



**US Army Corps
of Engineers**

A Conceptual Approach to Recreation Habitat Analysis

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Purpose

This technical note describes a procedure to identify and rank outdoor recreation habitats using principles of ecology as a guide. The Habitat Evaluation Procedures (HEP) is a commonly used technique for assessing human impacts on the vigor of wildlife species, and serves as the model for the Recreation Habitat Analysis Method (RHAM).

Each wildlife species has certain habitat requirements that can be evaluated using HEP. Recreation activities are also dependent on habitat attributes for their success. Ecological principles such as competition and succession also have parallel functions in analysis of recreation habitats. This technical note focuses on those water-based outdoor recreation activities that are consistently the most popular at large multipurpose lakes under the jurisdiction of the U.S. Army Corps of Engineers (1993). However, RHAM has application to all recreation experiences in a variety of settings, including smaller water bodies and riparian and terrestrial ecosystems. An example model is included.

Background

People are dependent upon Earth's natural resources for survival and for comfort. We have certain requirements of resources and combinations of resources for all of our activities, including workplace, living area, transportation corridors, and feeding areas. Collectively, these resources comprise our habitat.

An important activity of people is outdoor recreation. This activity, like all others, requires certain resource components, singly and in combination, to be successfully accomplished. Further, each recreation activity requires resources unique to that activity. Some activities are more compatible than others, permitting sharing of resources; other activities are more specialized and demand more individual requirements.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE FEB 1996		2. REPORT TYPE		3. DATES COVERED -	
4. TITLE AND SUBTITLE A Conceptual Approach to Recreation Habitat Analysis				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Army Engineer Waterways Experiment Station,3909 Halls Ferry Road,Vicksburg,MS,39180-6199				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT see report					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 13	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Wildlife biologists have known about habitats of wildlife species for many years. Just as it is possible to identify certain habitat requirements for wildlife, we can identify similar habitat requirements for the various activities of humans.

The Recreation Habitat Analysis Method described in this technical note is a conceptual procedure for expert identification, analysis, and classification of recreation habitats. RHAM is adapted from procedures used by wildlife scientists to classify wildlife habitat.

The Wildlife Model

Health and vigor of wildlife resources are assessed using several approaches that can be broadly grouped as follows: analysis of energy flow, estimation of population characteristics, and evaluation of habitat quality.

Each of the technology areas has its advantages and drawbacks. The first two approaches offer the most scientific appeal. Transfer and recycling of energy through food webs provides an adequate measure of ecosystem vigor. However, the excessive data requirements and difficulty of data interpretation make energy flow analysis essentially impractical for relatively short-term planning and research projects. Population modeling methods are technically feasible and provide the observer with direct information about the species being studied, but they are generally quite expensive and time consuming.

The most frequently used procedures are habitat-based. Habitat is, in most cases, the major factor influencing animal populations, and a high correlation between quality of habitat and animal numbers is assumed. Further, a linear relationship is assumed between long-term carrying capacity and habitat quality (Roberts 1985).

Several methods have been developed to evaluate habitat. Roberts and O'Neil (1985) reviewed 28 methods. The Habitat Evaluation Procedures (HEP) developed by the U.S. Fish and Wildlife Service (1980) is the most commonly used technique to evaluate environmental impacts of major water resource development projects. Through the HEP process, several Habitat Models have been developed for wildlife species of interest in major planning and assessment projects (Roberts, O'Neil, and Jabour 1986). Guilds are developed that incorporate vegetation, physical features, and other life requirements such as cover to describe habitat conditions for several members of interspecific associations based on their use of habitat (Roberts 1987).

The HEP process allows the resource manager and wildlife biologist to analyze habitat and produce an evaluation of its principal components for a given target species. This is known as the Suitability Index (SI). For example, using the Habitat Suitability Index for bobwhite quail (*Colinus virginianus*), it is possible to produce a measure of each of the bird's life requisites (nesting cover, escape cover, winter food, etc.). In this example, if the nesting cover SI is very low, while both escape cover and winter food have high SIs, the manager knows to concentrate on provision and maintenance of strategically located areas dominated by grasses.

The HEP process is quite flexible and is a valuable planning tool for assessing the environmental impacts of human activity and for natural resources management. The technique has been especially useful on large water resources development projects.

