Recreation ecology research in China’s protected areas: progress and prospect

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**ABSTRACT**

As a type of tourist destination, Protected Areas (PAs) have been the focus of recreation ecology research since their establishment. The contradiction between recreation and ecological protection of PAs in China is more prominent than in other countries because of China’s large population density and complex PA management system. Thus, a review of related research is urgent for promoting sustainable tourism development of PAs in China. Combining quantitative analysis with a literature review, this study analyzed the historical development process and current research topics of recreation ecology in China’s PAs, focusing on the impacts of tourism on the natural environment, environmental management of tourism, and the development of different types of sustainable tourism in PAs. Overall, the research gaps are as follows: (1) studies on impact mechanism of tourism based on long-term monitoring are lacking; (2) the existence of numerous local communities in most of the PAs in China is usually ignored; (3) insufficient attention has been paid to the impacts of tourism infrastructure construction; (4) assessments of sustainable PA tourism are lacking. Correspondingly, this paper presents implications for future research and serves as a reference for PA tourism management in other countries.

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**INTRODUCTION**

Protected Areas (PAs) often have multiple functions, such as biodiversity conservation, production of ecosystem services, and provision of recreational opportunities for the public (Soliku and Schraml 2018). At present, the percentage of land included in the global PA network has increased to 15% (UNEP-WCMC, IUCN and NGS 2018). Jones et al. (2018) found that one-third of this area has been physically modified by intensive human activities. According to the estimate of Balmford et al. (2015), the world’s terrestrial PAs receive approximately 8 billion visits per year. Concomitant with the increasing popularity of PAs as nature tourism destinations are the increasing human interference with the natural environments within PAs (Pickering et al. 2010). Thus, pressures are expected to intensify, particularly in the PAs of countries with a dense population (Weaver and Lawton 2017), like those in China.

In response to the impacts of outdoor recreation and tourism on natural or semi-natural environments, the concept of recreation ecology was created (Monz, Pickering, and Hadwen 2013). It has been defined as the scientific study of visitor impacts on the natural environment and their effective management (Leung 2012; Monz et al. 2010). Much research has been conducted for PAs (Marion et al. 2016). An iconic study on recreation ecology is the measurement of the recreation impacts on the Redwood Forest Park in California, USA (Meinecke 1928). Nature reserves, scenic areas, forest parks, geoparks, and other types of PAs have always been the main research fields of recreation ecology in China (Jin and Lu 2008).

Because of the presence of very different species, ecosystems, and types and levels of tourist activity, every country needs to carry out its own recreation ecology research, which is particular to its own environments (Buckley 2005; Buckley et al. 2006). China has rich biodiversity, a large area, and a very large population (Xu et al. 2019). In addition, millennia-old Chinese cultural values about relationships between nature and humans are centered around tian ren he yi-humans and nature as a unified entity, while Western values tend to separate humans from nature for conservation purposes (Xu et al. 2014). The uniqueness in China’s natural environment, cultural beliefs, and political and social factors make the visitation paradigm and PA management for sustainable tourism in China distinctive (Xu et al. 2019; Buckley, Zhong, and Ma 2017; Plummer and Fennell 2009; Buckley et al. 2008). By the end of 2018, China had established more than 11,800 PAs of 13 types at national and local levels (Tang et al. 2019). Since economic considerations have been the important driving force behind designating many of these parks (Wu, Gong, and Wu 2018), most of them have high biodiversity, high visitation rates, and
considerable anthropogenic modification; thus, many are facing intense recreation pressure. For example, China’s 3,505 forest parks accommodated a total of 826 million domestic tourists in a single year in 2017. Therefore, analyzing and solving the ecological and environmental problems related to tourism in China’s PAs is an urgent issue. It is thus of great significance to understand the present situation of recreation ecology research in China in order to strengthen its ability to adequately respond to the pressures facing China’s PAs.

