USDA For. Serv. Wash., D.C.

Develops converting factors to estimate acreage of recreation resource needed to satisfactorily accommodate one visitor-day of use. Many types of recreation areas are considered. Provides guidelines to managers for making capacity calculations. Also includes background information on use, use projections, area inventories, and inventory analysis and interpretation.

53. Wagar, J. Alan
1964. The carrying capacity of wild lands for recreation. Soc. Am. For., For. Sci. Monogr. 7, 23 p.

Analyzes the carrying capacity problem in terms of (a) the impact of the recreational environment on people, (b) the impact of people on the recreational environment, and (c) management procedures to modify these reciprocal impacts. Includes an analysis of the human as well as the ecological and management considerations that must go into administrative decisions to limit recreational use. Ecological considerations include an experiment in which recreational foot traffic was simulated on a series of vegetated plots. Management considerations include zoning, engineering, interpretation, and persuasion. Also evaluates the probable effects of crowding on satisfaction of the needs and desires that motivate wildland activities.

54. Wagar, J. Alan
1968. The place of carrying capacity in the management of recreation lands. Third Annu. Rocky Mountain-High Plains Park and Recreation Conf. Proc. 3(1), Fort Collins, Colo.

The basic objective of recreation management is to provide benefits for people. Four misconceptions thwart this goal: (1) That the manager's responsibility is to resources rather than people; (2) that each acre of recreation land has a natural level of durability; (3) that most of our recreation areas should be managed for naturalness and uncrowdedness; and (4) that recreation areas would be much easier to manage if we knew their carrying capacity. The real challenge, however, is to find the combination of use limits and other procedures that best achieves our objective of providing sustained benefits for the public. Design, zoning, management of biotic communities, and provision of information, education, and persuasion are important tools.

55. Wagar, J. V. K.
1951. Some major principles in recreation land-use planning. J. For. 49(6):431-435.

Lists eight principles that should be weighed in planning, one of which provides a definition of carrying capacity and the factors that influence it. These principles are related to some of the problems facing recreation planners.

Biological Investigations of Carrying Capacity

Vegetation and Soils

(Also see reference numbers 16, 24, 42, 43, 45, 46, 53)

56. Brown, C. S.
    1965. Recreation capability and soils. 12 p. Dep. For. and Rural Devel., Ottawa, Can.

    Discusses the development by the Canada Land Inventory group of a soils classification system for recreational purposes. Factors such as the ability of the land to sustain use under good management, the number of activities that could be supported, and the variety of recreational opportunities are considered. Also discusses the potential role that the soil scientist can play in recreation resource management.

57. Cieslinski, Thomas J., and J. Alan Wagar
    1970. Predicting the durability of forest recreation sites in northern Utah--preliminary results. USDA For. Serv. Res. Note INT-117, 7 p.

    Simulated trampling was used to test survival capabilities of vegetation on developed recreation sites. The relationship of soil and topographic factors to survival was examined by using multiple regression procedures. Also, aerial photos were tested as a substitute technique for on-the-ground measurements of site factors.

58. DeVos, A., and R. H. Bailey
    1970. The effect of logging and intensive camping on vegetation in Riding Mountain National Park. For. Chron. 46(1):49-55.

    Discusses the effects of logging and intensive camping on the composition and structure of vegetation in disturbed forest communities in southwestern Manitoba, which were investigated using quantitative and qualitative methods. Also discusses effects of logging on plant succession.

59. Dotzenko, A. D., N. T. Papamichos, and D. S. Romine
1967. Effects of recreational use on soil and moisture conditions in Rocky Mountain National Park. J. Soil and Water Conserv. 22(5):196-197.

Describes use related changes in soil compaction, soil organic matter, and soil moisture in three developed campgrounds.

60. Echelberger, Herbert E.
1971. Vegetative changes at Adirondack campgrounds 1964 to 1969. USDA For. Serv. Res. Note NE-142, 8 p.

The vegetation on campsites in the Adirondacks was measured and mapped to determine changes in vegetation. Results indicate that well-maintained sites deteriorated little during the study period.

61. Frissell, Sidney S., Jr., and Donald P. Duncan
1965. Campsite preference and deterioration. J. For. 63(4):256-260.

Describes research undertaken in the Quetico-Superior canoe country of Minnesota and Ontario to determine (a) preferences of canoeists with respect to campsite characteristics, (b) character and degree of campsite deterioration, and (c) feasibility of developing prediction equations for campsite "durability." Regression analyses were used to develop an equation for the prediction of the durability of alternative sites which might be developed in the future to disperse camping use.

62. Gibbens, Robert P., and Harold F. Heady
1964. The influence of modern man on the vegetation of Yosemite Valley. Manual 36, 44 p., illus. Berkeley:Univ. Calif. Div. Agric. Sci.

Compares vegetation in Yosemite Valley in 1961 with that existing in 1851, using early writings by naturalists and administrators and time-series photographs to document changes. Also discusses the effects of early grazing, wildlife populations, floods and rock slides, and recreationists on vegetation and soil.

63. Hartesveldt, Richard
1963. Sequoias and human impact. Sierra Club Bull. 48(9):39-45.

Results of a 5-year study in Yosemite's Mariposa Grove suggest that prolonged human impacts had only a slight effect on vigor of the Sequoias. However, associated plants were substantially influenced by trampling and soil conditions were noticeably affected. Erosion was an especially severe problem. The placement of pavement over the root systems of the sequoias was seen as having a potentially serious impact on tree growth.

64. Harvey, H. T., R. J. Hartesveldt, and J. T. Stanley
1972. Wilderness impact study report. An interim report to the Sierra Club Outing Committee on the effects of human recreational activities on wilderness ecosystems. Sierra Club Outing Comm., San Francisco, Calif.

A preliminary report on a series of studies by San Jose State College staff for the Sierra Club on biological and ecological impacts on wilderness. Interim reports on vegetation, firewood, stock use, water, and users are included. Additional research topics are listed and 36 tentative recommendations for reducing the impact of Sierra Club outings are given.

65. Herrington, Roscoe B., and Wendell G. Beardsley
1970. Improvement and maintenance of campground vegetation in central Idaho. USDA For. Serv. Res. Pap. INT-87, 9 p., illus.

Describes a 2-year test of the effects of seed, fertilizer, and water on ground cover vegetation on a deteriorated campground. Discusses various combinations of the three treatments in terms of their rehabilitative effects.

66. Ketchledge, E. H., and R. E. Leonard
1970. The impact of man on the Adirondack High Country. The Conserv. 25(2):14-18.

Increasing recreational use of the Adirondack High Country has created serious problems of trail erosion and destruction of alpine plant communities. Research was conducted to study the basic causes of the situation and to find some way to minimize existing deterioration before it worsened. Transplanting, fertilization, and seeding were tested.

67. LaPage, Wilbur F.
1964. A study of ground cover under the camper's feet. Am. Recreation J. 5(4):103-104.

Reports on a study of one developed campground in the Allegheny National Forest to determine what happens to the amount and composition of low-growing vegetation in response to various intensities of camper use (measured in camper-days of use). Makes recommendations for preserving the natural appearance of individual campsites; for example, minimizing cover disturbance and rotation measures.

68. LaPage, Wilbur F.
1962. Recreation and the forest site. J. For. 60(5):319-321.

Reports on a study to determine the ways in which a recreational site deteriorates under various levels of use. Penetrometer readings, soil samples, and increment bores were taken from 1/5-acre plots in three New Hampshire State Parks. Periodic annual diameter growth was graphed against years of recreational use. Results were inconclusive but suggest an inverse relationship between growth and recreation use.

69. LaPage, Wilbur F.
1967. Some observations on campground trampling and ground cover response. USDA For. Serv. Res. Pap. NE-68, 11 p., illus.

Reports on a study of vegetative change on a campground in Pennsylvania while site was in use. Examines annual vegetative loss over a 3-year period. Offers suggestions for the establishment of management objectives as well as for various methods of site rehabilitation.

70. Lull, Howard W.
1959. Soil compaction on forest and range lands. Northeastern Forest Exp. Stn., Upper Darby, Pa. USDA For. Serv. Misc. Pap. 768, 33 p., illus.

Reviews available information on soil compaction as related to soil and water conservation on forest and range lands. For the most part, pertinent information was derived from studies that were not primarily concerned with recreation. For example, engineering literature on soil mechanics was especially valuable in describing the compaction process. The three major parts of this report are:

(1) The overall compaction problem as it relates to compaction by logging, trampling, and rainfall; (2) the mechanics of the compaction process and factors affecting and affected by the process; and (3) remedies for compaction. Also includes an extensive bibliography.