The Concept

When one considers people as analogous to other animal species, one discovers that we use a variety of different habitats to satisfy a diverse array of needs and desires. These various habitats are chosen in both spatial and temporal contexts. A person chooses a mountain slope in the winter season for recreational skiing just as an eastern grey squirrel (*Sciurus carolinensis*) chooses a mast-producing hardwood forest in autumn to satisfy food requirements.

Greer (1990) calls the areas that are sought out for the values that will enhance or support some recreation activity "recreation habitats." The term fully captures the concept of use of space and time by humans for recreation activity.

Recreation habitats are composed of physical and social resource attributes. Many recreation activities are socially oriented and depend upon the presence or absence of other people for success. Campers who prefer organized campgrounds often are attracted by the companionship of others with similar interests, as much as the natural resource base. Primitive camping, certain hunting and fishing activities, and nature study are often practiced to escape the company of other people.

Recreation habitats may include man-made structures or facilities that have been incorporated into the ecosystem to facilitate or enhance recreational use of the area. Vehicular and pedestrian access in the form of roads and trails, boating access such as launching ramps, picnic tables, and cooking grills are examples of such attributes.

Recreation habitats can be represented graphically on a map by point, line, or polygon depending on the activity in question, scale, and description of the habitat for that activity. Picnicking and bank fishing can be considered point data habitats as long as the activity is confined to a rather restricted area. Use of trails for a variety of purposes (hiking, biking, and horseback riding) and whitewater canoeing occur along linear corridors and can be represented by line data. Hunting, birding, and waterskiing generally are done over larger areas and normally would be shown as a polygon on any map depicting recreation habitats. Figure 1 illustrates typical recreation habitats.

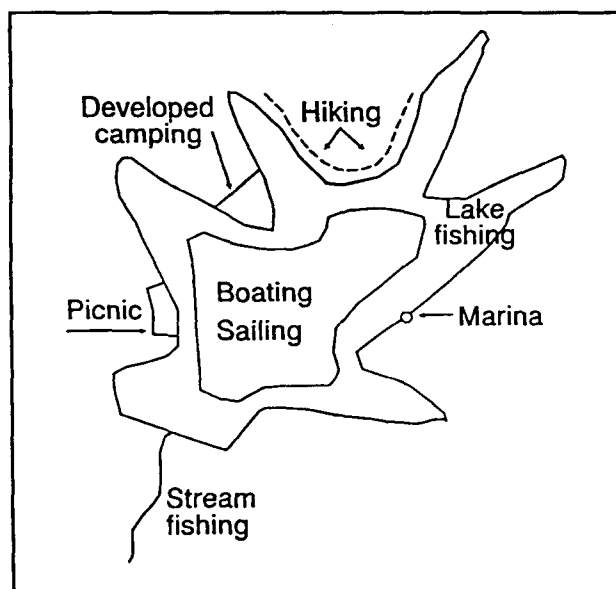


Figure 1. Typical recreation habitats

Overview of Recreation Habitats

The process of developing habitat-based evaluation models and techniques for wildlife begins with identification of the target species and other species that occupy its guild. Habitat attributes that are important to that species are identified and evaluated individually. An overall rating of the habitat is then established based on cumulative scores of the attributes.

Similarly, target recreation activities and physical and social attributes that are important to the success of the recreation endeavor are identified. Scores are compiled to arrive at an overall rating of the recreation habitat.

Over two decades has been devoted to perfecting the HEP methodology. Habitat Suitability Indices have been developed for nearly 100 species, and rather sophisticated models based on many man-years of professional work have been constructed to assist in the evaluation process. RHAM is a conceptual model based on the literature and the author's 35 years of professional work in the fields of wildlife science and outdoor recreation planning, management, and research. RHAM should be field-tested to verify the concept and the test assumptions.

Similarities of Recreation and Wildlife Habitats

Recreation Ecotones

Transitional zones between adjacent communities and ecosystems, which contain species and habitat attributes characteristic of both, as well as species and habitat attributes occurring only within the transitional zone, are known as ecotones. Recreation ecotones are analogous to ecological ecotones found in nature.

The most obvious recreation ecotone at large lakes is the interface between the large body of water and adjacent land. This shoreline is an important characteristic of the lakes and an area that attracts many recreation users. The use of the shoreline can be classified in two ways. Active use involves actual use of the shoreline for any of several recreation activities. Shoreline fishing from either boat or land, swimming, and wading are examples. Passive use includes viewing the shoreline as part of scenic vistas from hiking trails, boats, campsites, picnic areas, or other vantage points. In this context, shorelines can be the subject of photography or painting.

