

impact. Litter decreases the naturalness of a site, can indicate that an area is overused and/or misused, and detracts from the preferred conditions and, thus, quality of recreation experience received by users.

While forest recreation users exhibit preferences against some major impacts as listed above, they are not perceptive of and/or demonstrate preferences toward the majority of recreation resource impacts. For example, worn-out campsites and trails, as well as water pollution and wildlife disturbance, are not perceived by the majority of users as impacts or unpreferred conditions. A study of camper perceptions of site impacts at three Indiana state park campgrounds indicated that the majority of campers rated ground cover conditions as satisfactory to excellent, even in areas where over 75% of the campsites were 100% bare-ground and severely compacted. Two-thirds of the campers did not notice damage to trees or shrubs, despite the fact that damage was extensive in several areas. In addition, even the minority of users who rated the campsite conditions as poor reported that these conditions did not detract from their enjoyment of the area.

The lack of perception and reaction of recreationists toward recreation resource impacts has been troublesome to recreation resource managers, whose responsibilities include maintaining and enhancing the quality of the recreation resource. It seems the perceptions and preferences of users do not always match those of recreation scientists and managers. Managers tend to be more perceptive of site and experience conditions, and prefer higher standards of conditions than the majority of users. This is true for developed campgrounds, backcountry campsites, wilderness areas, roaded forest lands, and state parks. Impacts and problems studied in these areas have included litter, vandalism, theft, human waste, environmental impacts at campsites and along trails, water pollution, wildlife disturbance, excessive noise, rule violations, and conflicts among recreationists. Managers also tend to rate such issues as greater problems than do site users. Similar differences between managers and users have been found to occur concerning motivations and reasons for area and activity participations, and preferences/attitudes toward recreation management policies and practices. Thus, forest recreation scientists and managers not only need to understand the needs and preferences of recreation users, they must also understand the differences that exist between scientists, managers, and users of resources.

See also: **Landscape and Planning:** Forest Amenity Planning Approaches; Perceptions of Forest Landscapes; The Role of Visualization in Forest Planning. **Recreation:** Inventory, Monitoring and Management.

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Inventory, Monitoring and Management

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Introduction

Outdoor recreation in forested settings is a use of forest resources which has become more and more important for urbanized societies. It plays a prominent role in people's leisure time. Forests together

with other natural areas offer an environment where people can participate in many kinds of recreation activities, and where they can feel close to nature and natural resources. This article offers an overview of the key issues and research regarding the evaluation and management of forest recreation.

This article includes a brief history of recreation research, a description of methods and types of data gathered for recreation information concerning both demand of recreation and supply of recreation resources, and an overview of management methods of recreation resources and visitors.

History of Recreation Research

Research on forest recreation started to develop in the USA and European countries such as Germany in the late 1950s and 1960s. One of the first authors to discuss the information needs and provide a theoretical basis for producing information on outdoor recreation was Dr. Marion Clawson. The Outdoor Recreation Review Commission (ORRRC) was established in 1958 in the USA, and that started the process of producing regular nationwide recreation participation surveys. The ORRRC report was first published in 1962, with recreation participation surveys taking place at 5–12-year intervals up to that of 2000, led by Dr. H. Ken Cordell. Canada also has a long tradition of recreation participation surveys since the early 1980s. In Europe, some countries have done long-term monitoring for decades. Sweden was one of the first to produce outdoor recreation information on a population basis in 1964 and 1974, and repeated a population study in the 1990s. In Denmark, the first nationwide recreation participation survey was done in 1976–1977 by Niels Elers Koch, and repeated in 1993–1994. The Netherlands has also monitored outdoor recreation since the 1970s. In countries such as Finland and Italy, the first nationwide recreation participation surveys were done in the 1990s and early 2000.

In addition to nationwide surveys, development work for producing visitor information on recreation areas was needed. Visitor surveys and visitor-counting methods have been studied since the 1960s. Dr. George A. James in the USA and Dr. Lars Kardell in Sweden were the most prominent pioneers of this work. In the 1990s, a number of handbooks were produced to help park personnel to monitor visitation.