71. Lutz, H. J.
1945. Soil conditions of picnic grounds in public forest parks. J. For. 43(2):121-127.

Presents data indicating that soil density is increased and pore volume and air capacity are decreased as a result of recreational use. Permeability of soils subjected to trampling is but a fraction of the permeability of undisturbed soils.

72. Magill, Arthur W.
1963. Evaluating ecological trends in campgrounds. USDA For. Serv. Res. Note PSW-16, 3 p.

Reports on preliminary findings of a study to assess the impact of various levels of recreational use on developed campground soils and vegetation on National Forests in California. Data recorded at the time of plot establishment show some differences that might be related to intensity of use, but the significance of these differences could not be determined until plots are remeasured.

73. Magill, Arthur W.
1970. Five California campgrounds...conditions improve after 5 years' recreational use. USDA For. Serv. Res. Pap. PSW-62, 18 p., illus.

Changes in condition that may have been caused by recreational use, from 1961 to 1966, at five campgrounds in three widely separated locations in California were studied by measuring four variables: vegetation, plant litter, interunit screening, and overstory cover. The increase in vegetation after 5 years was attributed to barriers placed in campgrounds and to greater precipitation. The overall improvement in campground conditions is interpreted as an "adjustment" to recreational use.

74. Magill, Arthur W., and Eamor C. Nord
1963. An evaluation of campground conditions and needs for research. USDA For. Serv. Res. Note PSW-4, 8 p.

Documents the nature and extent of damage to campsites and picnic grounds on National Forests in California. Describes some of the causes of deterioration. Pleads for additional ecological studies of recreation site capacity. Concludes that site maintenance and site improvement are required to supplement currently improved practices of campground and picnic site management.

75. Marr, John W., and Beatrice E. Willard
1970. Persisting vegetation in an alpine recreation area in the southern Rocky Mountains, Colorado. Biol. Conserv. 2(2):97-104.

Describes the current situation and persisting vegetation on the more accessible alpine tundra areas. Data illustrates the harsh nature of the environment. Describes the more important local ecosystems.

76. McCool, Stephen F., Lawrence C. Merriam, Jr., and Charles T. Cushwa
1969. The condition of wilderness campsites in the Boundary Waters Canoe Area. Minn. For. Res. Note 202, 4 p. Sch. For. Univ. Minn., St. Paul.

Reports on a study to determine the physical condition of campsites within the Boundary Waters Canoe Area and to help in the selection of future sites. Measurements were taken of various physical parameters at over 100 sites. Results for island and mainland sites and onroute versus offroute locations are given.

77. Meinecke, E. P.
1929. The effect of excessive tourist travel on the California Redwood Parks. 20 p. Sacramento, Calif.: State Print. Off.

Documents the various detrimental effects of recreational use on vegetation and soil. Discusses the relationship of continuing resource damage to management objectives. Gives some general principles for preventing injury and specific recommendations for rehabilitating certain areas within the Redwood Parks.

78. Merriam, Lawrence C., Jr., Kent Goeckermann, J. A. Bloemendal, and T. M. Costello
1971. A progress report on the condition of newly established campsites in the Boundary Waters Canoe Area. Minn. For. Res. Note 232, 4 p. Sch. For. Univ. Minn., St. Paul.

Reports on the third year of a 5-year study begun in 1967 of 33 wilderness campsites. Explores how visitor use affects sites having different vegetation and soil types, varying locations, use, and aspects. Discusses potential classification of deteriorated campsites. Presents visitor reactions to campsite conditions and reasons for selecting alternative campsites.

79. Michaud, Howard H.
1967. Ecological impact and patterns of use of American forest recreation areas. P. 201-205, in: Int. Union for the Conserv. of Nature and Natur. Resour. Proc., New Ser. 7.

Offers two recommendations as possible solutions to safeguard forest resources against high-intensity recreational use: (1) The application of better techniques in site location, location of facilities, and regulation to preserve the natural condition of the forest; and (2) more effort directed toward educational campaigns to develop greater appreciation and perception of natural values. Pleads for continued research to cover the full spectrum of outdoor recreation needs.

80. Nord, Eamor
1962. Vegetative changes on recreation sites in National Forest campgrounds. Paper presented to 14th Annu. Univ. Calif. Ext. For. Field Sch. Univ. Calif. Sch. For., Berkeley.

Describes the nature and extent of problems recorded at 137 camping areas. Presents specific comments regarding damage to trees, shrubs, grasses, and soils. Describes the problems encountered using artificial plantings in attempts to improve campgrounds.

81. Ripley, Thomas H.
1962. Recreation impact on southern Appalachian campgrounds and picnic sites. USDA For. Serv. Res. Pap. SE-153, 20 p., illus.

Reports on a study to determine the general relationships between physical and biological properties and the degree of site degradation on 42 developed camping and picnic sites. The findings are presented as an aid in site selection, development, and rehabilitation.

82. Ripley, Thomas H.
1962. Tree and shrub response to recreation use. USDA For. Serv. Res. Note SE-171, 2 p.

Reports on a study to determine effects of recreation use on native vegetation at 42 developed camping and picnicking sites in three southern National Forests. Includes a list of trees and shrubs suitable for use on developed sites; comments regarding the relative durability of these trees and shrubs under different intensities of use are given.

83. Scott-Williams, Bettie Willard
1967. Effects of visitor use on the ecosystems of Rocky Mountain National Park, Colorado, U.S.A. P. 116-117, in: Proc. and Papers of the IUCN 10th Tech. Meet. (Lucerne)--Part I. Ecological impact of recreation and tourism upon temperate environment, Sec. 2A New Ser. 7.

Characterizes some findings of a 5-year study of visitor impacts on both tundra and lower elevation ecosystems. Studies show that impacts are slight if trails for visitors are well routed, well constructed, and well maintained in contrast to trails developed by visitor use. Other impacts discussed include trail erosion, campsite facilities, flower picking, wood gathering, rock collecting, fishing, and feeding of animals.

84. Scott-Williams, Bettie Willard
1967. Effects of visitors on alpine tundra associations in Rocky Mountain National Park, Colorado, U.S.A. P. 214-216, in: Proc. of the IUCN 10th Tech. Meet. (Lucerne)--Part I. Ecological impact of recreation and tourism upon temperate environment, Sec. 2A, New Ser. 7.

Reports on a study of the form and rate of recovery of alpine plants from trampling.

85. Settergren, C. D., and D. M. Cole
1970. Recreation effects on soil and vegetation in the Missouri Ozarks. J. For. 68(4):231-233.

Reports on a study to determine the effects of recreation on vegetation and soil environment. Compares available surface and subsurface soil moisture on used recreational areas with that on relatively undisturbed forest cover.

86. U.S. Dep. Health, Education, and Welfare
1965. Environmental health practice in recreational areas. 134 p., illus. Wash., D.C.:Gov. Print. Off.

Provides guidance to persons responsible for planning, designing, operating, and maintaining recreational areas. Includes a discussion of Federal, State and local guidelines for such problems as sewage disposal, food service sanitation, and insect and rodent control.

87. Wagar, J. Alan
1965. Cultural treatment of vegetation on recreation sites. P. 37-39, in: Soc. Am. For. Proc., Detroit, Mich.

When visitor use outweighs the natural capacity of plants to repair themselves, vegetation will deteriorate without added management. Describes a study in Utah to test the relative effectiveness of fertilizer and water, alone and in combination, in producing ground cover. Also describes the role of mulching and adequate tree spacing in site maintenance and rehabilitation.

88. Wagar, J. Alan
1967. Simulated trampling as a technique in recreation research. Int. Union of For. Res. Organ. Pap., 14th Congr. 7:239-245.

Simulated trampling, using either a tamp or a roller, helps eliminate four problems that often confront researchers studying vegetation management on actual recreation sites: (1) Human impact on each site is variable; (2) tests and equipment can be expensive; (3) research workers must use sites already chosen for development; and (4) visitor use can make it difficult to take vegetation measurements when needed. Such trampling provides the opportunity for testing selected intensities of impact. Variability in vegetation composition can be controlled and plots can be chosen to include factors of special importance. Limitations include (a) similarity to human trampling has not been defined; and (b) simulated trampling cannot represent all the impacts of recreation on vegetation.

89. Wagener, Willis W.
1963. Judging hazard from native trees in California recreational areas. USDA For. Serv. Res. Pap. PSW-P1. 29 p.

The desirability of abating tree hazards on heavily used recreation sites along highways and in the vicinity of homes or other structures in the woods is now generally recognized. This guide identifies what defects are likely to render a tree unsafe and how the trained forester can recognize potentially hazardous trees.