The impacts and management of outdoor recreation and nature tourism in PAs have been reviewed on a number of occasions under the rubric of recreation ecology (Garthe 2019; Zhong et al. 2015; Leung 2012; Newsome, Moore, and Dowling 2001). While there are discussions about an intercontinental comparison of impact characteristics between American and Australian colleagues (Pickering et al. 2010; Buckley 2005), much less attention had been paid to other countries, such as China, until Leung (2012) reviewed studies conducted in East Asia before 2011. However, there are many differences among China, Japan, South Korea, North Korea, and other East Asian countries in terms of population density, land area, biodiversity, tourism development, total protected area, and visitor pressure in PAs. Both the area and number of PAs in China are much larger than other countries in East Asia (Leung 2012). Thus, it is deemed necessary to comparatively examine the recreation impacts on the natural environment from a global perspective. In view of this, this study aims at understanding the effects of tourism on the ecological environment of PAs and the development of corresponding management approaches in China, a country where the tourism industry has developed rapidly in recent decades. It is the authors’ hope that this review of the literature on recreation ecology in the context of China will contribute to the body of knowledge of recreation ecology.

This paper is organized as follows: a quantitative analysis of papers reviewed is first presented, followed by a description of the historical development process of research on recreation ecology. Then, the research content of the literature is reviewed and discussed. Finally, issues that need to be addressed in future research are put forward based on an international comparison and an analysis of research status.

**Methodology**

We searched core Chinese journals listed on www.cnki.net for papers that include the words “tourism” or “tourists” in their titles; “environment” or “influence” as their themes; and “nature reserve,” “forest park,” “scenic area,” “geopark,” or “wetland park” as their keywords. With the same keywords, we also searched for papers using the words “tourism* OR recreation,” “environment OR influence,” and “China” as their themes in Web of Science. A total of 418 Chinese articles and 23 English articles published before May 2018 were obtained after excluding book reviews, proceedings papers, editorial materials, and other papers with no relevance to the study.

The results of the quantitative analysis show that the literature is mainly focused on the disciplines of tourism (31.3%), followed by environmental science and resource utilization (18.1%), building science and engineering (11.5%), and resource science (5.5%), while other disciplines such as agriculture, forestry, geology, and natural geography account for a relatively small percentage. These research efforts are mainly supported by the National Natural Science Foundation of China (28.8%). The number of published articles can be observed to have sharply increased in the first decade of the 21st century (Figure 1). In recent years, recreation ecology has been a hot research topic in China, with an average of about 25 papers published annually.

The results of keyword co-occurrence analysis by Citespace5.3 show that ecotourism, sustainable development and tourism environmental capacity, and environmental impacts of tourism are the main research topics for the recreation ecology of PAs in China, with nature reserves, forest parks, and scenic areas as the most important types of case study site (Figure 2). Based on the results of the keywords analysis and the in-depth literature review, the research topics were divided into the following three categories: the impacts of tourism on the natural environment, environmental management of tourism, and development of different types of sustainable tourism in PAs (Table 1).

![Figure 1. Number of papers on recreation ecology research in China’s protected areas published each year.](image-url)
Research process of recreation ecology in China’s PAs

We divided the process of recreation ecology in China’s PA into three stages: formative stage, expanding stage, and strengthening stage according to research emphasis and key events in different years (Figure 3). This follows the methodology of Leung (2012), who identified three developmental stages of recreation ecology research in East Asia.

### Formative stage

Since the beginning of the Reform and Open Policy in 1978, tourism has gradually flourished in China. In 1982, the first national forest park, Zhangjiajie National Forest Park, was established. In the same year, the China State Council approved the establishment of the first 44 scenic areas (Figure 3). With the increasing number of tourists, the negative environmental impacts of tourism on PAs was observed, which mainly inspired the rapid development of recreation ecology in PAs (Leung 2012), a trend similar to that experienced in North America and Europe. At this stage, Liu (1994) introduced the concept of recreation ecology in China and analyzed its potential research topics. Overall, qualitative analysis and seeking policy solutions to the negative...
environmental impacts of tourism were the key features of Chinese recreation ecology research during this stage. Few studies evaluated the environmental impacts of tourism using quantitative indicators (e.g., Feng and Bao 1999; Wu et al. 1994). Studies on recreation ecology appeared later in China than in North America, Europe, and Japan, where similar studies were conducted as early as the 1970s or before (Garthe 2019; Leung 2012; Monz et al. 2010).