Within the large, rather linear spatial area known as shorelines, several recreation ecotones are found. Shoreline that serves as transition from a developed camp area to the lake allows the user to go from developed camping habitat to lake fishing habitat or boating habitat. On land, a trail that comprises hiking habitat enters developed camp area habitat or picnic habitat by means of a recreation ecotone. Water-based activities employ recreation ecotones to transition from boating to waterskiing or from lake fishing to boating habitats.

Succession

Some recreation habitats have resulted from succession similar to that which occurs in natural systems. Access points to large bodies of water have become established as a

result of sheer popularity of an area, as demonstrated by evidence of overuse. Volunteer roads and substantial litter led to development of the area to accommodate obvious heavy public use. The "beer can planning" approach of establishing access often evolved into fully developed parks, through a successional process triggered by provision of facilities and services that complement the natural resources.

Guilds

Guilds have been constructed such that a preselected wildlife species is placed in a matrix with other species that have similar habitat requirements (Roberts 1987). By substituting recreation activities for wildlife species, one can guild these activities into recreation habitats. For example, boating, waterskiing, and sailing have similar habitat requirements and can be placed in a guild.

Competition

In natural systems, two species with very similar niches cannot coexist in the same place. One species will outcompete the other. Parallel situations have been experienced on Corps projects. Recreation areas were designated on some projects in the 1950s and 1960s by the beer can planning technique. Day-use and camping were permitted in the same areas. Use conflicts increased as popularity of the areas grew. The situation was heightened with institution of user fees for camping. Camping has outcompeted day-use in some cases; in other cases, the reverse occurred.

Representative Recreation Habitats

The following recreation activities are representative of public use at large multipurpose lakes. These are the most frequent activities at many Corps lakes. For each recreation habitat the important attributes are described, as summarized in Table 1.

Developed Camping Habitat

Natural features that are attractive to those who camp in developed camp areas include trees for shade and shelter, grass-covered sites, level sites, a view of the lake, and sites that are relatively free from insect pests and noxious plants.

Campers at developed camp areas expect well-defined camp sites, adequate circulation roads, and parking for their vehicles. Other man-made requirements include restrooms and potable water. Camp sites should offer a degree of vegetative screening for privacy, yet they should be located near each other for optimum social interaction. The quality of habitat increases with quantity and quality of man-made facilities and social attributes such as campfire programs and security.

Bumgardner and others (1988) contrasted two studies which showed the six most frequently stated attributes in campsite selection to be as follows: short distance from lake, convenience of site to lake, shadiness of site, lake visibility, access to the lake, and presence or absence of a covered picnic table. They summarized the results to indicate that availability of utilities and view of the lake are the most important factors that influence campers at Corps lakes. Developed camping habitat can be shown graphically as polygons.

Table 1. Attributes for Representative Recreation Habitats									
Attribute	Developed Camping Habitat	Picnic Habitat	Boating Habitat	Waterskiing Habitat	Sailing Habitat	Swimming Habitat	Lake Fishing Habitat	Stream Fishing Habitat	Hiking Habitat
TREE - Percent of tree canopy cover	X	X						X	X
GRAS - Percent of grass coverage	X	X							X
LAKEVIEW - View of the lake from habitat	X	X				X			X
PESTFREE - Degree to which habitat is free from insect and plant pests	X	X				X			X
DRNG - Drainage of habitat	X					X			X
LEVL SITE - Degree to which habitat or site is level	X								
DEFSITE - Degree to which site is defined	X								X
ROAD - Condition of access and circulation roads	X	X				X	X	X	
PARK - Condition of parking areas	X	X				X	X	X	
RESTRMS - Status and condition of restroom facilities	X	X				X			
POTWTR - Status of potable drinking water	X	X							
ELEC - Status of provision of electricity	X								
SEWDISP - Status of provision of facilities to dispose of sewage	X								
PRIV - Degree of screening to afford privacy	X						X	X	X
PROXOTHR - Nearness to neighboring recreationists	X		X		X	X			
SEC - Degree of security available	X					X	X	X	X
INTR - Status of interpretive or other programs	X								X
TBLS - Status and condition of picnic tables	X	X							
GRLL - Status and condition of cooking grills	X	X							
OPENAREA - Amount and proximity of open areas for recreation use	X	X				X			
OPENWTR - Amount and extent of open water available for recreation use			X	X	X	X	X		
LAKEACES - Status and condition of access to lake or stream			X	X	X	X	X	X	