90. Wanek, Wallace J.
1971. Observations on snowmobile impact. The Minn. Volunteer 34(199):1-9.

Considers the effect of snow compaction by snowmobiles on soil temperatures and soil microbe activity as well as the effects of these machines on vegetation and wildlife. Suggests some needed areas of research.

91. Willard, Beatrice E., and John W. Marr
1970. Effects of human activities on alpine tundra ecosystems in Rocky Mountain National Park, Colorado. Biol. Conserv. 2(4):257-265.

Describes the impact of summer visitors on a fragile portion of the Park. Proposes a scale for estimating visitor effects on vegetation and soils. Discusses the relative impact of visitors on different ecosystems. Also, describes other activities that affect the tundra, such as rock collecting and littering.

92. Willard, Daniel E.
1971. How many is too many? Detecting the evidence of over-use in State Parks. Landscape Archit. 61(2):118-123.

Discusses the concept of carrying capacity and its physical and social ramifications. Describes a study of recreation impacts on the physical environment of a Texas State Park.

Water

(Also see reference numbers 35, 41, 42, 46, 64, 86)

93. Barton, Michael A.
    1969. Water pollution in remote recreational areas. J. Soil and Water Conserv. 24(4):132-134.

The concentrated use of remote recreational areas, such as the Boundary Waters Canoe Area, threatens water quality. The importation of solid wastes, the discharge of enriched waters into remote areas from adjacent municipalities, the problem of human waste disposal, the release of gasoline from outboard engines, and the widespread use of insecticides all contribute to a potentially serious pollution problem. Natural inputs, such as sedimentation, must also be considered. Proposes a system for monitoring selected parameters (e.g., phosphorus, fecal coliform, etc.).

94. Baumann, Duane D.
    1969. The recreational use of domestic water supply reservoirs: perception and choice. 125 p. Univ. Chicago, Dep. Geogr. Res. Pap. 121.

Explores the nature and extent of the recreational use of water supply impoundments. Differing regional views as to the use of these impoundments for recreation, and the roots of these differences in managerial knowledge, attitudes, and motivation are outlined.

95. Beattie, Byron
    1964. Municipal watersheds and recreation can be compatible. p. 37-45, in: Water: development, utilization, conservation. Boulder:Univ. Colo. Press.

Lists the pro and con arguments for public use of municipal watersheds. Discusses current policy relative to public use of watersheds and reviews technical findings of the impact of human use of water quality. Urges increased application of scientific facts to watershed management.

96. Beneditti, A. J.
    1964. Watersheds and recreational land use in the Pacific Northwest. J. Am. Water Works Assoc. LVI:1467-1473.

Discusses the conflicts of interest associated with utilizing municipal watershed areas for recreational purposes. Emphasizes the land use situation in the Pacific Northwest. Principal topics include the growing need for water-based recreation opportunities; the risk of pollution and disease transmission resulting from the use of public drinking water supplies; economic considerations of mixed water uses; and public water resource policies for controlling the use of municipal watersheds.

97. California Department of Public Health
    1962. A study of recreational use and water quality of reservoirs, 1959-1961. 84 p., illus. Berkeley:Bur. Sanit. Eng.

Describes a study focusing on the relationship between recreational use of reservoirs (largely water supply reservoirs) and water quality. Field observations also were made of the behavior of those using reservoirs for recreation and of the management of the recreational development (notably sanitary facilities). Three classes of reservoirs were studied: (1) Domestic water supply impoundments closed to use; (2) domestic supply reservoirs open to controlled use; and (3) multipurpose reservoirs open to controlled recreational activities.

98. Committee on Recreational Uses of Public Water Supplies, New England Water Works Association.
1958. Final report and recommendations of committee on recreational uses of public water supplies. J. New England Water Works Assoc. LXXXI:409-415.

Discusses the moral and financial responsibility of the waterworks manager to provide a safe and palatable water supply. Basically opposes recreational use of water supply reservoirs because it poses a potential disease hazard.

99. Committee on Research in Water Resources, University of California
1956. Proceedings of a conference on recreational use of impounded water. 115 p. Berkeley:Univ. Calif.

Papers explore potential effects of using selected reservoirs in California for limited recreational use. Conference also provided forum for major interest groups to express their views. Divided into three parts: (1) Planning for recreational use of impounded water; (2) limitations on recreational use of impounded water; and (3) conflicting interests in the use of impounded water.

100. Cowgill, Peter
1971. Too many people on the Colorado River. Natl. Parks and Conserv. Mag. 45(11):10-14.

Discusses nature of some of the problems and efforts to control or reduce growing use pressures on the Colorado River. Also discusses future management direction for the Colorado River.

101. Muratori, Alex, Jr.
1968. How outboards contribute to water pollution. The Conservationist 22(6):6-8, 34.

Discusses design of two-stroke engine and reasons for its large amounts of exhaust. Presents new techniques for control of pollution from outboard motors.

102. Myles, George A.
1970. Effect of quality factors on water-based recreation in western Nevada. 62 p. Univ. Nev., Reno:Agric. Exp. Stn.

Recreation use at four western Nevada lakes was studied. A survey of users probed reasons for attendance at the various lakes, attractive and detractive elements of the lakes, desired facilities, and attitudes towards fees. Coliform counts were also made at developed lakefront areas.

103. ORRRC
1962. Water for recreation-values and opportunities. Study Rep. 10, Wash., D.C., 130 p.

Presents an analysis of future water-based recreation in the United States. Relates recreation uses of water to other types of water development and discusses the importance of including recreation in the planning of water resource projects. Discusses the problems of access and the effects of such factors as water quality and reservoir management upon recreation use.

104. Stewart, Ronald H., and H. H. Howard
1968. Water pollution by outboard motors. The Conservationist 22(6):6-8,31.

A review of the literature suggests oil contamination is both widespread and detrimental to water quality and marine life. A case study of outboard motor

fuel pollution near a resort area is discussed. Estimates are made on the amount of fuel-pollution and its effect on the aquatic environment and on the continuing role of the area as a popular resort.

105. Van Nierop, Emmanuel Theodorus
1966. A framework for the multiple use of municipal water supply areas. 153 p. Ithaca, N.Y.:Cornell Univ., Water Resour. Cent.

Focuses on the dilemma facing many municipalities today--multiple use of water supply reservoirs. With New York State as the example, the author examined the public health, legal, and economic implications related to the formulation of recreation policy for water supply reservoirs; the prevention measures associated with pollution abatement and financial realities of permitting public access to reservoirs; and the practicability of multiple use management on municipally owned reservoir lands. Interviews with waterworks managers served to identify basic attitudes on the potential multiple use of reservoirs and principal conflicts arising from such usage.

Wildlife

(Also see reference numbers 18, 22, 24, 90)

106. Adams, Charles C.
1925. The relation of wild life to the public in National and State Parks. Roosevelt Wild Life Bull. 2(4):371-401.

An account of the significance careful land management would have on increasing the human benefits of parks by enhancing opportunities for seeing and understanding wildlife. Issues such as the need to preserve wilderness in parks to provide needed habitat and the development of a distinctive park literature that helps the public understand wildlife are discussed.

107. Jarvinen, Julie A., and William D. Schmid
1971. Snowmobile use and winter mortality of small mammals. P. 130-141, in:1971 Snowmobile and Off-the-Road Vehicle Res. Symp. Proc., Michael Chubb (ed.). Dep. Park and Recreation Resour., Mich. State Univ., East Lansing.

Reports on an investigation of the effects of snow compaction by snowmobiles on small mammals. Animals were live-trapped on an experimental plot and counted. Mammal survival was compared between one plot with no snowmobiling and one with snowmobiling. A discussion of mortality factors is presented. (This symposium has several papers relevant to carrying capacity decisionmaking).

108. Leopold, A. Starker (Chairman)
1963. Wildlife management in the National Parks. U.S. Dep. Inter. Advis. Board on Wildl. Manage. (mimeo.)

Describes the role of wildlife management within the broader management objectives of the National Parks. Proposes management policy that would recognize the complexity of ecologic communities and the diversity of management procedures required to preserve them. Suggests methods of habitat management and the control of animal populations. Also suggests wildlife management directions for National Recreation Areas and new National Parks.

109. McMillan, John F.
1954. Some observations on moose in Yellowstone Park. Am. Midl. Nat. 52(2):392-399.

Focuses on the influence of tourist pressure on moose behavior in two areas in Yellowstone. In the area of heavy pressure, moose were observed to have developed considerable tolerance of visitors and would move off slowly when disturbed, returning soon afterward. At the control area, visitor disturbance caused animals to run from the area, not returning again until at least the following day.

