Classification of trail settings in an alpine national park using the Recreation Opportunity Spectrum approach

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Abstract: Considering trail settings in alpine national parks is important for both conserving nature and maximizing the quality of the experience for visitors. This study examines classifying trails in Daisetsuzan National Park, Japan, using the Recreation Opportunity Spectrum approach. A questionnaire was used to obtain data from park visitors concerning their preferences for the facility developments, accessibility, and visitor encounters. The responses were classified into four groups according to the preferences expressed for the types of trail settings. The trails were classified according to their characteristics as described by park visitors. The northern part of the park, with easier access and moderate development, was preferred by all groups, and the southern part of the park was preferred only by the those who favored more primitive surroundings.

Introduction

The purpose of Japan's natural parks is to provide people with recreation opportunities in natural settings in addition to conserving natural landscapes. Park plans are developed to achieve these objects, and park management is based on the objectives. The plans are divided into two categories in accordance with the purpose of the park: conservation plan and utilization plan. Each park is managed using such a system.

One difficult and consistent challenge of park planning is to design recreational activities that are compatible with conservation. As access to the mountainous areas of the national parks has been improved, the number of visitors has increased. The absence of park management with systematic planning have resulted in lack of control, overuse, and degradation of natural settings. It is expected that planning would ameliorate these problems. On the other hand, a utilization plan in conjunction with recreational management only defines how trails, roads, and facilities are to be allocated in the future. The utilization plan does not cover management issues. Without clearly defined policies for managing park visitors, conflicts occur involving recreational use and park conservation. The guidelines in the utilization plan were insufficient for maintaining high-quality and diverse recreational experiences that a park should provide to its visitors.

The intrinsic nature of mountainous settings should be maintained, and the impact of recreational pursuits should be held to a miminum. Therefore, it is important to develop systematic plans that will help park managers. Toward this end, the utilization plan should be revised to clearly define the areas and suitable recreational activities (Environmental Agency 1989).

The Recreation Opportunity Spectrum (ROS) that considers the diversity of recreation experience (Brown 1978, Buist 1982, Clark 1979, Driver 1978) will improve the utilization plan in this respect. This study is a report of clarifying the present situation of a national park using the ROS approach as an attempt to apply guidelines for the utilization plan.

Problems associated with planning in natural parks

National parks are under the jurisdiction of the Natural Parks Law. This law prescribes three types of natural parks: national parks, quasi-national parks, and prefectural natural parks. National parks are designated for nationally significant areas of outstanding natural beauty. Quasi-national parks are designated as areas of great natural beauty second to those of national parks. Prefectural natural parks are designated by prefectural governments to conserve areas of scenic beauty. National parks are generally the most outstanding of the three categories. There are 28 national parks in Japan. National, prefectural, municipal, and private lands are included within the park boundaries. Natural parks are managed for conservation and recreation and are also used for agriculture, forestry, mining, residences, and other uses.

The policy for the conservation and recreational use of national parks is established by a Park Plan (Ito 1990). As mentioned above, this plan is divided

into two plans. The conservation plan details the zoning of the natural parks. Because land ownership and land use are diverse, a zoning system is used for conservation. Forestry is the major land use in natural parks, and, therefore, it has the greatest influence on the zoning system (Ito 1996). The park area is classified into five zones, each distinct by the degree of regulation. The special protection area is the most strictly regulated, followed by special areas 1, 2, 3, and one classified as an ordinary area. Activities inconsistent with nature conservation, such as building, timber cutting, land development, and extracting natural resources, are controled according to how strictly regulated each zone is.

The utilization plan defines the allocation of park facilities. They include recreational facilities, such as roads, trails, campsites, visitor centers, and overnight accommodations. The development of park facilities is carried out on the basis of the utilization plan. The facilities are developed by national and local governments as well as by non-governmental organizations providing that the developments are consistent with park policy. Park plans are to be reviewed and updated every five years so that they remain compatible with the changing situations around the parks.

Daisetsuzan National Park is located in the center of Hokkaido, and the area includes 226,764 ha. It was established in 1934 and is the largest and one of the oldest national parks in Japan. It is categorized as a type II park on the United Nations' list of protected areas. The elevation reaches approximately two-thousand meters above sea level, and sub-frigid and alpine forest vegetation is dominant in the park. The park is busiest from July to September, as the winters are severe with heavy snowfall, and there are alpine flowers in summer and colorful foliage in the fall. The most popular recreation is hiking. Since some of the areas are accessible by aerial tram, people can easily enjoy alpine vegetation and mountain landscape. In addition, there are volcanoes and many hot springs. Several spa resort complexes have been developed.