**Expanding stage**

Chinese citizens have enjoyed the “golden weeks” – seven-day national holidays, which take place in May and October – since 1999. Increased leisure time significantly promoted the development of tourism in China’s PAs. Correspondingly, the demand for tourism in PAs grew, and environmental impacts became more serious. During the first decade of the 21st century, the number of articles on recreation ecology published in academic journals increased threefold (Figure 1). During this period, the first books named Ecotourism (Yang 2000) and Recreation Ecology (Yan 2004) were published. Research topics became more extensive, and methods used were more diverse. For example, research content covered tourism impacts on soil, organisms, water, and the atmosphere, with increasing use of quantitative research methods, such as statistics on tourism or biodiversity loss and experimentation (Wu et al. 2010; Liu et al. 2009; Kong et al. 2008; Ma and Cheng 2008; Li 2004; Shi, Zheng, and Zhong 2002; Shi, He, and Wu 2002). In contrast to Japan or South Korea, where the impacts of tourism on soil and water in environmentally vulnerable areas has tended to be the main concern, many studies on recreation ecology in China during this period were related to the tourism environmental carrying capacity (Li and Rong 2007; Dai 2006) and tourism ecological footprint (Hu and Zhang 2010; Dai et al. 2006).

**Strengthening stage**

Since “ecological civilization” was listed as one of the five goals in China’s overall development plan by the Chinese central government in 2012 (along with economic, political, cultural, and social progress), studies on recreation ecology of PAs have deepened along with increased research into ecological civilization (e.g., Shi et al. 2019). For instance, scholars pay more attention to environmental and visitor management (Zhong et al. 2015), the improvement of tourism efficiency (Zhu et al. 2017), and putting forward ecological compensation as a way of safeguarding environmental justice in and around PAs (Yang and Zhang 2012). In addition, the growing official recognition of ecotourism over the last decade is a good example of how the Chinese have been consistently exploring environmentally friendly ways of traveling to nature (Figure 3). Quantitative research approaches have become more prevalent in recent research, especially using social media data, such as Sina Microblog (Zhang et al. 2015). However, the application of innovative methods and technologies in the study of recreation ecology in China’s PAs is insufficient given that artificial intelligence, social big data, and other new technologies are increasingly being applied in other research areas (Chun et al. 2020; Teles da Mota and Pickering 2020; Walden-Schreiner et al. 2018).

**Impacts of tourism on the natural environment of PAs**

The impacts of tourism on the natural environment is the most important field in the study of recreation ecology in China’s PAs and is also the main subject matter in global recreation ecology (Monz, Pickering, and Hadwen 2013). Measuring the impacts of tourism and understanding the factors and mechanisms by which they occur are important research themes. Vegetation, soil, water, the atmosphere, and wildlife are the main elements of the natural environments in PAs. Thus, they are identified as indicators for measuring the degree and level of the impacts of tourism (Table 2).

Vegetation change is the most frequently mentioned environmental factor affected by tourism (Hammitt and Cole 1998). The impacts of tourism on vegetation include biodiversity loss, deterioration of community structure, and a decrease in plant productivity or even the extinction of some species. For instance, in the Changbai Mountain Nature Reserve, Jilin Province, the construction of tourism facilities has brought about significant ecological impacts on the tundra zone, with vegetation cover near the Tianchi Weather Station being reduced from 30% in the 1980s to approximately 10% in the 1990s (Yu et al. 1999). The main causes of damage to plants in PAs are poor management and physical damage from tourists caused by trampling, carving, and braking. When the disturbance caused by tourism reaches a certain level, both the abundance and diversity of plant species begin to decrease (Li et al. 2010; Shi, Zhong, and Wang 2004).