Science-based visitor management in recreation areas, national parks, and wilderness areas has demanded growing attention. Research related to concepts of ecological and social carrying capacity and conflict management, done by Dr. David Lime

and others, have been important in improving management methods in the 1970s–1980s. That line of research was adopted into a planning system or framework, e.g., limits of acceptable change (LAC) in the 1980s, developed by Dr. George Stankey and others. The LAC approach has been adopted in many countries as a tool for planning the sustainable recreational use of natural resources. Studies on recreation experiences and benefits gained from recreation have produced systematic development frameworks for visitor management, i.e., benefit-based management or outcomes approach to leisure, developed by Dr. Bev Driver and his colleagues in the 1980s and 1990s.

Beside the recreation participation surveys, research on recreation resource inventories has developed over the years. In the USA, the ORRRC report included a recreation resource classification. Next, the theoretical framework for classifying recreation environment, i.e., recreation opportunity spectrum (ROS), was developed by Dr. Bev Driver and Dr. Perry Brown and their colleagues in the late 1970s. The nationwide application of broad-scale resource inventories in the USA was led by that country's Forest Service in the late 1970s and 1980s. Methods to implement these scientific-based approaches into resources management were also developed, such as the early visual management system developed in the 1970s by the US Forest Service (*see Landscape and Planning*: Visual Resource Management Approaches). Recently, geographic information system (GIS)-based planning methods and participatory planning processes have advanced recreation planning and management in many countries.

Methods and Data for Recreation Information Gathering

Studies on recreation inventory and monitoring fall into two basic types – studies of user needs and activities (demand), and studies of the recreation facilities and land-based resources (supply).

Recreation Demand Surveys

Nationwide population surveys Recreation demand refers here to the actual or potential participation in recreation activities. There is a need to know how many people, and how many times, or how many days per year they walk for pleasure, hike, ride a bicycle, and do other recreation activities. The need for nationwide information on recreation demand was recognized 40 years ago, when the first National Recreation Survey (NRS) was conducted in 1960 in the USA. Monitoring of recreation demand will help

forest managers in allocation and planning of the use of forest resources in the future. The continuity of a core set of participation and demographic questions has ensured that trend construction and comparisons of recreation have been possible at the national level over the years. Similar efforts have been made in other countries like Canada, Denmark, and Sweden but the contents and extent of the nationwide recreation surveys vary considerably.

The latest National Survey of Recreation and Environment 2000 (NSRE) includes several themes of recreation research. In particular, information concerning recreation participation and recreation trips serves to monitor recreation demand. The survey covers 50 different outdoor activities. The survey had about 75 000 responses.

Denmark has conducted a series of recreation surveys, which offer the possibility of comparing forest recreation participation over time: Danish surveys covered overall visitation into the forestland, and included a remarkable set of data on forest and landscape preferences. The survey in 1993–1994 as well as the 1993–1994 survey reached a response rate of over 80%, from samples of almost 3000 persons. In Finland, only one nationwide recreation

survey has been conducted but the study is planned to be repeated in 2008–2010. The Finnish survey data included about 10 000 respondents. The main issues measured were participation in outdoor activities, recreation trips close to home, and nature trips including an overnight stay. In southern Europe, Italy has conducted its first nationwide recreation survey. Even though there are still many discrepancies in use of concepts, terms, and units of measurement, some international comparisons can be made. **Table 1** shows participation rates of some of the most typical recreation activities in six countries, expressing the diversity, similarity, and differences in recreation behavior among different nations. The issue of harmonizing policy and procedures for recreation information monitoring internationally has been discussed in the research community and may provide more comparable data in the future.

On-site user inventories: monitoring visitor flows and gathering visitor information On-site recreation inventories, i.e., visitation monitoring systems, are an important part of the management policy of recreational and protected areas in many countries.

Table 1 Participation rates in some recreation activities in six countries in the 1990s. Participation rate means the portion of population which recreate doing the activity at least one time during one year

Recreation activity	Participation rate (%)					
	Canada ^a	Denmark ^b	Finland ^c	Holland ^d	Italy ^e	USA ^f
Walking		63	68	74	40	67
Hiking			19		38	24
Bicycling			55	68	6	29
Jogging, running		14	16	16	4	26
Camping	19		18		2	14
Picnicking	26	10	28		45	49
Hunting	5	1	8		4	7
Picking berries or other forest fruits	11	2	57			
Picking wild mushrooms		3	41		21	
Cross-country horseback riding	2	1	2	6	3	5
Studying and enjoying nature	31	56	51		21	
Cross-country skiing	4		40		2	3

Empty spaces infer that a comparable figure was not available.