The special protection area, which is the most strictly regulated, makes up 16.2% of the park. The average of all national parks is 12.0%. Stricter than average conservation guidelines are in place at Daisetsuzan National Park. The areas for classes 1, 2, 3, and ordinary are 13.0%, 9.8%, 41.8%, and 19.1% of the total park area, respectively.

Because there is no systematic management policy, recreational use of the parks produces environmental destruction. Visitors concentrate in certain areas, and there are no policies for control, which results in overuse of these areas. The lack of management results in erosion and destruction of vegetation along the trails. In addition, the excessive number of visitors places a strain on the sanitary systems within the parks, which degrades the water quality and has a negative impact on the ecosystem. Furthermore, the level of the development of the trails and facilities is not always consistent with the preferences of the visitors, which reduces the quality of the visitors' experience. These problems are caused by the lack of systematic visitor management policy. Improvements with the ROS approach are expected to lead to better planning and the ability to overcome the current problems.

Application of the ROS in Daisetsuzan National Park

ROS is a framework for recreation planning. The objective is to provide diverse recreational experiences and manage them simultaneously in conjunction with other needs for land use. The ROS concept is briefly outlined in the following. There is a desire to obtain satisfactory recreation experiences by choosing specific settings for recreational activities. Recreation opportunity settings include a combination of physical, social, and managerial conditions. Examples of physical conditions are topography, vegetation, and landscape. Social conditions include crowding, user density, and type of activities, and managerial conditions include management regulations and orders. Recreation opportunities vary with the combination of these conditions.

Desirable recreation settings depend on both recreation experiences and the type of activities visitors desire. Those who prefer a wild environment prefer few facilities and the least contact with other park visitors. On the other hand, users who want to experience a natural environment with the least effort desire acccessibility by automobile and comfortable facilities and services. Suitable recreational facilities should be provided to meet the desires of users.

Managers are required to supply and manage appropriate recreational opportunities based on a specific set of policies. ROS was designed for use in recreation management offering diverse recreation opportunitiy settings. A practical procedure for providing diverse recreation opportunities is as follows: diverse recreation opportunity settings are classified according to the users' preferences, and then it is decided where the categories should be allocated in a particular area. Clark et al. (1979) state that the ROS can indicate a distributional change of recreation opportunities caused by management activities such as timber cutting and the development of roads and recreational facilities. Therefore, ROS is useful to allocate recreational opportunities while keeping other land uses in mind. In this sense, ROS is desirable for the Japanese park system, in which multiple land use is the rule.

Daisetsuzan National Park was assessed using the ROS in this study. The northern part of the park was studied since it is the most popular among visiting hikers. Most of the park visitors come in the summer, which crowds the access roads and aerial trams. The vegetation along the trails becomes damaged because of the heavy traffic. To control the damage, it is

necesary to zone areas and to gain control of the visitors with the use of planning with ROS. For this study, the focus was on the summer use of the park. Because of the growth of a particular type of dense bamboo, called *sasa* in Japanese, leaving the trails is difficult. In addition, because trespassing on alpine vegetation is prohibited in natural parks, off-trail recreation is rare. As a result, off-trail analysis was not conducted. Access roads were also excluded from the analysis because this study focuses on the alpine area, in which conflicts are most likely to occur between conservation and recreational use.

Method

The process of analysis is shown in Figure 1 (Sangaku Recreation Kanri Kenkyukai 1998, 2002, Yamaki et al. 2003). We used a return-mail questionnaire to examine visitor preferences. The data obtained from the survey was used to classify the areas (Kliskey 1994). Because recreation opportunity settings are consisted of physical, social and managerial conditions as described in the early section, appropriate variables that represent recreation opportunity settings were selected and used for the survey. The variables selected for the study are shown in Table 1. The questionnaires were distributed to visitors at trailheads. The visitors were asked to answer the questionnaire and return it later. Respondents indicated their preferences to recreation opportunity settings by ranking the variables from one to five. The survey was conducted in August in 1997. A total of 1,443 questionnaires were distributed, and 658 (45.6%) were returned.