Table 1. (Concluded)									
Attribute	Developed Camping Habitat	Picnic Habitat	Boating Habitat	Waterskiing Habitat	Sailing Habitat	Swimming Habitat	Lake Fishing Habitat	Stream Fishing Habitat	Hiking Habitat
HAZFREE - Degree to which habitat is free from hazards such as steep cliffs and treacherous water	X	X	X	X	X	X	X	X	X
DEEPWTR - Status of deep water available to accommodate deep-draft watercraft					X				
FTCH - Amount of fetch across open water to facilitate sailing					X				
SAND - Amount and condition of sand on beach						X			
WTRQUAL - Condition of water quality			X	X	X	X	X	X	
SHORVEG - Amount and condition of shoreline vegetation for fish habitat							X	X	
FASTWTR - Amount and condition of fast moving water in stream								X	
DIRSIGN - Status and condition of directional signs									X
INFOSIGN - Status and condition of informational or interpretative signs									X
SCNCVIEW - Opportunities and condition of vistas for scenic views		X				X			X
TRSHCANS - Amount and condition of trash containers	X	X				X	X	X	X

Picnicking Habitat

Picnickers come to enjoy a meal in the outdoors, but they do expect more than that and have certain requirements. Tree cover for shade and open areas for group games and play by children are prime requisites. Picnickers also require a view of the lake. Adequate automobile access and parking and other man-made facilities are required for this habitat. Tables with bench seats, grills for food preparation, toilet facilities, and containers for garbage are expected. Picnic habitat should be relatively safe. No dangerous fast water, large cliffs, or other obvious hazards are found in this habitat. This habitat should also be relatively free from noxious plants such as poison ivy and biting and stinging insects. Picnic habitat can be displayed on maps as polygons.

Boating Habitat

Large expanses of flat water with no safety hazards (such as stumps or structures submerged slightly below the water surface) offer ideal boating habitat. Access is an important attribute of this habitat. Access can be provided in several ways, including launching ramps for towed boats, marina facilities for stored boats, and private boat-mooring facilities for those who have private access to the lake. Parking for vehicles and trailers is also required. The water surface should be relatively free of other activities to reduce use conflicts and potential accidents. Scenic aspects of adjacent land are also important. When displayed on a map, boating habitat would be shown as a polygon.

Waterskiing Habitat

This recreation habitat is the same as boating habitat. The two habitats fit nicely into a common guild.

Sailing Habitat

Sailing habitat also is accommodated in the guild with boating and waterskiing habitats. Additional attributes required to complete sailing habitat are enough fetch across the water surface to provide adequate wind to propel the sailing craft and deep enough draft to accommodate the keel of the vessel. Sailing habitat is spatial and can be shown graphically as a polygon.

Swimming Habitat

Sandy beaches that are open without vegetation are required. Aquatic vegetation should not be present, and the sandy surface of the beach should extend under the water throughout the entire swimming area. No foreign materials that might prove injurious to the beach and swimming enthusiasts' bare skin can be present. No boating or activity such as use of vehicles on the beach should be permitted. Water quality is very important, and adequate circulation must be maintained to ensure conditions that prevent stagnation. Water clarity improves swimming habitat. Many visitors to beaches use the land area as a place to lie in the sun and relax. They seldom or never enter the water. That component of the beach users sees the actual beach area or land portion of the swimming habitat as their primary use area, although proximity to water is an equally important part of the habitat. Swimming habitat can be depicted on maps as polygons.

Lake Fishing Habitat

Lake fishing habitat is used here in juxtaposition to stream fishing. Lake fishing is that activity that generally occurs on large, slow-flowing bodies of water. Such water bodies are usually impounded by dams and are deeper, larger in areal extent, and may experience more frequent and greater changes in elevation of the water surface when compared to streams. Lake fishing also takes several forms. Trolling from moving boats, casting along shorelines from a boat or from the shore, still-fishing from boat or shore, running trotlines, jugging, or wading in shallow water are some activities incorporated into lake fishing.

A primary requirement of lake fishing habitat is the presence of game fish. It logically follows, then, that good habitat for game fish is usually good lake fishing habitat. Recognizing that different species of game fish have different habitat requirements, some generalizations can be made. Variable water depths, presence of some hard substrata, adequate vegetation in the water body and along shorelines for production of forage food and cover, and acceptable water quality are basic requirements for most game species.

