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# Recreation Ecology and Visitor Carrying Capacity Management : Implications for Protected Areas in East Asia

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**ABSTRACT:** Ever-growing recreation, tourism and ecotourism worldwide have become a significant factor of resource degradation in many protected areas. Managers of these areas are increasingly challenged to implement policies, strategies and actions that would protect the resource base while providing quality visitor experience. One major issue in managing protected area visitations is that of carrying capacity, or the question of "how much use is too much?". Scientific studies of visitor impacts, often known as recreation ecology, has generated a knowledge base that provides valuable input to the visitor carrying capacity management process adopted by the U.S. National Park Service. This paper aims at (a) providing an overview of recreation ecology research and its application in managing visitor carrying capacity, and (b) examining the relevance of recreation ecology to East Asian protected areas with special reference to the visitor capacity issue.

***Key words*** : Recreation ecology, Visitor carrying capacity management, Protected areas.

## INTRODUCTION

It is widely recognized that recreation and tourism can generate a variety of benefits to protected areas and local communities, and visitation is often a legitimate use of protected area' s resources. Indeed, visitations to many protected areas worldwide have experienced continual growth (Eagles *et al.* 2001). With increasing visitor use, unfortunately, comes with some undesirable effects, one of which is resource impact caused by visitors. Examples of visitor impacts include loss of ground cover vegetation, vegetation composition change, soil compaction, soil erosion, wildlife disturbance, excessive nutrient input to water resources, and aesthetic/cultural resource impacts (Hammitt, and Cole 1998, Liddle 1997, Leung and Marion 2000). While some degree of resource impacts is inevitable with any visitation and many impacts are localized, they may have significant ecological, social and managerial implications. For instance, extensive soil erosion can lead to a host of ecological effects. Visitor enjoyment and experiences can also be affected by degraded resource conditions. Such negative impacts tend to compromise the preservation and visitor use goals of protected areas.

Managers of protected areas are increasingly challenged to implement policies, strategies and actions that would maintain a balance between protecting the resources and providing for quality visitor experience. One important issue of managing protected area visitation is that of carrying capacity, or the question of "how much use is too much?". Visitor impact studies, often known as recreation ecology, have generated a knowledge base that provides valuable input to the carrying capacity management. The objectives of this paper are two-fold. Firstly, it provides an overview of recreation ecology research and its application in managing visitor carrying capacity. Secondly, it examines the relevance of recreation ecology to protected areas of East Asia with special reference to the visitor carrying capacity issue.

## RECREATION ECOLOGY

The scientific study of visitor impacts can be traced back to the 1930s. However, the term recreation ecology has only been used since the early 1970s (Liddle 1997, Leung and Marion 2000). Recreation ecology has been defined differently, but most of the definitions refer it as a field of study that seeks to assess, monitor and manage visitor impacts in protected or natural areas. In the United States, much recreation ecology research was developed in response to rapid growth of outdoor recreation activities and associated resource degradation in national parks and wilderness areas. These studies have generated important understandings of visitor impacts and a body of scientific literature. For recent and comprehensive reviews of recreation ecology and its implications to protected area management please refer to Cole (2000) and Leung and Marion (2000). The field of recreation ecology is multi-disciplinary, with studies conducted by scientists from as diverse disciplines as botany, ecology, forestry,

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geography, soil science and wildlife science. In general, recreation ecologists focus on four major research questions:

**1) What types of resource impacts exist and what are their significance?**

A variety of visitor impacts have been identified and examined by researchers (Hammitt and Cole 1998, Liddle 1997, Leung and Marion 2000). Early studies, however, were geared toward understanding impacts on soil and vegetation, particularly trampling-caused soil and vegetation damage. Soil erosion is another popular research area. The majority of studies were conducted on trails and campsites in natural and semi-natural areas. In recent years, the scope of recreation ecology has expanded to include wildlife, water and microbes. The social and managerial significance of visitor impacts was examined mostly through examination of managers' and visitors' perceptions (Leung and Marion 2000).