^aThe Nature Survey; sample of 86 951 Canadians by Statistics Canada in 1997. DuWors E, Villeneuve M, Filion FL, *et al.* (1999) *The Importance of Nature to Canadians: Survey Highlights*. Ottawa, Canada: Environment Canada.

^bA mail questionnaire regarding forest recreation on a sample of 2826 of the Danish adult population in 1993–1994, conducted by the Danish Forest and Landscape Research Institute. Jensen FA and Koch NE (1997) *Friluftsliv i Skovene 1976/77–1993/94*. [Forest Recreation 1976/77–1993/94.] Forskningsserien nr. 20. Copenhagen, Denmark: Forskningscentret for Skov & Landskap, 215 s., ill.

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^eA mail questionnaire on a sample of 3000 of the whole Italian population in 1995; recreation activities in forest. Scrintzi G, Tosi V, Agatea P, and Flamminj T (1995) Gli Italiani e il bosco. Coordinate quali-quantitative dell'utenza turistica in Italia. [Italians and the wood. The forest recreation demand in Italy.] *Comunicazioni di Ricerca ISAF 95/1*, Trento.

^fNRSE telephone survey of sample of 12 000 people in 1994–1995. Cordell KH (principal investigator) (1999) *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends*. Sagamore.

Recreation monitoring as applied is most often a science-based system for data collection, data management and reporting, which supplies managers with baseline, updated visitor information on a continuous basis. Monitoring systems differ between countries, but often standardization of methods and harmonization of information content have taken place within one country or at least within one public land agency.

The most common visitation information measured includes number of visits, duration of visit, and distribution in the area. Information gathered from visitors often consists of socioeconomic factors such as sex, age, income, and municipality/region/country of residence, length and means of travel, and money used. Visitor behavior pattern describes recreation activities participated in, length of stay in the area, and company of visit. Visitor satisfaction, motives, and expectations of visit and experiences are also studied in most cases.

In the USA, the National Park Service implements a mail-back customer satisfaction card (referred to as the visitor survey card or VSC), which is similar to surveys used by other agencies. All National Park Service units systematically measure and report annually on visitor satisfaction. The customer satisfaction card enables parks, clusters, regions, and national program offices to measure their progress toward meeting annual and long-term goals of park management. The US Forest Service has implemented a sophisticated on-site visitor monitoring system called the National Visitor Use Monitoring (NVUM) system. With this system, one-fourth of the 160 national forests in the country are sampled each year through a system of site-day sampling. Activities, duration of visit, satisfaction, trip spending profiles, and sites visited are collected and geographic information systems (GIS) referenced to provide location-specific, regional, and national estimates to guide policy, management, maintenance, budgeting, and customer responsiveness.

In Denmark, automatic monitoring of the car-based forest visitation at four selected forest areas was established in the mid-1970s and has been going on since that. In addition, on-site inventories have been carried out in more than 300 forest areas in 1976–1977 and again in 1996–1997 in more than 500 Danish forest and nature areas. In the UK, visitor counting and surveys are also applied widely and used in planning and management processes. Finland has standardized visitor study procedures in order to get comparable visitor information from all state-owned recreation and protected areas. The national recreation management policy directs the conduct of visitor countings and visitor surveys in

order to develop customer-driven management in recreation areas. In many other European countries, visitor information collection systems are still in a developmental stage.

In New Zealand, the Visitor Asset Management System (VAMS) was created to provide a basis for an integrated visitor counting and reporting system. The VAMS is an interactive database on key management information about the 4000 designated visitor sites throughout New Zealand.

Inventories of Recreation Resources

Geographical information system GIS-based methods have become important for collecting information on recreation resources. GIS-based recreation resource inventories are useful for GIS-based management systems. Countries using GIS-based recreation supply databanks are, for example, Denmark, Finland, the Netherlands, and the USA. GIS offers several benefits of analyzing recreation resources. The most important aspect is that it is possible to gather inventory information on natural resources such as forest types, water bodies, and topography from other GIS data sources, which decreases the costs of data collection. Also, the same information is easily used on a local, regional, and national level.