110. Moment, Gairdner B.
1969. Bears: the need for a new sanity in wildlife management. Bio-Science 18(12):1105-1108.

Examines the policy of the National Park Service regarding bears and questions whether it is possible to have people and bears in the parks together. Injuries and deaths to humans by bears are reviewed. Calls for the intelligent use of discrimination by man in his wildlife management programs.

111. Ream, Catherine H.
1968. Research on loon productivity and pesticide residues. Final Rep., Bur. Sport Fish. and Wildl., Fish and Wildl. Serv., Dep. Inter. 25 p.

Investigates reasons for the decline in the reproductive rate of the common loon, *Gavia immer*, in the Superior National Forest of Minnesota. Increasing use of island campsites by canoeists was found to be the primary cause for the decrease. Pesticide residues were found to be a potential danger on some lakes.

112. Stearns, Forest W.
1967. Wildlife habitat in urban and suburban environments. P. 61-69, in: Trans. 32d North Am. Wildl. and Nat. Resour. Conf., March 13, 14, 15.

Discusses role of wildlife for the urban dweller. Outlines problems in providing wildlife habitat and techniques for maintaining and improving it.

113. Webb, William L.
1968. Public use of forest wildlife: quantity and quality considerations. J. For. 66(2):106-110.

Focuses on the need to manage forest resources, with an emphasis on wildlife, for quality. The problem of defining quality is raised. Argues for joint consideration of qualitative values with quantitative ones. Discusses changing public use of wildlife resources and consequent changes in quality evaluations.

114. Wetmore, Stephen, Carl H. Nellis, and Lloyd B. Keith
1970. A study of winter coyote hunting in Alberta with emphasis on use of snowmobiles. Wildl. Tech. Bull. 2, Fish and Wildl. Div., Gov. of Alberta Dep. of Lands and Forests, 22 p.

Describes hunting pressures on coyotes and compares survival rates under hunted and nonhunted conditions. Analyzes opinions regarding the use of snowmobiles and dogs to hunt coyotes among farmers, sportsmen, and Alberta Fish and Wildlife Division personnel. Discusses opposition to their use. Summarizes suggestions concerning winter coyote hunting regulations made by farmers, sportsmen, and game department personnel.

Investigations of Esthetic Carrying Capacity

Perception of Resource Quality

(Also see reference numbers 10, 16, 24, 40, 42, 43, 44, 45, 46, 49, 53, 61, 64, 78, 94, 100, 102, 103, 113.)

115. Barker, Mary L.
1968. The perception of water quality as a factor in consumer attitudes and space preferences in outdoor recreation. Assoc. Am. Geogr. Annu. Meet., Wash., D.C.

Attempts to measure some of the social consequences of deteriorating water quality and the attitudes of people toward recreational use of public waterways. Examines the relationships between water quality evaluation and variables such as recreational activity, personal experience, and attitudes toward the environment.

116. Clark, F. G.
1936. Some preferences of forest visitors. J. For. 34(9):840-843.

Provides a description of users in the Northern Rocky Mountains, including a discussion of visitor preferences for facilities, public acceptance of primitive area policy, and attitudes about multiple use. Offers a brief commentary regarding potential management implications.

117. Cordell, Harold K., and George A. James
1972. Preferences of visitors for certain physical characteristics of developed campgrounds. Southeast For. Exp. Stn., Asheville, N.C. USDA For. Serv. Res. Pap. In press.

A case study of visitors to a Southern Appalachian campground was conducted during summer camping seasons from 1966 through 1970 to determine preferences for such things as campsite spacing, comfort stations and water hydrants, amount of understory and overstory vegetation, and other site characteristics. Three data sources were used to determine visitor preferences: personal interview, self-administered questionnaire, and observations concerning actual campsite occupancy.

118. Cordell, Harold K., and Clinton K. Sykes
1969. User preferences for developed-site camping. Southeast For. Exp. Stn., Asheville, N.C. USDA For. Serv. Res. Note SE-122, 6 p.

Campers at Indian Boundary Campground in Tennessee were interviewed during 1966 and 1967 to determine their needs for campground facilities and preferences for campsite characteristics. Their expressed needs and preferences varied greatly, indicating more variety might be offered within campgrounds to create a satisfying camping environment for people.

119. Hecock, Richard D.
1970. Recreation behavior patterns as related to site characteristics of beaches. J. Leisure Res. 2(4):237-250.

An analysis of conditions existing at various Cape Cod sites and patterns of visitor use. Investigates the influence of facilities, beach location, socio-economic characteristics, and other origin characteristics on use.

120. James, George A., and Harold K. Cordell
1970. Importance of shading to visitors selecting a campsite at Indian Boundary Campground in Tennessee. Southeast For. Exp. Stn., Asheville, N.C., USDA For. Serv. Res. Note SE-170, 5 p.

Campers were interviewed to determine the amount of shading they preferred. The overstory in this campground was selectively thinned several years earlier. This gave campers a choice of campsites, ranging from those so heavily shaded that little sunlight reached the forest floor to campsites that received almost full sunlight. Study findings indicate that recreation managers and planners should critically examine the current design standard that advocated little or no tree cutting in developed campgrounds.

121. Klukas, R. W., and D. P. Duncan
1967. Vegetational preferences among Itasca Park visitors. J. For. 65(1):18-21.

Forest type preferences of visitors were ascertained by both direct observation and interviews. Expressed preferences are compared to normal vegetational successional patterns and the implications for park management are discussed.

122. LaPage, Wilbur F., and Dale P. Ragain
1971. Trends in camping participation. Northeast For. Exp. Stn., Upper Darby, Pa. USDA For. Serv. Res. Pap. NE-183, 22 p., illus.

A study of the camping participation patterns of a panel of 565 New England campers over 5 years (1964-1969). Changes in participation are described and discussed. Describes three broad categories of behavorial influences and discusses tentative explanations of the participation changes.

123. Lime, David W.
1971. Factors influencing campground use in the Superior National Forest of Minnesota. North Central For. Exp. Stn., St. Paul, Minn. USDA For. Serv. Res. Pap. NC-60, 18 p., illus.

From a study of campground use in 1967 and 1968, relationships were determined between the intensity of use and 74 onsite and location characteristics. Campers were interviewed to learn what factors influenced their choice of a particular campground. Outlines recommendations to management and discusses topics for further research.

124. Lime, David W., and Charles T. Cushwa
1969. Wildlife esthetics and auto campers in the Superior National Forest. North Central For. Exp. Stn., St. Paul, Minn. USDA For. Serv. Res. Pap. NC-32, 8 p., illus.

Attempts to determine if seeing wildlife is a primary attraction or not for campers visiting the Superior National Forest. Discusses the extent to which wildlife was seen and the types seen.

125. Lucas, Robert C.
1970. User evaluation of campgrounds on two Michigan national forests. North Central For. Exp. Stn., St. Paul, Minn. USDA For. Serv. Res. Pap. NC-44, 15 p., illus.

Campground use on the Huron and Manistee National Forests was studied in relation to resource characteristics, location, facilities provided, and visitor attitudes about the environment. Applies regression analysis to explain variation in campground use per unit. Compares visitor ratings of quality to nationwide Forest Service recreation resource inventories.

126. Lucas, Robert C.
1963. Visitor reaction to timber harvesting in the Boundary Waters Canoe Area. Lake States For. Exp. Stn., St. Paul, Minn. USDA For. Serv. Res. Note LS-2, 2 p.

About two-thirds of the Boundary Waters Canoe Area is available for logging under certain restrictions. This brief Note explores the extent to which visitors were aware of logging and how many were bothered by seeing it.

127. Lucas, Robert C.
1964. Wilderness perception and use: the example of the Boundary Waters Canoe Area. Nat. Resour. J. 3(3):394-411.

Examines the perception of wilderness in the Boundary Waters Canoe Area. Discusses conflicts between user groups and between management policies and visitors. Compares perceptions of wilderness held by resource managers and various user groups. Outlines possible management alternatives for the Boundary Waters Canoe Area.

128. Merriam, L. C., Jr., and R. B. Ammons
1968. Wilderness users and management in three Montana areas. J. For. 66(5):390-395.

Provides a comparison of the attractions, features, and management of the Bob Marshall Wilderness, Mission Mountains Primitive Area, and Glacier National Park. Analyzes user concepts of wilderness, wilderness experience, and management. Discusses the implications of the study findings to future management of these and other wilderness lands. (Also see, by the same authors, *The Wilderness User in Three Montana Areas*, Univ. Minn. Sch. For., 1967. 54 p.)