**2) What are the patterns and trends of impacts in space and time?**

The spatial and temporal patterns and trends of visitor impacts have been investigated. Research suggests that many visitor impacts are not evenly distributed in space and time, and they often affect a small portion of a protected area except for impacts associated with motorized recreation (Hammitt and Cole 1998). When new recreation sites are established, these sites often suffer most impacts during the first few years of use. Recovery rates vary, depending on the resilience of different ecosystems (Liddle1997).

**3) What are the factors that influence the quality of impacts and what is the relative importance of these factors?**

The influence of environmental and use-related factors on visitor impacts has been studied. The factor of amount of use has received most research attention. Previous research has consistently shown that many use-impact relationships are curvilinear, implying that substantial impacts are generated during low levels of use, while subsequent impacts are minimal with further increases in use. Fig. 1 illustrates this generalized curvilinear use-impact relationship model. Different environments or ecological communities may exhibit varying responses to impact force, as portrayed by two curves with different degrees of curvilinearity in the model– Curve (a) indicates highly sensitive environments such as alpine meadow, whereas Curve (b) represents less sensitive environments such as grasslands, with a more gradual response to changes in amount of use. This model suggests that most types of impact can be substantially reduced only if visitor use is limited to extremely low levels. Accordingly, a containment strategy is considered to be an effective way to minimize impacts by concentrating visitor use on small number of resistant sites or established sites where impacts tend to stabilize (Hammitt and Cole 1998, Leung and Marion 1999).

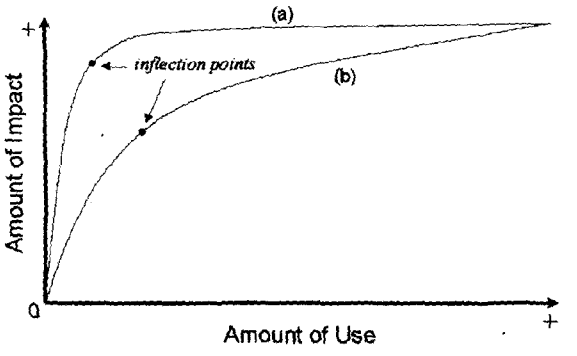


**Fig. 1.** The generalized relationships between amount of use and amount of impact. Inflection points (a) and (b) indicate two different response patterns of ecological communities.

Visitor behavior is another factor that can influence the type and extent of resource impacts. For example, vegetation and soil disturbance may be minimized by traveling or camping on resistant or existing disturbed surfaces. Such minimum-impact outdoor skills are the focus of visitor education campaigns such as the Leave No Trace program (Leung and Marion 2000).

**4) How effective are management strategies and actions implemented for reducing resource impacts?**

The knowledge of recreation ecology has been applied in selecting visitor and site management strategies and actions. Such knowledge is especially useful in managing natural areas where facility development and site hardening practices may not be feasible or inappropriate. Protected area managers can influence use-related and/or environmental factors to avoid or minimize impacts. For example, the spatial distribution of facilities or use may be modified in such a way that resistant areas are utilized while sensitive habitats are shielded from visitor use (Leung and Marion 1999). Low-impact activities and visitor behavior can be encouraged through education or required through regulations. Finally, rehabilitation efforts can facilitate recovery on sites unacceptably degraded by visitor use.

## VISITOR CARRYING CAPACITY MANAGEMENT

Among various visitor management issues, visitor carrying

capacity management is perhaps the most challenging one, which also receives a great deal of research attention (Shelby and Heberlein 1986, Manning 2001, Lindberg *et al.* 1997). The concept of carrying capacity originated in the field of range management and was later adapted to recreation and tourism contexts (Shelby and Heberlein 1986, Manning 2001). The term visitor carrying capacity may be defined as the amount and types of visitor use that can be sustained without compromising the integrity of the resource or the quality of visitor experiences. Shelby and Heberlein distinguish four major dimensions of recreation carrying capacity, including ecological, social, design and managerial (Shelby and Heberlein 1986). This paper limits its focus to the ecological or resource aspect of visitor carrying capacity.