The most essential components of recreation supply are the number and land area of recreational areas, trails or trail networks, and the array of facilities and services supporting recreation participation. The quality aspects of natural resources are important in terms of scenery, topography, water elements, nature values, accessibility, and safety. The factors and indicators measured must be valid in order to support the ecologically and socially sustainable recreational management of natural resources. The recreation specific criteria and indicators of ecologically and socially sustainable use vary among different countries and between the types of recreational area according to ROS classification. Landscape preference studies have produced a strong information basis to assess the landscape quality in many countries e.g., BC (Canada) tourism capability and recreation features/activity mapping (*see Landscape and Planning: Visual Analysis of Forest Landscapes*). In general, people appreciate forested landscape with a variety of different types of forest: old growth, a mix of broad-leaved, and conifer stands with some open views are appreciated in many countries. Water elements – ponds, rivers, streams, lakes, and sea – are appealing landscape elements. Accessibility means first, distance and need of transportation, and second, safety and tranquillity of route to recreation site. The importance of

distance and other factors of accessibility depends on the type of recreation areas and recreation activity. Close-to-home recreation areas, which allow daily visits, stress the safety and close distance, preferably a walking possibility. Areas used during a weekend or annual vacation may be located at longer distances, but then the demand for other qualities is of much higher importance (*see Recreation: User Needs and Preferences*). Recreation opportunities (i.e., resources provided for people's use) needed depend on both the time and money budget of the population. The mobility of the population is a detrimental factor to determine the recreation behavior patterns and thus the demand of different types of recreation areas and other recreation resources.

Management of Recreation and Nature-Based Tourism in Forests

Approaches and Concepts Related to Managing Recreation Resources and Visitors

The carrying capacity concept describes a sustainable level of recreational use. The ecological carrying capacity is defined as the number of visitors or visits an area can sustain without degrading natural resources. The social carrying capacity refers to level of recreational use where the fulfillment expectations of visitor experiences are not threatened because of crowding or misbehavior of other visitors. Most professionals agree that both ecological and social carrying capacity factors must be considered for effective area planning and management. For managerial applications, it is essential to learn about the user attitudes, user preferences, and site use impacts relating to management objectives.

The ROS is a management framework designed to respond to the diversity of experiences desired by recreationists and is used by many recreation resource management agencies all over the world. The original ROS framework describes six levels of recreation opportunities as a spectrum of natural to more developed categories – primitive, semiprimitive, nonmotor, semiprimitive motor, roaded natural, rural, and urban. Recreation opportunities comprise of activity, setting, and recreation experience.

The term limits of acceptable change (LAC) is the management process developed for recreation and wilderness planning and management. The focus is to determine the degree of change caused by recreationists which is acceptable in a specific area. The LAC principles include ecological, economic, and social dimensions of recreation and nature-based tourism. The LAC concept is based on nine steps, where different parameters, such as vegetation and

littering, and their indicators (e.g., presence of seedlings and litter) are monitored to detect when the limits are reached. In the LAC process, the general principles of recreation and nature tourism management are divided into more detailed aims and indicators. Furthermore, the management actions will be defined beforehand if the LAC of a certain indicator is being approached or reached. The LAC process can also be applied as a tool for assessing the impacts of recreation and nature tourism on natural areas as well as managing visitor conflicts and other visitor-related problems.

Applying theoretical approaches of carrying capacity and limits of acceptable change into planning and management processes sets a demand of monitoring both of recreational use and its impacts on natural resources. A contemporary framework for managing carrying capacity in the US national parks is visitor experience and resource protection (VERP), which focuses on formulating indicators and standard of quality for desired future conditions of park resources and visitor experiences.

A broad management framework was developed in order to combine both resource and visitor management, paying more attention to the final desired outcomes of resource use. The benefit-based management (BBM) approach focus on optimizing net benefits of use for recreation resources. The BBM requires benefits-oriented management prescriptions, guidelines, and standards to assure provision of optimal recreation opportunities to citizens.

The most advanced visitor management approach is the outcomes approach to leisure (OAL). It focuses on both ecologically and culturally sustainable use of natural resources and the realization of satisfying recreation experiences of recreationists. It stresses applying science-based knowledge in planning and management systems. It also includes the notion of creating and maintaining collaborative partnerships with affected stakeholders. OAL covers all aspects of recreation production, both input and output elements, facilitating outputs as well as final outcomes, i.e., benefits gained on an individual and societal level. Inputs refer to the agency efforts such as time, knowledge, and capital investments used for the production of recreation opportunities as a whole. Facilitating outputs are the results of provider actions, i.e., recreation services such as trails and information. Outcomes can be beneficial or unwanted consequences resulting from the management and use of recreation resources.