Respondents were classified by the data obtained from the questionnaire. Categorial principal component analysis (CATPCA) in a statistical software package (SPSS) was used with the data. CATPCA is applicable to principal component analysis using data with categorical scales. CATPCA was carried out to sum up the variables into a smaller number of components and extract important components for visitor preferences. Cluster analysis was performed next. The respondents were classified using object scores obtained from the CATPCA.

Trail settings were evaluated using the result of the visitor classification in order to reflect the preferences of the respondents. The information from the

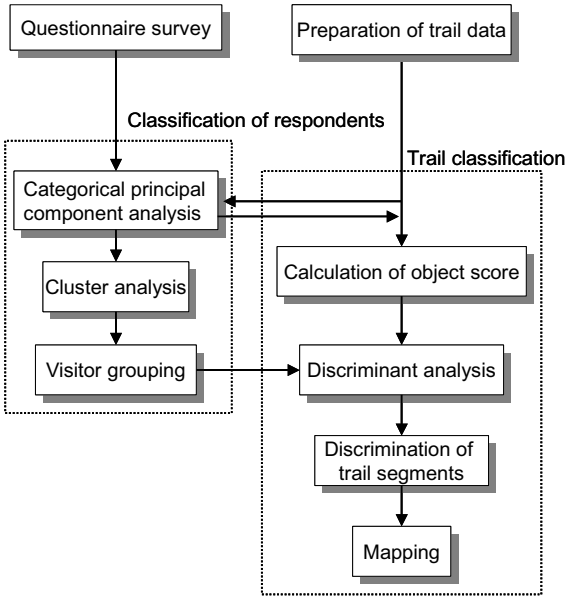


Figure 1. Process of analysis.

Table 1. Variables used in the questionnaire.

	Variables	Score				
		1	2	3	4	5
1.	Trail condition	Town shoes or heels are usable	—	Ahletic shoes are usable	—	Trekking boots are necessary
2.	Bench and table	Both bench and table	—	Only bench	—	No bench and table
3.	Guide sign	Every regular distance	—	Only junction	—	No signpost
4.	Interpretation Board	As many as possible	—	As few as possible	—	No interpretation Board
5.	Warning Sign	As many as possible	—	As few as possible	—	No warning Sign
6.	Rope for no trespassing	Everywhere	—	Only important places	—	No rope
7.	Ranger	Always patroling	—	Sometimes patroling	—	No watchman or ranger
8.	Frequency of meeting others	Continuouslly meet	Several times in 10 minutes	Several times in 10 minutes	Several times in a day	Less than once in a day
9.	Possibility of encountering bear	No possibility	—	Low possibility	—	There is possibility
10.	Walking hours from trailhead to destination	In 1 hour	In 3 hours	In a half day	In a day	Overngiht stay in mountain is needed

respondents and that regarding the trails was combined to implement the procedure. The trail settings were evaluated based on the visitor classification by calculating the distance between the trail settings and the gravity of each visitor group.

The trails were divided into segments depending on the physical, social, and managerial conditions of the environment, and then data sets were made for each segment. Second, we substituted the data of the trail segments into the formula that was made for calculating the object scores of the respondents in the CATPCA procedure, and then obtained object scores of the trail segments. Next, we performed a discriminant analysis to discriminate the trail segments according to the visitor classification. For this analysis, distants between the trail segments and the gravities of the visitor groups were calculated using Maharanobis distant. The distants to the gravities of the visitor groups were compared for each trail segment, and each trail segment was classified as the group that has the closest distant.

To carry out the procedure, we assumed the homogeneity of the visitor data and trail data. However, it is difficult to ensure that both data are homogeneous, as they were obtained using different means. Nevertheless, we treated them as if they were homogeneous because the scales used for both data were the same.

Results

A total of 514 bits of data from the returned questionnaires were used for the CATPCA. The results are shown in Table 2. Eigenvalues from the first to third dimensions were larger than 1, and the accumulative proportion of the three dimensions totaled 54.6%. Because the first dimension indicated large component loadings to most of the variables, it is provable that this dimension represents the general characteristic of preferences to the recreation opportunity settings. The second dimension showed large component loadings to ”1. Trail condition” and ”10. Walking hours from trailhead to destination”, which is likely to indicate preference to the trail setting itelf. Because the third dimension had a large positive component loading on ”3. Guide sign” and a large negative component loading on ”8. Frequency of meeting others”, it presumably means the trade-off of the two variables. That is to say, guide signs are preferefed by users who desire the low possibility of encounter for route finding, but are not prefered by users who desire the possibility of encounter because they obstruct the view.