Numerous studies have attempted to approach the question "how much use is too much?" directly by determining numeric capacity values. Studies utilizing this *traditional* approach focused primarily on the amount of use and placed less attention to other influential impact factors. Due to the complexity of factors influencing carrying capacity, and to the fact that many impacts are poorly related to the amount of use, this traditional approach has limited utility in determining ecological or social carrying capacities (Lindberg *et al.* 1997).

Recognizing the limitations of the traditional approach, recreation research since the 1980s has largely reconceptualized 'carrying capacity' using a *management-by-objectives* (MOB) approach. Instead of asking "how much use is too much?", the MOB approach addresses the question "how much change in resource condition is too much?" (Manning 2001). Accordingly, scientists and managers now focus on defining and maintaining acceptable resource conditions rather than merely controlling the amount of use. The MOB approach facilitates research that assists in setting resource indicators and standards as well as in developing monitoring programs. A number of MOB-based visitor capacity management frameworks have been developed, including three from the United States: The Limits of Acceptable Change (LAC) process by the U.S. Forest Service, the Visitor Impact Management (VIM) framework by the National Park and Conservation Association, and the Visitor Experience and Resource Protection (VERP) framework by the U.S. National Park Service. These and other frameworks have been examined and compared by McCool and Cole (1997). The three U.S.-based frameworks share a lot of similarities. A generalized MOB-based management framework is presented in Fig. 2.

Recreation ecology contributes to a visitor capacity management framework in several different ways (Leung *et al.* 2001). As indicated in Fig. 2, data collected in recreation ecology research help identifying good resource indicators (Step 2) and setting realistic standards for these indicators (Step 3). Measurement techniques for selected indicators can be developed and written into procedural manuals for future monitoring (Step 4). Basic

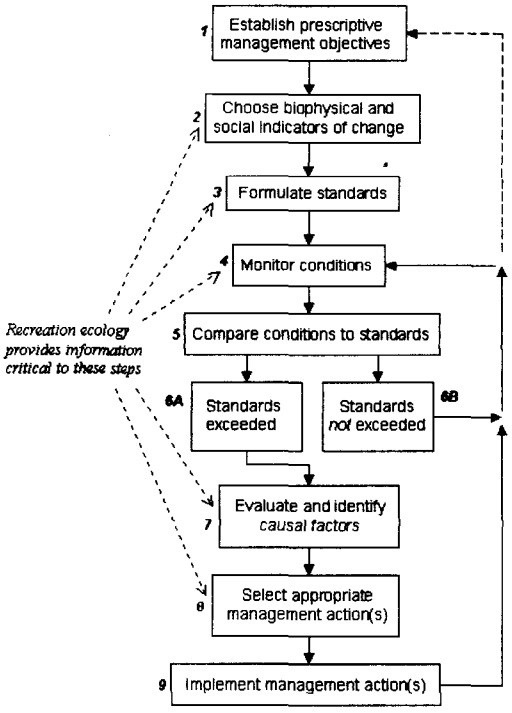


**Fig. 2.** The role of recreation ecology in a generalized visitor capacity management framework (Leung and Marion 2000).

research can provide insights on possible causes and relative importance of factors that influence the quality of impacts (Step 7). Finally, research techniques and data can be utilized to examine the effectiveness of various management strategies and actions (Step 8).

One example of application of recreation ecology is the VERP framework of the U.S. National Park Service (1997). This framework was first experimented at Arches National Park in Utah, and is now being implemented in a large number of national park units (Manning 2001). Recreation ecology research is an integral component of the VERP implementation processes in Arches National Park, Boston Harbor Islands National Park Area, and Yosemite National Park (Manning 2001).