The impacts of tourism on soil vary. First, trampling can affect the physical properties of the soil, such as decreasing soil porosity, increasing bulk density, decreasing water content, and reducing the thickness of soil layers (Li et al. 2009; Liu et al. 2009; Jin and Lu 2009; Kong et al. 2008; Chen and Yang 2004). Secondly, tourism affects soil chemical properties, such as decreasing soil fertility and increasing heavy metal pollutant content (Li et al. 2009; Ma and Zhu 2008). Thirdly, because of changes in soil properties, the total amount of microorganisms in 0–5 cm of the soil layer
will also decrease, which had been confirmed in the Zhangjiajie National Forest Park (Yang, Yang, and Xiao 2007).

The impacts of tourism on water and the atmospheric environment within PAs has been less documented compared to that of other elements. Wang et al. (2020) found that tourism development considerably affected water quality, which further decreased α-diversity but increased β-diversity in open areas for landscaping and recreation in the Xixi National Wetland Park. Although there are fewer studies on the impacts of tourism on the atmosphere, the results of the research by Shi, Wu, and He (2002) and Qiao et al. (2013) show that tourism had serious impacts on atmospheric quality in Hunan’s Zhangjiajie National Forest Park.

Tourism provides financial support for wildlife protection in PAs, yet the negative effects of tourism on mammals, amphibians, and birds have gradually emerged (Table 3). Road construction, vehicles, and sightseeing activities, among others in and around PAs can affect the extent and quality of habitats and the reproduction and migration of wildlife. It is not uncommon to find that animals have been run over by vehicles (Wang, Su, and Huang 2013). The giant panda population in Tangjiahe National Nature Reserve has exhibited an apparent avoidance of the hiking route (Liu et al. 2016). The number of frogs in the Hengshan Scenic Area decreased by 65.8% in 2009 compared with that in 1998, while the number of snakes fell by approximately 91% from 1997 to 2009 (Chen, Huang, and Huang 2010). Cheng (2008) found that tourism activities in the Anbang River Provincial Nature Reserve have a certain influence on the daily activity of the common coot (Fulica atra) during breeding, with feeding time being fragmented as a result.

In addition, scholars have evaluated the impacts of tourism on ecosystems, landscapes, and the total environment based on indicators. For example, different types of indicators were established to evaluate the change of biodiversity in Wulingyuan National Scenic Area, the landscape of Wulingxiahai Nature Reserve, and spatial and structural changes in the scenic forests of Taihu Xishan National Forest Park in the context of tourism (Ma 2016; Wang et al. 2015; Pang 2014). The assessment by Liu, Yang, and Chen (2012) on Kanas National Nature Reserve shows that buildings and power lines have a certain influence on the visual landscape.

Based on current research results, the type and degree of impacts depend on a range of factors, including the number of people, activity, and terrain. According to the simulation test of Cong et al. (2012) in Daqinggou Nature Reserve, the degree of the adverse effect of tourists’ trampling was related to the terrain, slope, and porosity of the land and tourists’ weight and walking speed. It is found that downward walking damaged the surface more seriously than upward walking. Zhang et al. (2011) found that with increased human disturbance intensity, soil fertility showed a downward trend, and the trend was evident in 0–20 cm soil layer in Wulingshan Nature Reserve. Although research on the relationships between recreational use and ecological impacts has made certain progress in the West, little progress has been made in China (Monz, Pickering, and Hadwen 2013). Resistance and resilience of ecosystems and vegetation types, the susceptibility of the site to erosion, the severity of direct impacts from different activities, and other factors that affect the severity of environmental impacts of visitors in PAs have drawn little attention.

