



Impact Assessment and Dynamic Management towards Sustainable Tourism in Antarctica

Shahab Kariminia¹, Sabarinah Sh. Ahmad²,
Rugayah Hashim³, Zulhabri Ismail²

¹ Faculty of Art, Architecture and Urban Planning,
IAU, Najafabad Branch, Isfahan, Iran

² Faculty of Architecture, Planning and Surveying,

³ Faculty of Administrative Science and Policy Studies,
Universiti Teknologi MARA, 40450 Shah Alam, Selangor D. E., Malaysia

sabar643@salam.uitm.edu.my

Abstract

Over the past two decades, Antarctica has experienced a severe eco-environmental degradation due to tourism impacts. The new, diverse and complex tourism activities and technological advancements demonstrate the current regulatory system is insufficient. This study aims to analyse the Antarctic tourism impact, investigate the assessment methods and propose a dynamic management system. This paper suggests two assessment indicators i.e. ATEF and ATECC along with nine management strategies. A flowchart demonstrates the dynamic process of impact analyses, assessment and management. This system can be deployed to design a dynamic regulatory system toward sustainable Antarctic tourism.

Keywords: Antarctic tourism; impact; management; eco-environment.

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1.0 Introduction

As an extreme and desolate region of the earth, Antarctica for centuries has remained relatively pristine due to its harsh physical conditions. However, over the past two decades, this area faced serious eco-environment degradation and tourism risk. Increasing tourism activities often impact negatively on the fragile Antarctic ecosystem. Historically, the late 1950s were the time when the modern era of Antarctic tourism started. Between 1958 and 1987, the average numbers of Antarctic tourists were below 1000. However, between 1993 and 1994, the number of tourists unprecedentedly exceeded the number of scientists (Bastmeijer & Roura, 2004). In 2007-2008, the total number of tourists who travelled to Antarctica was near 35000 (Liggett, McIntosh, Thompson, Gilbert, & Storey, 2011) (Fig.1).

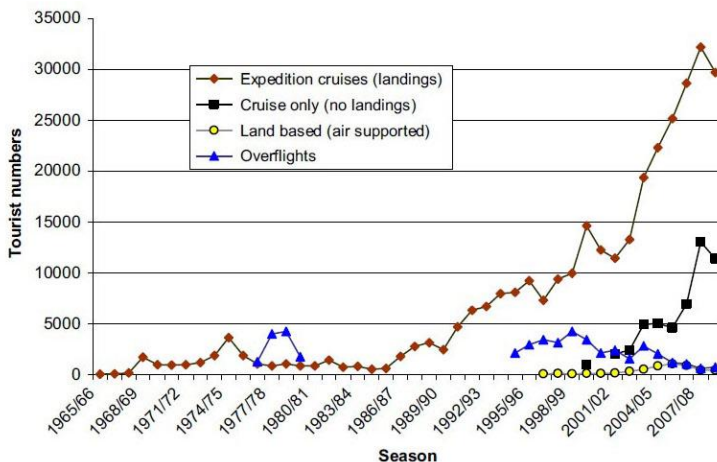


Fig. 1. Estimated numbers of Antarctic tourists in 1965-2009 (Liggett et al., 2011).

Treaties such as the 1991 Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol) formed the environmental standards for the Antarctic Treaty System (ATS). This treaty contains environment impact assessment, fauna and flora conservation, and controls over waste disposal and marine pollution. However, increasing number of academics and parties regarded the Antarctic environment with concern (Bastmeijer & Roura, 2004; Haase, 2005) due to the conflict between Antarctic tourism development and ecological environmental protection. Meanwhile, tourism growth is inevitable and should be anticipated along with improvements to the current regulations.

The literatures categorised Antarctic tourism aspects into three: nature of tourism, activities and impacts; assessment of the impacts through theoretical or empirical methods, and management methods and strategies (Lamers, Haase, & Amelung, 2008). However, there is a limited number of comprehensive and efficient studies which adequately addresses diverse tourism activities, impact and management methods. Furthermore, researchers mostly noted specific aspects such as air/water pollution or decrease in dominant prey and

usually overlook non-polluting ecological effect. They focused on the microscopical impacts, whereas the macroscopical effects had a critical role, as well. Various human and natural parameters inter-connect simultaneously with the ecological system, which is a dynamic, complex system.

This paper aims to develop Antarctic tourism impacts, provides a view on impact assessment tools and proposes practical management strategies. In total, Antarctic tourism impacts can be categorised into three: environment population, non-population effects and interregional diffusion. This study investigated the negative impacts based on three sectors involving the tourism industry, i.e. tourism developers, tourists and the enterprises.

2.0 Literature Review - Analyses of tourism impact

2.1 Tourism developers

Tourism development involves a wide range of activities related to construction and maintenance of facilities such as hotels, resorts, restaurants and scenic area that are provided in any tourism destination. The facilities' construction and maintenance consume energy, generate waste material and affect the surrounding ecosystem. This effect is considerably higher in a pristine environment rather than built areas. However, construction in Antarctic for tourism development is not at a high level (Lu et al., 2011) since Antarctic expeditions are mostly ship-based and visitors only visit ashore for a short duration. Tourism related construction in Antarctica is mostly for the air base stations and the support facilities. In addition to the facilities provided for the national Antarctic programs, the affiliated stations provide the opportunity for the tour operators to facilitate their activities such as airstrips, transport channels and accommodations (Lamers et al., 2008).