Cluster analysis was performed to classify the respondents using the object scores of the three dimensions. They were classified into four groups with the Ward method. The numbers of respondents of groups 1 to 4 were 84, 145, 119, and 166, respectively.

Table 3 shows the average of the object scores by each group. Considering the result, the following classifications were used: 1. Primitive, 2. Semi-primitive, 3. Semi-urban, and 4. Urban. The primitive group preferred wild and natural settings, and the urban one, developed and artificial environments. The semi-primitive and semi-urban groups were closer in their preferences to the primitive and urban ones, respectively. Here it should be noted that, since the classification was produced using several

Table 2. Result of CATPCA.

	Variables	Component loading Dimension		
		1	2	3
1.	Trail condition	0.539	0.583	-0.134
2.	Bench and table	0.588	0.214	0.320
3.	Signpost	0.517	-0.244	0.503
4.	Interpretation Board	0.691	-0.080	0.260
5.	Warning Sign	0.609	-0.469	-0.191
6.	Rope for no entrance	0.544	-0.462	-0.251
7.	Watchman or ranger	0.438	-0.400	-0.107
8.	Frequency of meeting others	0.552	0.130	-0.558
9.	Possibility of encountering bear	-0.371	-0.203	-0.407
10.	Walking hours from trailhead to destination	0.539	0.570	-0.184
	Eigenvalue	2.974	1.427	1.063
	Contribution (%)	29.738	14.273	10.625
	Accumulative contribution (%)	29.738	44.011	54.636

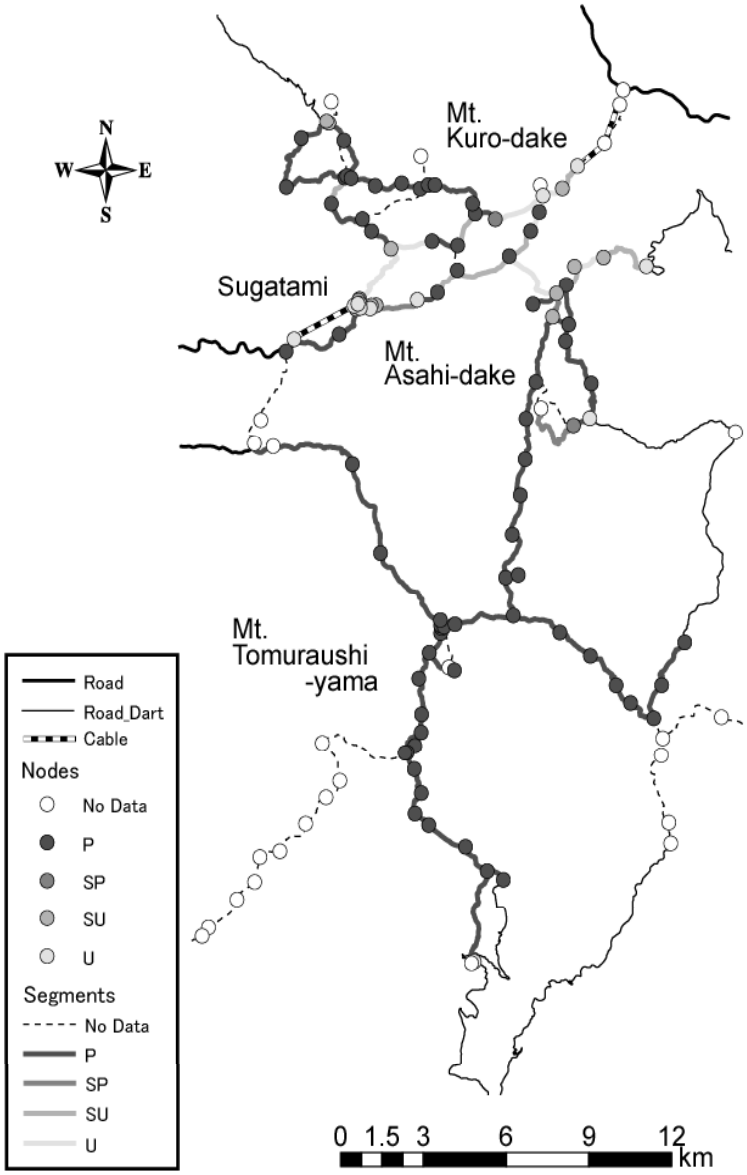
Table 3. Average of the object scores.