### Table 2. Impacts on the natural environment of tourism.

| Elements | Impacts | Indicators | Representative literature |
|----------|---------|------------|--------------------------|
| Flora    | Decrease of community diversity | vegetation type; Simpson index; Shannon index; Pielou index; height of tree; timber volume | Li et al. (2010); Shi, Zhong, and Wang (2004); Ren et al. (2018); Duan and Shi (2015); |
| Water    | Degradation of water quality | organic matter; chemical oxygen demand; total nitrogen; total phosphorus | Shi, Wu, and He (2002); Qiao et al. (2013); Li et al. (2009); Liu et al. (2009); Kong et al. (2008); Jiang and Huang (1990); Yang, Yang, and Xiao (2007); Feng and Bao (1999) |
| Atmosphere | Decline of atmospheric quality | SO₂; NOₓ; total suspended particulate; | |
| Soil     | Changes of physical and chemical properties; decrease of the amount of soil microorganisms | soil water content; bulk density; soil porosity; integrated soil quality index; soil pH | |

### Environmental management of tourism in PAs

Given the increasingly negative impacts of tourism on the natural environment of PAs, a number of
researchers have called for serious attention to be paid to environmental management of tourism (Jin and Lu 2017). Understanding the characteristics of tourists and the tourism resources of PAs are vital for environmental management of tourism (Ghazvini, Timothy, and Sarmento 2020). Capacity is usually calculated based on resource surveys and assessments (Wu and Liao 2010). A comprehensive evaluation, or evaluation from a certain type or perspective (such as the assessment of recreation value, suitability, and ecological security) are the main contents of resource evaluation (Lei, Yang, and Yin 2015; Wu 2008; Cao, Zhang, and Chen 2007; Zhong, Xiao, and Zhao 2002). Tourists have been analyzed mainly in terms of the relationship between tourist characteristics (such as demographic characteristics, attitude, market segments, and travel behaviors) and environmental impacts (e.g., Cheng and Niu 2016; Huo and Yang 2008). Corresponding strategies and suggestions for appropriate management of the tourism environment have been put forward based on these analyses, such as setting the maximum number of visitors according to environmental capacity.

The most common methods of environmental management of tourism in China’s PAs include zoning, limiting the maximum number of tourists, and the use of pre-tour reservation systems. It has been suggested that all nature reserves should be divided into three zones: core, buffer, and experimental (The State Council 1994). No access is allowed in the core area unless it serves purposes for scientific research at the approval of the nature reserve’s administration. If it is a national nature reserve, the entry into the core area shall be approved by the provincial administrative department. The buffer zone can only be entered for scientific research and observation with the approval of the nature reserve’s administration. Among the three, visitors are only allowed to enter the experimental area. Other types of PAs also have their own forms of zoning (see Table 4 for details). For example, visitors cannot visit specific areas such as the special protected areas of a scenic area, the ecological conservation area of a forest park, or the conservation area of a wetland park. In 2014, the National Tourism Administration of China issued Guideline for Measurement of Carrying Capacity of Scenic Area to guide the maximum number of tourists permitted into scenic areas daily which also applied to some protected areas. In practice, tourists can find out if they are permitted access to a PA through the reservation system. Although there are many other management methods, such as environmental education (Chen et al. 2017) and tourist monitoring (Feng et al. 2010), limiting the number of visitors appears to remain the main strategy for environmental management of tourism in China. Overall, the management of tourists in the PAs of China is often discussed from a manager’s perspective with tourists’ needs largely ignored (Liu and Lu 2016). This may be explained by the fact that PA managers in China may feel greater pressure to meet the rapidly growing demand for tourism in PAs compared to their counterparts in North America or even in densely populated European countries.

There are still some problems in the environmental management of tourism of China’s PAs (e.g., visitors present in the buffer zone of a nature reserve). Hence, an effectiveness evaluation is essential for promoting tourism sustainability in PAs. The evaluation of the effectiveness of environmental management of tourism is usually included in the evaluation of the overall

Table 3. Impacts of tourism on wildlife in PAs.