129. Penfold, Joseph W.
1961. The outdoors, quality, and isoprims. P. 109-116, **Wilderness: America's living heritage**, David Brower (ed.). San Francisco: Sierra Club.

Asserts that remoteness is the most important characteristic of wilderness. Develops a map of the Rawah Wilderness in Colorado to show gradations in quality, illustrated by use of "isoprims" or lines connecting points of equal primitiveness.

130. Priddle, George B.
1964. Wilderness perception in the Algonquin Park interior. Unpubl. M.A. thesis, Clark Univ., Grad. Sch. Geogr.

Describes the history, setting, and recreational use of Algonquin Park, with particular emphasis on the Park's interior. "Wilderness" users are described from sample information in terms of their socioeconomic characteristics. The major emphasis is on "wilderness perception", the method of analysis, and the spatial variation by types of recreationists. Discusses implications for public policy in light of perceived "wilderness" limitations and future demands.

131. Priddle, George B., Cameron D. Clark, and Larry O. Douglas
Factors affecting the quality of interior recreation in Algonquin Provincial Park. Ontario Dep. Lands and For., Toronto. Res. Pap., in press.

Users were interviewed during their trip to determine the degree of satisfaction they received while using particular segments of well-known canoe routes. The basic output of this "Canoe Network Analysis" are criteria that can be used to determine, in perceptual or attitudinal terms, the carrying capacity of a particular section of the park, taking into consideration the quality of the lakes, the number of potentially good campsites, and the number of people that can be accommodated before a "crowded" situation would be experienced.

132. Shafer, Elwood L., Jr.
1969. Perception of natural environments. Environ. and Behav. 1(1):71-82.

A key objective of recreation resource planning and management is to promote perception of natural environments. This can only be accomplished by understanding how and why recreationists perceive those natural environment factors that can be controlled by management processes. Discusses several research techniques with special emphasis on man's awareness of certain aspects of the natural environment. Outlines research problems in environment perception.

133. Shafer, Elwood L., Jr.
1969. Preferences for outdoor recreation facilities in four State Parks. J. For. 63(7):513-518.

Personal interviews were conducted to measure the direction and amount of the demand for outdoor recreation facilities at four Pennsylvania State Parks. A photochoice method was used in the survey. Compares preferences of campers and noncampers and weekday versus weekend users.

134. Shafer, Elwood L., Jr., John E. Hamilton, Jr., and Elizabeth A. Schmidt
1969. Natural landscape preferences: a predictive model. J. Leisure Res. 1(1):1-19.

Competition and pressure for new land uses have accelerated the need for natural resource managers to understand the interrelationships between natural features in a landscape and the public's preferences for that landscape. This study identifies what quantitative variables in photographs of landscapes were significantly related to public preference for those landscapes. Using factor and multiple-regression analyses, an equation was developed that used six variables and accounted for 66 percent of the variation in preference scores for photographs of landscapes.

135. Sommarstrom, Allan R.
1966. The impact of human use on recreational quality: the example of the Olympic National Park back country user. Unpubl. M.S. thesis on file at Univ. Wash., Seattle.

Explores the nature and significance of human impact on perceived recreational quality. Discusses attitudes regarding use levels, extent of damage, and administration and management. Suggests possible policy changes and discusses the provision of wilderness quality as a management objective.

Human Interactions

(Also see reference numbers 24, 42, 43, 45, 46, 47, 49, 50, 53, 64, 100, 102, 116, 117, 118, 122 123, 125, 127, 128, 129, 130, 131, 135)

136. Ashton, Peter F.
1971. Recreational boating carrying capacity: a preliminary study of three heavily used lakes in southeastern Michigan. 184 p. Unpubl. Ph.D. Diss., Dep. Resour. Dev., Mich. State Univ., East Lansing.

Posits that water-carrying capacity is a function of both the impact of users on the physical resource and the ways in which satisfaction changes with different amounts of use. Investigates attitudes of water-oriented users during periods of intense use and develops a measure of the level of boating activity intensity through a least-squares stepwise deletion analysis technique. Relates boater attitudes to levels of boating intensity. Examines the relationship of selected socioeconomic characteristics and user evaluations of use levels.

137. Bissell, Lewis P.
1971. The social and political impact of snowmobiles. The North. Logger 19(9):21, 32-34.

Focuses principally on the social and political impacts of snowmobiling but also touches on the environmental consequences. Discusses the economic associated benefits of the snowmobile and impacts it has had on luring increasing numbers of Americans to participate in winter outdoor recreation. Discusses political consequences of snowmobile use, including problems of noise, trespass, theft, use zoning, and other public use restriction policies.

138. Burch, William R., Jr., and Wiley D. Wenger, Jr.
1967. The social characteristics of participants in three styles of family camping. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg. USDA For. Serv. Res. Pap. PNW-48, 29 p., illus.

Presents some selected findings from a camper survey made on the Three Sisters and Lake of the Woods areas in Oregon, including details about ages, family size, economic position, and attitudes of the participants in three different camping styles.

139. Fisher, Anthony C., and John V. Krutilla
1972. Operational concepts of optimal recreation capacity for low density resource-based recreation facilities. In: Natural environments: studies in theoretical and applied analysis, p. 115-141. John V. Krutilla (ed.). Johns Hopkins Univ. Press.

Outlines the structure of an economic model designed to maximize the value of the service flow from tracts of wildlands. Utilizes measures of aggregate

satisfaction with probabilities of encounters to estimate aggregate utility. Examines visitor expressions of willingness to pay to retain some desired wilderness experience and outlines some future research directions.

140. Godfrey, E. Bruce, and Robert L. Peckfelder
1972. Recreation carrying capacity and wild rivers: a case study of the Middle Fork of the Salmon. Paper presented to the Annu. Meet. of the West. Agric. Econ. Assoc., Logan, Utah, July 25. Water Resour. Res. Cent., Univ. Idaho, Moscow.

A survey of recreationists on the Salmon River of Idaho describes the values and benefits visitors sought in visiting the area. Attempts to determine what use characteristics affect capacity perception. Potential constraints on future increases in use of the river are seen as the ability of the flora and fauna to withstand use and the availability of campsites. Discusses the problem of controlling congestion externalities.

141. Lime, David W.
1972. Large groups in the Boundary Waters Canoe Area--their numbers, characteristics, and impact. USDA For. Serv. Res. Note NC-142, 4 p.

Discusses the impact of "large" parties in the BWCA in terms of their effect on the resource and on the experience of other visitors. Describes the amount of use by large groups and the visitors most likely to be affected by a party size limitation.

142. McCool, Stephen F., and Lawrence C. Merriam, Jr.
1971. Camper-outfitter interaction and the Boundary Waters Canoe Area, Superior National Forest, Minnesota. Minn. For. Res. Note 225, 4 p. Sch. For., Univ. Minn., St. Paul.

This study focuses on describing the communication processes of outfitters and wilderness visitors. More specific goals stressed visitors' information sources and levels of knowledge about the Boundary Waters Canoe Area, and their attitudes on several important management policy issues.

143. McCool, Stephen F., and Lawrence C. Merriam, Jr.
1970. Factors associated with littering in the Boundary Waters Canoe Area. Minn. For. Res. Note 218, 4 p. Sch. For., Univ. Minn., St. Paul.

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. Examines the need for managers to establish relationships with nonoutfitted groups in order to gain compliance.

144. McCool, Stephen F., and Lawrence C. Merriam, Jr.
1970. Travel method preferences of BWCA campers. Minn. For. Res. Note 219, 4 p. Sch. For., Univ. Minn., St. Paul.

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

145. Shafer, Elwood L., Jr., and James Mietz
1960. Aesthetic and emotional experiences rate high with northeast wilderness hikers. Environ. and Behav. 1(2):187-197.

Utilizes an attitude scale to quantify a few values of wilderness recreation. Reports on a survey of users of two areas and describes the relative importance visitors place on various esthetic, emotional, educational, and social aspects of wilderness recreation.

146. Stankey, George H.
1972. A strategy for the definition and management of wilderness quality. In: Natural environments: studies in theoretical and applied analysis, p. 88-114. John V. Krutilla (ed.). Johns Hopkins Univ. Press.

Utilizes an attitude scale to measure visitor definitions of wilderness. Defines a population of wilderness users whose values and opinions are considered especially relevant to management decisionmaking and examines the response of this group to various parameters of use. Discusses the implications of the findings to wilderness management.