	Group	Variables										
		1	2	3	4	5	6	7	8	9	10	n
1.	Primitive	0.531	0.732	0.700	0.958	1.127	1.091	0.856	0.928	0.579	0.648	84
2.	Semi-primitive	0.621	0.481	0.317	0.385	0.118	0.080	-0.013	0.184	0.227	0.438	145
3.	Semi-urban	-0.014	-0.061	-0.054	-0.050	-0.147	-0.183	-0.109	-0.029	-0.076	-0.156	119
4.	Urban	-0.801	-0.747	-0.592	-0.785	-0.568	-0.490	-0.343	-0.609	-0.437	-0.599	166

dimensions, there is no linear relationship among the groups, as shown by the basic concept of ROS.

The trails were classified according to the classification of the respondents. As mentioned earlier, trails were divided into several segments. The data for each segment were obtained from a field survey with the same scores that were used in the questionnaire. The segments consist of 104 sections and 107 nodes, with a total of 211 segments. Only segments that were surveyed were analyzed. The sections and nodes analyzed were 87 and 95, respectively, for a total of 182 segments.

The result of the analysis are mapped in Figure 2. All the segments in the southern area were classified as primitive. This indicates that the southern part is the most preferable for those who prefer a primitive environment. Because this area is far from the trailheads, less developed, and less visited, it is likely that visitors who prefer a primitive environment can obtain the recreational experiences they desire. On the other hand, developed and artificial settings, such as those in the urban and semi-urban areas, are located in the northern part of the park. Users who indicated a preference for urban and semi-urban areas will have the recreation experiences that they prefer in this area. It is easily accessible and developed with several facilities, thus, attracting many visitors. On the contrary, segments classified as semi-primitive are rare. This does not mean, however, that there are few choices for those who prefer semi-primitive areas. It should be noted that most segments are more preferable to other groups.



P: Primitive, SP: Semi-primitive, SU: Semi-urban, U: Urban

Figure 2. Map of the trail classification.

Management implications

Visitors to Dassetsuzan National Park were classified into four groups according to the preferences to the recreation opportunity settings of the survey respondents. The park trails were classified according to visitor preferences. From the results, the recreational opportunitiy settings were classfied within the ROS framework. The next step will be to use ROS to improve the utilization plan. As prescribed in the Natural Parks Law, one of the main goals of natural parks is to increase the number of visitors. However, by present-day standards, it is not reasonable to simply increase the number of visitors to a national park; what is needed is to improve the quality of the experience for park users. Every visitor seeks a different recreational experience, and, therefore, diversity of opportunities is necessary.

In addition, there has not been a well-organized planning framework from the recreational point of view. The utilization plan has, thus, become merely a plan for roads, accommodations, and recreational facilities for mass tourism. Consequently, it has been criticized as only “an allocation plan with points and lines. Since overuse is one of the most critical problems facing national park managers, it would be wise to allocate recreational opportuniy settings more accurately by considering visitors’ preferences. As shown in this study, different types of classifications mingle in the northern part of the study area; as a result, it is difficult to have a consistent management policy, and visitors’ experiences are, on the whole, worse. The utilization plan should be improved so that desirable recreational opportunities would be avilable to all visitors to national parks. This is one reason that ROS should be integrated into a utilization plan.

Moreover, the overlapping of the ROS-based utilization plan and the zoning plan included in the protection plan allows for both recreation use and nature conservation to be considered. Levels of use vary among different ROS classifications and, therefore, use management policiy should also be different for each individual ROS classification. However, no previous management guidelines have ever taken into acount the diversity of recreation opportunity settings. For example, though ”Urban” and ”Primitive” zones in the special protection area should be managed in different ways, clear management policy has not been specified in the park plans. This worsens the quality of environment in both ecological and perceptual aspects. Because the utilization plan and the protection plan have not been well integrated so far, the conflict between recreational use and nature conservation has not been evaluated during the development of park plans. ROS will reinforce the utilization plan and combine it with the protection plan; in this way, the park plan will become a comprehensive park management plan.

In addition, since land ownership and land use in Japan’s natural parks are diverse, natural parks are managed on the basis of multiple use. Changes in land use allocations are common and result in changes in the settings for recreational opportunity settings. If the distributuion of recreation opportunity settings is clarified by the ROS, we can assess how land use change will affect the recreation opportunities. In conclusion, the ROS will lead to improvements of Japan’s natural park planning in terms of visitor management.

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