| Wildlife                        | Impacts                                                                 | PA                                      | References                      |
|---------------------------------|-------------------------------------------------------------------------|-----------------------------------------|---------------------------------|
| Giant panda (Ailuropoda melanoleuca) | Avoidance of roads                                                       | Tangjiahe National Nature Reserve       | Liu et al. 2016                |
| Coot (Fulica atra)               | Time contraction of one – time incubation                                | Anbang River Provincial Nature Reserve  | Cheng 2008                     |
| Golden snub-nosed monkey (Rhinopithecus roxellanae) | Avoidance of roads                                                       | Shennongjia National Nature Reserve     | Li et al. 2015; Zhang et al. 2017; Sun et al. 2010 |
| Tibetan macaque (Macaca thibetana) | The number of individuals in the monkey community is smaller.           | Emeishan National Scenic Area           |                                |
| Macaques/Rhesus macaques        | Decrease in the reproduction rate of rhesus monkeys; increase in the mortality rate of newborn monkeys increased. | Nanwan National Nature Reserve. Zhanjiajie National Nature Reserve | Jiang, Wang, and Liu 1994; Luo et al. 2019 |
| Giant salamander (Andrias davidianus) | Habitat quality decline                                                 | Hengshan National Scenic Area           | Chen, Huang, and Huang 2010    |
| Rat snake (Elaphe carinata)      | The quantity decreased by 91% from 1997 to 2009                         |                                         |                                |

Table 4. Different types of PAs and their zoning in China.

| Type                  | Zoning                                             |
|-----------------------|----------------------------------------------------|
| Nature reserve        | core, buffer, and experimental area                |
| Forest park           | Core landscape area, general recreation area, management service area, ecological conservation area |
| Scenic area           | special protected areas, scenic spots, landscape recreation area, development control areas, tourist service areas, etc. |
| Geopark               | first-class protected area, second-class protected area, third-class protected area |
| Wetland park          | conservation area, rehabilitation and reconstruction area, educational exhibition area, reasonable utilization area, management service area, etc. |
management of PAs. However, the assessment results are not comparable due to the lack of uniform criteria and similar indicators (Tang and Li 2012; Wu et al. 2014; Ma and Bao 2009). According to the evaluation of management effectiveness, some factors were identified as the main constraints on the management and conservation of nature reserves in China. These factors include unreasonable resource protection, insufficient environmental education, and excessive ecotourism (Tang and Li 2012). Wu et al. (2014) established an evaluation indicator system for the construction effect on Xinghu National Wetland Park in Guangdong Province by using the analytic hierarchy process. They showed that the scores of popular science education and community development were higher than those of resource conservation and scientific research monitoring. Yi and Fang (2014) found that coupling the coordination of economic and ecological benefits in Mount Song National Geopark showed a fluctuating upward state, gradually exhibiting a good coupling trajectory based on the analysis of data from 2004 to 2012. The results of Wang, Su, and Huang (2013) showed that a positive interaction and coupling relationship exists between the tourist economy and ecological environment in the forest parks of Shanxi Province.

**Different types of sustainable tourism in PAs**

Ecotourism, low-carbon tourism, responsible tourism, green tourism, and other forms of sustainable tourism have been explored and encouraged to reduce the environmental impacts of tourism activities on PAs in China. Among these, ecotourism and low-carbon tourism have emerged as the main focus of research.

Since the 1980s, increasingly serious environmental problems in PAs caused by tourism have prompted scholars in China to introduce the concept of ecotourism and promote its development (Buckley et al. 2008). The emergence and development of recreation ecology have been accompanied by that of ecotourism. Research on ecotourists, ecotourism resources, education and interpretation, the impacts of ecotourism, and ecotourism management are the main study themes of research on ecotourism in the PAs of China (Cheng and Niu 2016; Zhao and Wang 2015; Li et al. 2014; Ma and Cheng 2008; He et al. 2007). Similar to other countries, minimizing the impacts on the natural environment is a key criterion in the definition of ecotourism in Chinese literature.

Ecotourism has become the most popular model of sustainable tourism in China’s PAs (Zhong, Ma, and Zeng 2016). For example, since the establishment of the ecotourism certification system, 111 PAs have become ecotourism demonstration areas in China. This is slightly different from the trend seen in the West, where ecotourism has been treated as a small-scale and small-group activity. The annual number of tourists to PAs in China is also much higher than that of PAs in the West of comparable size. From an aesthetic and cultural point of view, attitudes in China tend to present a higher tolerance for crowding and the exploitation of natural resources in PAs. However, standards in the West have favored the beauty of wilderness and tend to maintain PAs in a pristine and primeval state (Buckley et al. 2008). This cultural difference is important to understand the concept of ecotourism in China and is one of the important reasons why ecotourism may have negative impacts on the environment within some Chinese PAs.