147. Stankey, George H.
1971. Wilderness: carrying capacity and quality. The Naturalist 22(3):7-13.

Critically reviews the traditional concept of carrying capacity and discusses the difficulty of using it in the wilderness context. Outlines four broad parameters of wilderness use that affect visitor perception of capacity and reports the results of a questionnaire survey. Offers an operational definition of wilderness quality.

Managing for Carrying Capacity

Rationing Techniques

(Also see reference numbers 22, 24, 26, 34, 40, 43, 46, 47, 49, 50, 53, 54, 102, 103, 135, 137)

148. Bechter, Dan M.
1971. Congested parks--a pricing dilemma. P. 3-11, in: Mon. Rev. Fed. Reserve Bank of Kansas City.

The effect of a no-price (or low price) policy on park use is illustrated. The role of pricing as a method to alter use numbers and distribution is discussed. The effects of public opinion regarding charging for recreation is recognized.

149. Davis, Robert K.
1963. Recreation planning as an economic problem. Nat. Resour. J. 3(2):239-249.

Discusses the role economics can play in optimizing public expenditures on outdoor recreation. Treats outdoor recreation as a form of consumption similar to other commodities and attempts to define the outdoor recreation market through the use of interviews.

150. Gilbert, C. Gorman, George L. Peterson, and David W. Lime.
1972. Toward a model of travel behavior in the Boundary Waters Canoe Area. Environ. and Behav. 4(2):131-157.

Focuses on the general overuse problem that exists in the Boundary Waters Canoe Area and stresses the importance of determining social and ecological carrying capacities to prevent overuse occurring. Proposes that once capacities are recommended, a method (predictive model) is required to evaluate the impacts of alternative use control measures on intensity of use over space and time. Identifies possible regulatory and manipulative use control techniques. Suggests Markov renewal theory as a promising tool to predict user distributions in dispersed recreation areas. Describes hypothetical model of migration of overnight campers between campsites. Presents plans for testing the model with actual travel data.

151. Hardin, Garrett
1969. The economics of wilderness. Nat. Hist. 78:20-27.

The increasing use of wilderness leaves three possible future courses of action: (1) Open wilderness to everyone; (2) close it to everyone; and (3) allow only limited access. The latter action seems the only rational approach. Rationing access could be accomplished through the marketplace, by queues, lottery, or merit. A merit system is proposed as the best system of allocation.

152. Hendee, John C., William R. Catton, Jr., Larry D. Marlow, and C. Frank Brockman
1968. Wilderness users in the Pacific Northwest--their characteristics, values, and management preferences. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg. USDA For. Serv. Res. Pap. PNW-61, 92 p., illus.

Contains an analysis of user attitudes toward dimensions of wilderness management and certain codes of behavior. It describes visitors' socioeconomic characteristics, conservation club membership, and recreational experiences. The authors develop a typology of users based on response to an attitude scale.

153. LaPage, Wilbur F.
1968. The role of fees in campers' decisions. Northeast For. Exp. Stn. Upper Darby, Pa. USDA For. Serv. Res. Pap. NE-118, 24 p., illus.

Examines how fees influence campers' decisions of where, when, and how much to camp. Examines how size of fee and method of charging affect camping frequency and campsite selection. Develops a demand curve analysis to estimate the maximum revenue-producing fee.

154. McCurdy, Dwight R.
1970. Recreationists' attitudes toward user fees: management implications. J. For. 68(10):645-646.

Describes the results of a study of recreationists' opinions of Land and Water Conservation Fund fees at Crab Orchard National Wildlife Refuge in Illinois. Discusses reasons why fees were favored by certain groups and opposed by others. Outlines a public relations program to enhance public acceptance of user fees.

155. McCurdy, Dwight R., and B. Gene Miller
1968. The recreationist at Crab Orchard National Wildlife Refuge and his opinions of user fees. Dep. For. Publ. 1, 26 p. Carbondale: South. Ill. Univ.

Describes who uses the Refuge, activities engaged in while visiting the area, and how visitors feel about a use charge.

156. Schlatter, John
1972. Great Smokies trails: the backpacking permit system. Natl. Parks Mag. 46(9):13-17.

Discusses environmental and social consequences of growing use in the Park and describes steps initiated in 1972 to restrict the number of overnight visitors in certain areas of the Park. Stresses the need for dispersing use.

157. Snyder, A. P.
1966. Wilderness management--a growing challenge. J. For. 64(7):441-446.

Discusses some of the practical problems of wilderness management. Cites specific problems from the John Muir Wilderness in California, including trail design and location, litter, recreation stock, and the possible future need to restrict use.

Zoning

(Also see reference numbers 9, 24, 40, 46, 47, 50, 53, 54, 73, 79, 127, 129, 135, 137, 152)

158. Bassett, Ray E.
1950. Zoning as applied to wilderness. Planning and Civic Comment 16(1):16-19.

Describes the management objectives for the Quetico-Superior area and outlines legislation that has been established to meet these objectives. Defines the three major management zones in effect. Outlines some of the yet unresolved problems.

159. Beltran, Enrique
1962. Use and conservation: two conflicting principles. P. 35-43, in: First World Conference on National Parks, Alexander B. Adams (ed.). Wash., D.C.:Gov. Print. Off.

Proposes the use of a three-stage zoning plan to protect National Parks. Discusses the administration of such a proposal in regard to the National Parks of Mexico and lists the fundamental objectives used in studying the problems of the Mexican park system.

160. Brooks, Lloyd
1963. Zoning as a step in the planning of natural parks. 6 p., in: 2d Fed. Prov. Parks Conf. Proc. Ottawa: Can. Natl. and Hist. Parks Branch.

Describes some of the experiences of Canadian park officials in implementing park zoning. Discusses advantages in zoning in terms of achieving management objectives, protecting the natural environment, and providing quality recreation.

161. Burch, William R., Jr.
1964. Two concepts for guiding recreation management decisions. J. For. 62(10):707-712.

Suggests some sociological concepts to aid resource managers. By considering the collective aspects of recreation behavior, the manager can plan to enhance variation in recreational opportunities. Also recommends that consideration of the recreationist's definition of the resource system will enhance user satisfaction and lessen managerial problems.

162. Carhart, Arthur H.
1961. Planning for America's Wildlands. 97 p. Harrisburg, Pa.:The Telegraph Press.

Outlines some of the philosophical aspects of wildland planning as well as practical operational guidelines. Gives physical and social definitions of wildlands. Outlines the problems of traditional multiple use planning and discusses examples of use-planning units and the types of uses permissible in various zones.

163. Hart, William J.
1966. A systems approach to park planning. Morges, Switzerland, Int. Union for the Conserv. of Nature and Nat. Resour. 118 p., illus. (IUCN Publ., New Ser.:Suppl. Pap. 4)

This monograph introduces the concept of park systems planning. Discusses choosing among various land use alternatives, carrying out inventories, physical and biological factors affecting park development, park administration, and sources of planning assistance. Gives examples of park planning in Turkey, Columbia, Zambia, and Korea.

164. Jaakson, Reiner
1971. Zoning to regulate on-water recreation. Land Econ. 47(4):382-388.

Proposes a zoning system based on grouping those activities which exhibit similar density requirements and speed characteristics. Defines activity zones: (1) A Shoreline Activity Zone, (2) an Open Water Zone, (3) a Wildlife Zone. Guidelines for implementing the system are noted as are some of the legal, administrative, and ecological constraints that will necessitate certain alterations in the application of the model to different water bodies.

165. Wagar, J. Alan
1963. Campgrounds for many tastes. Intermt. For. and Range Exp. Stn., Ogden, Utah. USDA For. Serv. Res. Pap. INT-6, 10 p., illus.

The need to provide a diverse system of camping areas is the focus of this paper. Outlines a classification of campgrounds, designed to satisfy different user needs. Campsites in the backcountry, for example, would be designed so as to not only protect the resource, but provide solitude to the visitor.

166. Wagar, J. Alan
1966. Quality in outdoor recreation. Trends in Parks and Recreation 3(3):9-12.

Outlines certain basic premises that should underlie land management decisions. Criticizes the past tendency to manage land area by area rather than by opportunity. In order to insure quality recreation, zoning is suggested as a way of accommodating diverse and often conflicting tastes.

167. Wehrwein, G. S., and H. A. Johnson
1942. Zoning land for recreation. Land Econ. 18(1):47-57.

Reports on an early study of recreation zoning ordinances in Wisconsin. Recreational landowners are surveyed. Conflicts between recreation and agriculture are described as are ways in which the activities complement one another. Discusses zoning violations and puts forth some ideas for improving recreational zoning.