## IMPLICATIONS TO EAST ASIAN PROTECTED AREAS

There are currently 766 protected areas in East Asia, covering the area of over 880,000 km$^2$ and representing the rich natural and cultural heritage of the region (Sheppard 2001). These protected areas offer excellent potential for recreation and tourism (Jim and Li 1996). The question is how to realize this potential in a sustainable manner (Eagles *et al.* 2001). Indeed, East Asian protected areas are facing several significant challenges, the

most significant one being the immense population and development pressure (Sheppard 2001). Furthermore, international and domestic tourism in East Asia is rapidly growing, with estimated growth rates of over 7 percent in the next 20 years (World Tourism Organization (WTO) 1999). Several countries have identified tourism as national development strategies and consider protected areas as prime attractions (Sheppard 2001, World Tourism Organization (WTO) 1999). All these factors contribute to the increasing visitor use pressure in and subsequent impacts to East Asian protected areas. In fact, visitor impacts have long been recognized in this region and research has been conducted in a number of protected areas (Table 1). Unfortunately, many of these protected areas were recently established with very limited structure, staff and funding to deal with visitor use and impact problems (Eagles *et al.* 2001).

In view of the tremendous need for visitor use planning and management, IUCN and the United Nations have recently published guidelines for sustainable tourism development specifically for this region (Eagles *et al.* 2001, United Nations, 2000). Both of these guidelines call for research on visitor impacts and establishing carrying-capacity management frameworks. In order to better understand and manage visitor impacts in East Asian protected areas, research in several areas is particularly needed. Firstly, there is a great need for developing and implementing region-specific visitor management planning frameworks for different types of protected areas of the region ranging from strict nature reserves (IUCN Category Ia) to managed resource protected areas (IUCN Category VI) (Sheppard 2001, United Nations, 2000). One of the MOB-based frameworks, LAC, has been applied in a protected area in Taiwan (Eagles *et al.* 2001). This and other early applications can serve as models for other protected areas. Secondly, there is a need for developing reliable and efficient ways to assess and monitor visitor impacts in protected areas. While some procedures may be directly adapted from the existing literature (Hammitt and Cole 1998, Liddle 1997, Leung and Marion 2000), region-specific methods would be needed for unique natural and cultural resources. These customized procedures can be shared among agencies through regional information networks (Sheppard 2001, Jim and Li 1996). Thirdly, there is a need for basic research on impact susceptibility of representative ecological communities in the region. Fourthly, current visitor carrying capacity management practices in protected areas of the region need to be inventoried and compared. Finally, visitor education campaigns for reducing depreciative visitor behavior need to be developed and evaluated.

## CONCLUSIONS

This paper has outlined recreation ecology research and discussed its relevance to visitor carrying capacity management in protected areas. While recreation and tourism are attractive alternatives for economic development, they must be carefully planned and managed. The VERP and other management frameworks have been developed to deal with the visitor carrying capacity issue and can be adapted to the protected areas of the region. Guided by management goals and objectives, these frameworks provide a systematic and objective approach to planning and managing for visitor use. The field of recreation ecology offers a knowledge base and techniques integral in implementing these management frameworks. With better understanding of visitor impacts and their management techniques it is hopeful that recreation and tourism would be sustainable in the protected areas of East Asia.

Table 1. Some recent examples of published recreation ecology studies in East Asian countries and territories[1]

| Country/Territory | Protected Area(s) | Study Topic(s) | Citation(s) |
|---|---|---|---|
| China | Zhangjiajie NFP[2] | Soil & vegetation damage | Deng, Y. |
| | Nanwan Reserve | Wildlife impacts(rhesus monkey) | Jiang, H. |
| Hong Kong SAR[3] | Sai Kung CP[4] | Soil & vegetation damage | Jim, C.Y. |
| | Shing Min CP | at camping and picnic sites | |
| Taiwan (China-Taipei) | Yushan NP[5] | Vegetation damage & Soil erosion on trails | Liu, J-Y. |
| Korea - North | Unknown | Trampling impacts on vegetation | Mucina, L. |
| | Sorak NP | Soil erosion on trail & vegetation | Park, B.W. |
| Korea - South | Tokyusan NP | Soil erosion on trail | Park, J. M. |
| | Chiak NP | Campsite damage and vegetation | Lee, G.J. |
| Japan | Daisetsuzan NP | Soil erosion on trails | Watannabe, T. Yoda, A. |

[1] No published studies were identified for Mongolia and Macau SAR; [2] NFP = National Forest Park; [3] SAR=Special Administration Region(China); [4] CP = Country Park; [5] NP = National Park.

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