The concept of low-carbon tourism emerged after ecotourism and sustainable tourism. It is a form of sustainable tourism with greater emphasis on energy savings and emissions reduction, and the innovation of low-carbon technology and the application of clean energy (Tang, Zhong, and Cheng 2011). Research in this area mainly focuses on the evaluation of low-carbon tourism attractions and the factors that influence tourists’ participation in low-carbon tourism (Yang and Wen 2014). Although several evaluation systems for low-carbon tourist attractions have been established (Zhu et al. 2013; Li and Yin 2012), empirical research on specific scenic spots have been relatively limited, and a set of generally accepted evaluation criteria have not been formed. Therefore, the results of such evaluations are not comparable.

**Discussion and implications**

**Comparison of Chinese and western studies**

Although recreation ecology research in China lags behind that in North America, Europe, and Oceania, the three stages of recreation ecology research that China has experienced are similar to those experienced in Western countries (Leung 2012). In addition, similar to the situation in North America, Europe, and Oceania, research regarding recreational impacts on the atmosphere, water, and wildlife are limited in China (Marion et al. 2016). This is particularly true in terms of human–wildlife interactions in China’s PAs.

As previously mentioned, people’s recreational activities may differ from country to country, and thus, recreational impacts on the natural environment and associated recreation ecology research may also vary regionally. For example, whereas the impacts of trail trampling and campsites on vegetation and soil has been extensively investigated in North America, Australia, and Europe, such research is still limited in the context of China (Leung 2012). First, hiking and camping are not as popular in China as in Western countries. Second, trails are usually paved with stone or concrete slates in China’s PAs. As such, impacts from hiking and other recreational activities are largely confined to paved trails.
Other recreational activities that are popular in Western countries, particularly in the USA, include the use of OHVs (off-highway vehicles, e.g., all-terrain vehicles, ATVs), mountain biking, climbing, and horse riding, whose impacts on the biophysical environment including wildlife habitats and behavior, as well as visitors’ recreational experiences, were found to be more serious than hiking and camping. This is particularly true in the case of motorized vehicles (Marion and Olive 2006). Since these activities are not popular in China, research on these topics is rare in the country. However, findings from Western society can be used by China as a reference point from which potential impacts can be anticipated and preemptive measures can be taken. It should be noted that adventurous outdoor activities such as climbing have become increasingly popular among Chinese youths in recent years. This may add an extra burden on the appropriate management of bio-physical resources in China’s PAs.

Compared to North American and European PAs, where experiencing “natural quiet” is considered very important and hence, much research has been conducted in this regard, experiencing quiet areas in PAs appears not to be a policy concern in China. There are two possible explanations for this. First, noise pollution in China’s PAs is not a significant issue as in the USA, where the use of OHVs/ATVs as well as planes flying over a park may “pollute” users’ experience of enjoying the park’s tranquility. Second, Chinese people tend to enjoy being in a crowd more than people from Western countries. This cultural difference may explain why the Chinese are more likely to tolerate noise and crowding than Americans. It is worth noting that the National Park Service of the USA has formed a “Quiet Parks Program” that aims at reducing park-generated noise, whereas there is no such program in China.

Recreation ecology research gaps in China’s PAs

Research has begun to explore the comprehensive assessment of the impacts of tourism on the natural environment in PAs; however, the impact factors and the relationships between recreational use and ecological impacts have not been sufficiently explored. Furthermore, the sources of impacts on Chinese PAs include tourist behavior, tourism infrastructure construction, and local people. The impacts from the last two have been insufficiently explored, given the fact that tourism infrastructure and a large number of residents exist in China’s PAs. Furthermore, due to insufficient funds and inadequate knowledge of statistics, China has failed to establish environmental monitoring systems in PAs from the point of their establishment; there are no long-term monitoring systems on the ecological environment or biodiversity. Lack of baseline data has greatly restricted research on the long-term impacts of tourism. Studies on the impacts of tourism on the natural environment in China’s PAs are still focused on the analysis of current problems. In contrast, comparative studies on the differences in impacts across different PAs or changes in impacts over time are limited.