A primary need of lake fishermen is access to the water body. Launching ramps and parking near fishing areas are a must. Unrestricted pedestrian access to shorelines is needed for many participants of this sport.

Conflicts often arise among lake fishermen and boaters. Activities that involve high-speed boating which causes wakes and potential safety hazards are not compatible with slower moving activities designed to stalk and capture wild animals. Lake fishing habitat, therefore, does not easily fit guilds of other recreation activities.

Scenic vistas, presence of wildlife associated with aquatic systems, and adequate vegetation and other structure in the lake and along shorelines complete the important attributes of lake fishing habitat. Lake fishing habitat is usually depicted on a map as a polygon.

Stream Fishing Habitat

Many of the components of lake fishing habitat are also important to stream fishing habitat. Game fish habitat requirements are obvious, but one can usually expect to find different species composition in streams than in lakes. Pedestrian and boating access are also important. Major differences are in configuration of the water bodies. Streams are linear systems and can be expressed as such on maps. Water flow is generally swifter than in lakes due to confinement of the water to a smaller channel and, usually, a greater grade of the bottom of the water body. Riffles, cascades, and waterfalls are common in streams, but not in lakes. Streams in association with lakes are found in the headwaters of the lakes and in outlet areas below the dam.

Hiking Habitat

Hiking habitat is terrestrial in nature, although frequent scenic views of the lake along the trail are important attributes of the habitat. A trail consisting of solid, durable surface of any of a number of compositions is the basic part of hiking habitat. Variation of terrain, vegetation, and scenery and opportunities for wildlife encounters or historical areas are important. Length of trails varies greatly, but the width of a hiking trail should be approximately 4 to 5 ft of path with about 8 ft cleared of overhanging vegetation. In addition to vegetation clearing and surface maintenance, other man-made aspects of hiking habitat are signs that provide direction and interpretation of natural and historical features and, on long trails, provision of primitive camp sites and potable water.

The Procedure

Important habitat attributes are identified and rated individually. Cumulative scores are calculated based on analysis of the component parts of the habitat. Scores are rated on the basis of 10 as optimum recreation habitat. Lesser ratings indicate habitats of lesser quality. A hypothetical example is offered in the form of developed camping habitat.

Table 2 lists the attributes of developed camping habitat, categorized under the headings of physical and social. Physical attributes are further classed as natural and man-made. These are components of the habitat that are physically present and can be observed. Social attributes are amenities that are provided in the design and management of the camp area to enhance the recreation experience of the user of this habitat type.

Table 2. Developed Camping Habitat Attributes		
Physical		Social
Natural	Man-Made	
Tree cover	Level sites	Privacy
Grass	Defined sites	Near others
Lake view	Roads	Security
Pest free	Parking	Interpretation
Drainage	Restrooms	
	Potable water	
	Electricity	
	Sewage disposal	

Table 3 presents each attribute with a description of the condition and a range of values for each condition. A score is assigned to each attribute based on the professional judgment of the rater.

Table 3. Evaluation Criteria — Developed Camping Habitat			
Attribute	Condition	Score	Example Score
Natural			
Percent tree cover	0-25	0-2	4
	26-50	3-5	
	51-75	6-8	
	76-100	9-10	
Percent grass cover	0-25	0-2	7
	26-50	3-5	
	51-75	6-8	
	76-100	9-10	
Lake view	Very limited or none	0-3	9
	Partial view	4-7	
	Complete, unobstructed	8-10	
Pest free	Plant/insect pests in abundance	0-3	8
	Moderate pest infestation	4-7	
	No obvious pests	8-10	
Drainage	Puddling, moist soil	0-3	9
	Moderately well drained	4-7	
	Well drained	8-10	
(Continued)			