168. Wilson, George T.
1964. Lake zoning for recreation: how to improve recreational use of lakes through regulation and control. 30 p. Am. Inst. Park Executives, Oglebay Park, Wheeling, West Va.

Offers guidelines for developing lake zoning ordinances and regulations. Provides administrators a better understanding of the ecological problems involved in management of lakes for recreational purposes. Discusses the character of lakes, lake uses and activities, development cycle for lakes, space requirements for various uses, and the various means of regulation and control.

Site Maintenance and Rehabilitation

(Also see reference numbers 40, 46, 49, 50, 52, 53, 54, 55, 56, 57, 61, 64, 65, 66, 67, 68, 69, 70, 73, 74, 76, 77, 78, 79, 80, 81, 82, 85, 86, 87, 88, 89, 92, 120.)

169. Appel, A. J.
1950. Possible soil restoration on "overgrazed" recreation areas. J. For. 48(5):368.

Suggests the application of sawdust to combat problems of humus loss, soil compaction, and loss of moisture to vegetation. Discusses potential benefits.

170. Beardsley, Wendell G., and Roscoe B. Herrington
1971. Economics and management implications of campground irrigation--a case study. USDA For. Serv. Res. Note INT-129, 8 p., illus.

Irrigation of campgrounds can aid in establishing and maintaining ground cover vegetation. This report analyzes the costs and benefits involved in irrigating a campground in central Idaho. Discusses some problems in irrigating and presents alternative campground designs and construction layouts.

171. Beardsley, Wendell G., and J. Alan Wagar
1971. Vegetation management on a forested recreation site. J. For. 69(10): 728-731.

Reports on the effectiveness of selected cultural treatments for establishing and maintaining vegetation on recreation sites. Relates amounts of herbaceous ground cover and the growth rates of trees to various combinations of three cultural treatments, to visitor use, and to selected site factors. Gives recommendations for site maintenance and rehabilitation.

172. Bohart, Charles V.
1968. Good recreation area design helps prevent site deterioration. J. Soil and Water Conserv. 23(1):21-22.

Focuses on matching design criteria with recreation site objectives; optimizing site selections by considering factors such as soil, topography, aspect, and climate; restricting use by facility design; and the requirement of complementing site design with adequate operation and maintenance efforts.

173. Cordell, Harold K., and George A. James
1971. Supplementing vegetation on southern Appalachian recreation sites with small trees and shrubs. J. Soil and Water Conserv. 26(6):235-238.

Discusses suitability of using small planting stock to supplement existing vegetation.

174. Cordell, Harold K., and Daniel R. Talhelm
1969. Planting grass appears impractical for improving deteriorated recreation sites. Southeast For. Exp. Stn., Asheville, N.C. USDA For. Serv. Res. Note SE-102, 2 p.

Reports on an attempt to establish grass on damaged sites using the best possible treatment for growth and survival.

175. Densmore, Jack, and Nils P. Dhalstrand
1965. Erosion control on recreational land. J. Soil and Water Conserv. 20(6):261-262.

Shows how many erosion control techniques originally developed for use on agricultural land can be modified and applied to recreation areas. Focuses on disposing of surface water from recreation sites and on providing adequate soil cover for sites.

176. Duncan, Donald P.
1971. Managing the forest environment: role of the professional. J. For. 69(1):8-11.

Examines the management objectives for three different areas: Itasca State Park in Minnesota; Yellowstone and its elkherd; and the John Muir Wilderness in California. Outlines and compares the different techniques necessary to achieve established goals. Stresses the necessity for deliberate management to achieve desired ends.

177. Heinselman, Miron L.
1970. Preserving nature in forested wilderness areas and national parks. Natl. Parks and Conserv. Mag. 44(276):8-14.

The natural forest ecosystems of some national parks and wildernesses are endangered by subtle ecological changes, primarily because we fail to understand the dynamic nature of these ecosystems and because protection programs frequently exclude those factors that produce natural communities. Maintaining natural ecosystems requires that elemental forces, such as fire, must prevail.

178. Heinselman, Miron L.
1965. Vegetation management in wilderness areas and primitive parks. J. For. 63(6):440-445.

The Wilderness Act and longstanding national park objectives require a new approach to preserving natural landscapes. The objective should be maintenance, or where necessary, restoration of natural forest communities. Natural agents need to be used. Commercial logging is incompatible, but a "hands off" policy, which has included the exclusion of wildfires, will not usually accomplish desired ends either. Suggests new programs including resource inventories, wilderness research, and active vegetation manipulation. Envisions regulated fires as a major tool for initiating new successions.

179. Hopkins, Walter S.
1971. Forest recreation: how much is too much? Paper presented to the Northeast. Sect. Meet. of Soc. Am. For., Bedford, N.H.

Focuses on the question, how can foresters provide more and more visitors a rewarding experience and still maintain a healthy, productive resource? Discusses the present recreational use of National Forests and compares recreation use of American campgrounds and a German forest. Suggests positive management programs to improve recreational quality.

180. Houston, Douglas B.
1971. Ecosystems of national parks. Science 172(3984):648-651.

Emphasizes that ecological processes, including plant succession and the natural regulation of animal numbers, should be permitted to proceed in national parks as they did under pristine conditions. Proposes these objectives appear ecologically feasible if it is recognized that such areas have a finite capacity for absorbing man's consumptive and disruptive influences. Discusses the use of national park interpretation programs in contributing to an environmental ethic that extends beyond the park environment.

181. James, George A., and Richard L. Cottrell
1968. To cut or not to cut. J. For. 66(1):57-59.

Reports on three related studies being conducted in a developed campground on the Cherokee National Forest of Tennessee. Two of the studies seek to determine biological relationships, and include the following objectives: (1) To determine relations between the timing and intensity of overstory density reduction on the response of understory vegetation, and (2) to determine native and introduced understory species best suited for planting on recreation sites. The third study focuses on camper reactions to the cutting treatments installed. The report is principally concerned with study objectives and methods rather than with results.

182. Ketchledge, Edwin H.
1971. Facility rehabilitation. P. 166-173, in: For. Recreation Symp. Proc., Northeast For. Exp. Stn., Upper Darby, Pa.

Describes an attempt to involve the largest regional hike-climbing organization in a sustained program of trailsmanship to assist the State of New York's Environmental Conservation Department in effecting vegetational controls. In the Adirondack Mountains, the ecological impact of recreationists on the natural environment has become critical in two high-quality interior areas: on the steep higher slopes where trails soon become eroding stream channels, washing away the thin mountain soils; and on the open summits where the fragile alpine communities are trampled. Research efforts of 6 years have yielded results in restoring the deteriorating summits.

183. Mackie, Donald J.
1965. Site planning to reduce deterioration. Soc. Am. For. Proc., 1965:33-34.

Describes a recreation soils classification as a means of determining the degree of limitations and restrictions necessary to prevent excessive site deterioration. Discusses site protection in relation to picnic area design, trail placement and construction, and campground development.

184. Magill, Arthur W., and Andrew T. Leiser
1967. New help for worn out campgrounds. 5 p. USDA For. Serv., Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Reports on a cooperative research program in California to identify trees, shrubs, and ground cover that will resist intensive recreational use. Identifies various plant species being studied.

185. Meinecke, E. P.
1932. A camp ground policy. 16 p. USDA For. Serv., Ogden, Utah.

Characterizes the effects both to the resource and to visitor experiences of uncontrolled, high intensity use of recreation sites. Discusses the general lack of planning in site location and design, and proposes the kinds of biological information pertinent to establishing a campground management policy. Identifies the importance of soil and vegetation relationships and stresses the need to consider the types of camper the area will attract, proper access roads, the importance of facility placement on the individual campsite, and the motivations and types of recreation opportunities the visitor expects from the area. Discusses methods for rehabilitating worn sites or extending the life of satisfactory ones (rotation of use, for example).

186. Meinecke, E. P.
1932. Camp planning and camp reconstruction. 23 p. USDA For. Serv., Ogden, Utah.

Expands on the previous article (see No. 185) and focuses more directly on campground location and design principles. Although some attention is given to the adverse effects of concentrated use on the resource (soil, vegetation, moisture) the major emphasis is directed to internal road systems of campgrounds and the proper design of individual campsites.

187. Muesser, H. B.
1961. Topdressing mixtures for turfgrass areas. Park Maint. 3(1):17-19.

Emphasizes the need for periodic top dressing of recreation surfaces that become impaired due to concentrated use. Topics of discussion include: (1) Reasons for the development of poor physical conditions of soils and how soil quality can be improved or restored; (2) topdressing mixtures; (3) the role of organic matter in topdressing mixtures; and (4) the requirement of topdressing mixtures to be uniform and fine enough in texture to be matted into the turf satisfactorily.