Related concepts and frameworks on visitor resources are discussed in the article on VRM (*see Landscape and Planning: Visual Resource Management Approaches*).

Implementation: Development Programs and Planning Systems

Forest recreation is nowadays an essential component when planning the use of forest resources. There are many ways to integrate different components of forest uses into the planning system. One goal of integrated, multiobjective forest planning is improving the quality of forest planning by utilizing advanced decision-support tools. Decision makers' values, including recreation-related values, which can be either in conflict or compatibility with other values, could be added into the planning process in a systematic way by using recreation criteria and indicators.

The planning processes are to a great extent developed into a direction where public involvement plays an essential role (*see Social and Collaborative Forestry: Public Participation in Forest Decision Making*). The participatory planning principle is used widely in many countries. Visitor studies, public meetings, and recreation user group participation are the most typical ways to get public input into the agency-driven planning and management system for recreation resources.

There are two important research fields, which offer valuable additional information into the planning process for recreation. The first is economic valuation, which includes the methods of travel cost modeling and contingent valuation. The contingent valuation method measures with the help of survey techniques people's personal valuation of unpriced recreation opportunities by using contingent markets. For example, people are asked how valuable in monetary terms for them is the possibility to use the neighborhood park. Values related to the recreational use of forests can be compared to other forest values. The economic valuation procedures also provide forecasting models, revenue potentials, and equity analysis components. The second is economic impact assessment, which produces income, employment, local tax generation, and other macroeconomic statistics for recreation scenarios. These tools, integrated with participation surveys, resource inventories, ROS, LAC, and other approaches to planning, provide a broad overview and a more complete picture for more effective recreation planning management.

Planning of forest recreation in designated recreation areas has many styles and scales in different countries. In some countries, there are rather standardized styles, applied by forest and park services and other state land agencies, to produce management plans, which cover both the management of resources and visitors. The management plan of a recreation area, for example, includes the

strategic and tactical policies and decisions of how much use is appropriate, what kind of activities are acceptable, and how visitor use is to be managed. An important part of the plan is to define the management tools for implementation, such as how to limit access or what regulations are needed to limit length of stay or group size.

In the USA, broad-scale studies of the demand and supply of outdoor recreation and wilderness, for the first time, paid attention to social change and its consequences to recreation, and have reported long-term outdoor recreation trends. The research indicates rapid and continuing growth in recreation demand in the USA. The same trend applies to many other countries with urbanized societies. Responding to the growing demand for outdoor recreation, large national programs and plans for development of recreation and nature-based tourism are conducted to enhance welfare and positive economic impacts of forest recreation. The development actions are directed to improve recreation resources supply, to rationalize recreation resource management and administration, and to increase research and education.

See also: Landscape and Planning: Visual Analysis of Forest Landscapes; Visual Resource Management Approaches. Social and Collaborative Forestry: Public Participation in Forest Decision Making. Recreation: User Needs and Preferences.

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Reduced Impact Logging *see* **Harvesting**: Forest Operations in the Tropics, Reduced Impact Logging; Forest Operations under Mountainous Conditions; Harvesting of Thinnings; Roding and Transport Operations; Wood Delivery.

Regeneration *see* **Ecology**: Reproductive Ecology of Forest Trees. **Plantation Silviculture**: Forest Plantations. **Silviculture**: Natural Regeneration of Tropical Rain Forests; Natural Stand Regeneration; Silvicultural Systems; Unevenaged Silviculture. **Site-Specific Silviculture**: Ecology and Silviculture of Tropical Wetland Forests.

Rehabilitation *see* **Silviculture**: Bamboos and their Role in Ecosystem Rehabilitation; Forest Rehabilitation. **Site-Specific Silviculture**: Reclamation of Mining Lands; Silviculture in Polluted Areas.

Remote Sensing *see* **Resource Assessment**: Forest Change; Forest Resources; GIS and Remote Sensing; Regional and Global Forest Resource Assessments.

Reproduction *see* **Ecology**: Reproductive Ecology of Forest Trees. **Genetics and Genetic Resources**: Genetic Systems of Forest Trees; Propagation Technology for Forest Trees. **Silviculture**: Natural Stand Regeneration. **Tree Breeding, Principles**: Conifer Breeding Principles and Processes. **Tree Physiology**: Physiology of Sexual Reproduction in Trees; Physiology of Vegetative Reproduction.