Table 3. (Concluded)			
Attribute	Condition	Score	Example Score
Man-made			
Level sites	Steep, camper & equipment too tilted for safe or comfortable use Moderate slope, blocks needed to level camper Level, little or no camper adjustment needed	0-3 4-7 8-10	6
Defined sites	Sites not defined Sites poorly defined Sites well defined	0-3 4-7 8-10	7
Roads	Dirt or gravel, ruts or corrugated surface Paved or gravel, well drained, graded Paved, well maintained, no ruts or holes	0-3 4-7 8-10	7
Parking	None or inadequate for easy access to site Dirt or gravel, near site Paved, well maintained at camp site	0-3 4-7 8-10	6
Restrooms	Pit or temporary, no water Vault, water may be available Waterborne	0-3 4-7 8-10	9
Potable water	None nearby Hand pumps or spigots, testing uncertain Running water near each site, tested regularly	0-3 4-7 8-10	2
Electricity	None near sites Available at central location Electric hookup at site	0-3 4-7 8-10	1
Sewage disposal	No dump station Dump station provided, but not near camp area Dump station central to camp area or hookup at each site	0-3 4-7 8-10	1
Social			
Privacy	No vegetation or other screening to block noise or vision with other sites Some screening, but noise from and view to adjacent sites with ease Site well screened, vision and noise from neighbors not apparent	0-3 4-7 8-10	2
Proximity to others	Adjacent sites >100 yd or <10 yd Adjacent sites 50-100 yd Adjacent sites <50 yd but >10 yd	0-3 4-7 8-10	10
Security	No ranger patrol Roving ranger Ranger onsite	0-3 4-7 8-10	7
Interpretative program	No program Nature hikes or other programs at peak use periods Regularly scheduled programs	0-3 4-7 8-10	2

To arrive at an overall cumulative score for the developed camping habitat being studied, one would add all the scores for the individual attributes and divide by the total number of attributes. A hypothetical score has been assigned to each attribute in the far right column of Table 3. The total score for all attributes is 97. The overall evaluation of the subject habitat is 5.71 ($97 \div 17$).

Based on 10 as a perfect score, evaluation of the habitat in the example at a score of 5.71 shows the need for some improvement to enhance the quality of the area. Use of RHAM enables a manager to identify those parts of the habitat which need improvement. That information is valuable in preparation of a sound management plan for existing habitat, for describing deficiencies in the course of environmental assessment, or in planning recreation resources.

The example shows a need for more tree canopy cover to provide shade. Other natural attributes rated fairly high. In fact, when one excludes tree canopy cover, the

total score for natural attributes is 8.25 ($33 \div 4$). A manager or planner can determine from this evaluation that potential for campground is good, with percent of tree cover as the main deficiency. Planting trees and grass (rated 7) would enhance the habitat.

Major deficiencies occurred in the area of man-made physical features. Resource managers can greatly improve the quality of the campground by providing electricity, sewage disposal, or drinking water. Analysis of social attributes indicates the need to provide vegetative screening for privacy and to add interpretive services.

By classing habitat attributes by natural, man-made, and social, one can evaluate the natural characteristics of the habitat for planning or assessment purposes and determine what facilities or programs should be provided. Other tools for resource management such as economic evaluations, carrying capacity, and user fee analyses will help determine what additions are practical and if a return on investment is possible.

Research Needs

The RHAM procedure presented here is conceptual in nature. The procedure should be validated in the field using acceptable research procedures to verify the following:

- Nine recreation habitats are described based on frequency of use at Corps of Engineers lakes. These habitats should be verified, and others identified for study as appropriate.
- Habitat attributes vary regionally. The example presented in this technical note uses percent of tree canopy as an attribute. Tree cover is appropriate in much of the Nation, but not in the Great Plains and other areas characterized by prairie where trees are scarce.
- Field verification is needed to determine the proper attributes for each recreation habitat.
- Recreation habitat requirements may vary for different ethnic populations. This should be examined, especially with respect to social and man-made attributes.
- The example treats all habitat attributes equally. In reality, some attributes are probably more important than others, as illustrated by Bumgardner and others (1988). The relative importance of attributes for each recreation habitat should be determined and a system devised to weight scores for the attributes in the evaluation.

Summary

Our population continues to grow. Competition and conflicts for available resources also grow, probably at a rate greater than the population increase due to technological advances and innovative ideas for resource uses. Most analysts agree that this trend will continue with expanding demands for finite resources. Outdoor recreation opportunities are already stressed in some regions. Innovative means of analyzing resources and optimizing use are needed. RHAM affords the resource manager one means of accomplishing this.

Sound resource management strategies and intelligent land-use planning are sorely needed if we are to meet our obligations as responsible stewards. Resource analysis and evaluation such as that envisioned in RHAM can be a valuable tool in that effort.

While RHAM is focused on analysis of recreation habitats, similar procedures can be developed for other aspects of human habitat such as home, workplace, and school. RHAM offers nothing new or revolutionary in resource analysis other than a more careful and different view of what resource planning and analysis is all about. Most of the items discussed in this paper are intuitive to good resource managers. RHAM merely provides a procedure to pull the pieces of a habitat apart, study them, and put them back together.

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