188. Neff, Paul E.
1965. Applied silviculture in managing outdoor recreation sites. Soc. Am. For. Proc. 1965:34-35.

Focuses on the problem of blending timber harvesting with esthetics. Lists some ideas involving "positive scenic treatment," including: (1) Vistas; (2) variety in the roadside; (3) transition vegetation; (4) open woods; and (5) variety in the stand.

189. Reid, Neil J.
1968. Ecosystem management in the national parks. P. 160-169, in: **Trans.** 33d North Am. Wildl. and Nat. Resour. Conf.

Discusses the impact of the Leopold Report (No. 108) on park management policy. Proposes ecosystems management as the most apt and functional concept for park management purposes and gives examples of management problems at Saguaro National Monument and Everglades National Park.

190. Ripley, Thomas H.
1965. Rehabilitation of forest recreation sites. Soc. Am. For. Proc. 1965:35-36.

Outlines an orderly procedure of actions that managers could undertake in site rehabilitation including maintenance of drainage systems, an efficient traffic flow system, vegetation management, and an effective plan of continuing maintenance. Recommends the development of plant conditions to attract wildlife.

191. Smith, Robert Leo
1967. Impact of recreation on natural areas. P. 10-12, 16 in: W. Va. Univ. Agric. Exp. Stn. Bull. 554.

Reviews some of the realities of growing and unchecked recreational use and cites examples of studies that have documented resource degradation. Describes both ecological and sociological constraints necessary to determine carrying capacities. Discusses several potential strategies for managing resources and visitors for a certain capacity. Recognizes that steps the manager employs should depend to a large extent on the type of recreational opportunity being sought.

192. Spooner, Charles S.
1971. Solid waste management in recreational forest areas. 96 p. Solid Waste Manage. Off. U.S. Environ. Prot. Agency. Wash., D.C.:Gov. Print. Off.

A study of manpower needs and costs incurred in handling solid wastes on several Forest Service Ranger Districts. Amounts spent on collection are compared with those spent on disposal. Reviews collection techniques to determine where major costs lie.

193. Stevens, Mervin E.
1966. Soil surveys as applied to recreation site planning. J. For. 64(5): 314-316.

Explains the use of soil surveys in recreation site planning, and lists interpretations that can be made from these surveys. Shows a series of three diagrams used to demonstrate campground layout before and after soil survey data were available. Suggests research to assist the manager to plan, design, develop, and maintain recreation areas.

194. Stone, Edward C.
1965. Preserving vegetation in parks and wilderness. Science 150(3701): 1261-1267.

Criticizes the Forest Service, and Park Service especially, for a lack of commitment to natural ecosystem preservation--both animals and vegetation. Presents a strategy for a research and management program of natural vegetation preservation. Pleads for more and better trained ecologists employed by public agencies to implement needed natural ecosystem preservation programs.

195. Taylor, T. G., and W. L. Hansen
1934. Public campground planning. Logan, Utah, Utah Agric. Exp. Stn. and Sch. For. Misc. Publ. 13, 31 p., illus.

Focuses on important factors in the planning and development of public campgrounds. Addresses conceptual principles and criteria in planning rather than details of structural design and construction. Stresses that techniques managers use in campground planning must be dictated by the objective and type of recreational experiences the camping area is to provide. Discusses uses of vegetation, barriers, roads, parking areas, foot trails, water systems, toilets, and locating site facilities. Concludes with one section on procedural steps in planning of campgrounds, and another on specific campground plans and the particular conditions and problems associated with each.

196. Thorud, David B., and Sidney S. Frissell, Jr.
1969. Soil rejuvenation following artificial compaction in a Minnesota oak stand. Minn. For. Res. Note 208, 4 p. Sch. For. Univ. Minn., St. Paul.

Study investigates the time required for artificially compacted soil to approach its original uncompacted state. Offers some ideas as to the factors that cause rejuvenation.

197. Tocher, S. Ross, J. Alan Wagar, and John D. Hunt
1965. Sound management prevents worn out recreation sites. Parks and Recreation 48(3):151-153.

Suggests a variety of managerial techniques to promote quality recreation including: (a) Interpretation and education; (b) law enforcement; (c) better use distribution; (d) rationing; (e) zoning; (f) use of recreational silviculture; and (g) site rotation.

198. Tyul'panov, N. M.
1965. Management of forest-parks. 131 p. Published for U.S. Dep. Agric. and Natl. Sci. Found. by Israel Program for Sci. Transl. (Russian).

Discusses basic concepts of the forest as a plant community as they relate to the development and management of forest-parks (largely urban-related preserves) in the Soviet Union. Examines the biology and types of forest and the relationships between forest and environment. Describes forest management principles as well as methods of landscape assessment, planning and construction of the forest-park.

199. U.S. Department of Agriculture
1963. Turf, the rug for recreation. Agric. Res. 12(5):13.

Reports basic findings of a 4-year study by agronomists to evaluate several varieties of Kentucky bluegrass as to their potential as turf for recreation sites and other heavily trampled surfaces.

200. Wagar, J. Alan
1961. How to predict which vegetated areas will stand up best under active recreation. Am. Recreational J. 1(7):20-21.

Summarizes research to determine relationships between recreational use of a developed site and the condition and survival of vegetation at Brighton Recreation Area, Michigan. Develops a "slide rule" to rate potential sites as to their suitability for recreation development. Ratings are made on the basis of vegetation, soil, and topographic characteristics and relationships.

201. White, William C.
1964. Soil tests for better park grounds. Park Maint. 9(1):39-40.

Discusses techniques and procedures for taking soil samples.

Information and Education

(Also see reference numbers 16, 31, 40, 46, 47, 49, 50, 53, 54, 64, 79, 106, 124, 142)

202. Brandborg, Stewart
1963. On the carrying capacity of wilderness. Living Wilderness 82:29-33.

Describes the basic provisions of the Wilderness Act. Recognizes problems inherent in "preserving for use;" discusses resource damage as well as a loss of the experience. Proposes the use of educational and interpretive devices to aid in preventing wilderness damage. Discusses maps, interpretive brochures, and roving rangers. Recommends good trail systems to promote better use distributions.

203. Brown, Perry J., and John D. Hunt
1969. The influence of information signs of visitor distribution and use. J. Leisure Res. 1(1):79-83.

Tests the effect of information signs on use of two roadside rest stops in Utah. Examines the effect of signs on use distribution and on stimulating use of a previously unsigned area.

204. Darling, F. Fraser
1969. The park idea and ecological reality. Natl. Parks Mag. 43(260):21-24.

Focuses on some of the basic philosophies by which national parks in selected parts of the world have been established. Pleads for the management of these nature preserves as natural ecosystems. Presents a proposal for enlarging our whole concept of the national park idea to include suburban parks, gardens, and ponds.

205. Darling, F. Fraser, and Noel Eichhorn
1967. Man and nature in the national parks: reflections on policy. 80 p. The Conserv. Found.

Examines the basic objectives for which national parks were established and the extent to which policy and increased use have permitted the fulfillment of these goals. Discusses numerous examples of developments within national parks that seriously endanger park quality. Questions the policy regarding fish and game management in the national parks. Concludes the Park Service needs clear, rigorous statements of objectives as well as continuing programs of public education.

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

Suggests there are numerous wildernesslike recreation opportunities adjacent to the Boundary Waters Canoe Area in 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 BWCA could be substantially lessened. Discusses some of the kinds of information needed to help recreationists choose among alternative areas.

207. Shoman, Joseph J. (Ed.)
1968. Manual of outdoor interpretation. 104 p. Natl. Audubon Soc., N. Y.

Stresses the significance of outdoor interpretive and education programs as a means of preserving ecological conditions in recreation areas and enhancing visitor experiences. Fourteen well-qualified authors cover various aspects of modern outdoor interpretation. Focuses not only on why outdoor interpretation is important, but on *how* best to do it. Articles range from the philosophical point of view to such practical aspects as how and to what extent interpretative programs should be carried out on sensitive natural areas.

208. Wagar, J. Alan
1971. Communicating with recreationists. P. 161-165, in: For. Recreation Symp. Proc. Northeast For. Exp. Stn., Upper Darby, Pa.

Recreationists are free to ignore many of a land manager's communication efforts. Greatest effectiveness can be expected for presentations that are dynamic and are tailored to the interests and other characteristics of selected visitor groups, that permit participation and reward learning, and that provide both an idea of what is coming and a framework to give it coherence.

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