Regarding environmental management of tourism, Chinese scholars are so far not fully aware that a large number of local communities exist in most PAs in China compared to that of the USA, Canada, and Australia. According to the National Forestry and Grassland Administration, by the end of 2014, 12.56 million people were living in 1,657 nature reserves with clear boundaries. These people can either be sources of environmental impacts or guardians of nature.

Sustainable tourism indicators have been developed by many researchers and organizations (e.g., Asmelash and Kumar 2019; World Tourism; Organization 2004; Miller 2001), yet few have been applied to PAs, especially in China. Ecotourism and low-carbon tourism are generally considered to be effective models with which to reduce the environmental impacts of tourism on Chinese PAs. Nevertheless, their effectiveness in promoting the sustainability of PA tourism in China needs to be assessed.

Implications

Corresponding to these gaps, the areas that need to be addressed in future research are as follows. First, emphasis should be laid on the long-term environmental monitoring of PAs, and the use–response relationship should be explored. It is very urgent that research based on long-term monitoring, both in China and throughout the world, is prioritized (Monz et al. 2010). Research based on long-term monitoring can more clearly show the evolution of the relationship between tourism and ecosystem change. This research can be used to predict trends, and to some extent, can make up for the deficiency of baseline data. Monz, Pickering, and Hadwen (2013) argue that “future research could more directly model the use–response relationship through more sensitive methods of measurement and improved experimental designs.” This argument may also apply to China.

Second, researchers should focus on the environmental impacts of local communities and their special role in the environmental management of tourism in PAs. There are a large number of local communities in most of the PAs in China. The environmental impacts of tourism in PAs partially comes from the interaction of communities and the ecological environment. In addition, residents in or around PAs are the earliest owners of the land; thus, they have a better understanding of the local environment and how it changes, and have an attachment to the place. Using local
ecological wisdom, stirring the enthusiasm of the local community, and exploring community-based environmental management of tourism models are of great importance in promoting local cultural inheritance, community development, and ecological protection of PAs.

Third, attention should be paid to the environmental impacts of infrastructure for tourism as well as emerging tourism activities. Compared with sightseeing, research on the impacts of roads, toilets, and other tourism infrastructure construction is limited. Under the impetus of government policies, traveling by caravans and camping will be the trend of tourism in the future. Researchers should focus on the environmental impacts of constructing caravan parks and campsites, as well as exploring the reasonable scale of construction and the sustainable development of resident vehicle tourism and camping in and around PAs in the future. The regularity of the impacts of the above tourism activities on soil, vegetation, geomorphology, and aquatic organisms require additional attention, and the relationship between the extent of human-made interference and environmental change in PAs also needs to be clarified.

Fourth, research on how the functional zoning of the new PA system in China should be subdivided to facilitate environmental management of tourism. In 2019, the central government of China decided to establish a PA system, including national parks, nature reserves, and nature parks. The first two both have two functional areas – the general control area and the core protected area; the latter has only one functional area – the general control area. This simple zoning is not conducive to visitors and local community management. Therefore, we recommend that future studies explore how to subdivide the general control area, such as subdivided into ecological restoration, reasonable utilization, and management service areas. Nature parks should establish ecological conservation areas uniformly to protect the core protection object. In this case, visitors know exactly where to move in the PA.

Finally, sustainable tourism in PAs should be assessed. Sustainability assessment is an effective way to promote sustainable development, and tourism in PAs is no exception. Identifying the core indicators for PAs is the key to assessing sustainable tourism in PAs, considering that tourism sustainability assessment has been conducted for more than 20 years. Regarding China, attention should be paid to the coordination of the relationship between local community development and ecological protection in PAs.

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