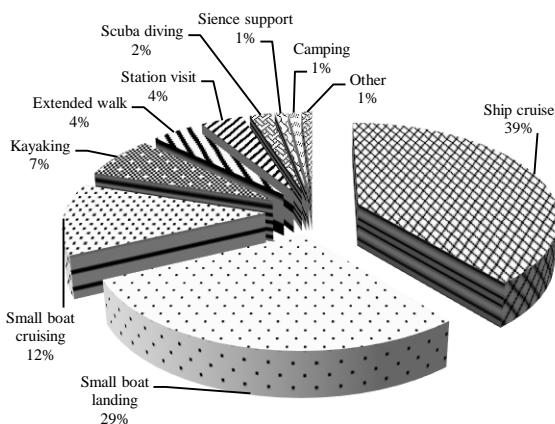


Fig. 2 Distribution of Antarctic tourism activities in 2010-2011 (IAATO, 2011)

2.2 Tourists

Based on International Association of Antarctic Tour Operators (IAATO, 2011) reports, tourism activities in Antarctica could be divided into eight key groups: ship borne expeditions, small boat landing, kayaking, extended walk, station visit, scuba diving, science support and camping (Fig. 2). Tourists are inherently interested in visiting the most picturesque and wildlife-rich areas with vulnerable ecosystem. Table 1 represents environment pressure including polluting, non-polluting and interregional impacts in Antarctic tourism. Major negative impacts of tourist's activities are: site degradation, waste generation, wildlife disturbance, fauna and flora diseases, damage to the ice layers and fresh water consumption. Meanwhile, visitors who travel individually or small parties create a new generation of Antarctic tourists. The potential environment degradation by this group is high since they do not have adequate information about the environment they encounter.

Table 1. Polluting, non-polluting and interregional impact of the three sections involved in Antarctic tourism

Developers	Construction and demolition waste
	Wildlife disturbance
	Damage to ice layers
	Sewage and solid disposal
	Air pollution
Tourists	Aesthetic issues
	Degradation of visiting environment and heritage sites
	Generation rubbish and littering,
	Wildlife disturbance
	Ice-land damages
	Sewage disposal
Enterprises*	Fauna and flora diseases
	Fresh water consumption
	Engine fallout
	Potential of crash
	generation compatible material and conflict with recycling system
	Ice breaking
	Oil spoils
	Wildlife threat by making noise

* Impacts of this section cover the transition area as well (global impact)

2.3 Enterprises

This group contains all the facilities and individuals involved in providing services for tourists. In terms of facilities, large vessels are the highest potential risk. They might encounter a crash, an accident, grounded on uncharted rocks, break the ice lands or pollute the water. Indeed, the cruise traffic around the frequently visited sites, increases environment stresses. Operators prefer to use large vessels since small vessel are not economic enough. Liggett et al. (2011) studied twenty-nine accidents and incidents such as damage, aircraft crash, ship grounding and oil spoil recorded between 1967 and 2003. Amazingly, nearly half of them happened in the last 12 years. Futhermore, airborne travelling creates potential of crash and wildlife disturbance. Despite increasing between 1950s and 1970s, Antarctic air-based tourism has not grown over the recent years. In the past few years, the number of tourists

who frequented this area via flight has steadily declined (Fig. 1). However, the potential of crash and degradation related to air based travels contributes to the concern on Antarctic ecosystem.

3.0 Discussion

3.1 Impact assessment

The impact of anthropogenic activities such as tourism on the environment signals the need for better care and regular assessment using appropriate tools. These tools assist policymakers and environmental enforcers to protect and sustain the environment. Thus, sustainability assessment is currently associated with environmental impact indicator/indices. Indeed, indicators are straightforward and mostly quantitative measures with a wide scope and sensitive to change (Ness, Urbel-Piirsalu, Anderberg, & Olsson, 2007).

Tourism ecological footprint (TEF) is the sum of biological productive land and water resources which produces the consumption and waste of a tourism population (Huiqin & Linchun, 2011). Some researchers applied TEF for time, origin, destination and travelling approach of tourists based on primary and secondary data (Becken, 2002).

Gössling, Hansson, Hörstmeier, and Saggel (2002) presented a different view by dividing the total TEF value into two components: transit-related and destination-related. They included emissions of flight to the category of fossil energy as a potential for climate warming and suggested that airborne tourism should be discouraged. Hunter and Shaw (2007) proposed a 5-step procedure to calculate annual TEF for international tourism on air travel. It estimates flight distance, energy use per tourist, equivalent land area, aircraft radiative emissions and multiplying it by an equivalent factor. They suggested extending the concept of TEF incorporating different methods and transportation approaches to individual source domains based on national TEF data. Data on the resources consumption by tourism products in a given region are then collected.

According to the confirmed regional and global tourism impact, *Antarctic tourism ecological footprint* (ATEF) can assess the environment pressure of tourism in Antarctica. ATEF uses localised monitoring data and individually estimates the different distances, time and travel approaches.

Fragile environments are easily disrupted under influx of visitors. Overcapacity could create substantial, irreversible consequences on an environment. Tourism environmental carrying capacity (TECC) was developed on a concept of the ability of an environment to contain or accommodate people based on their social, economic and environmental status (O'Reilly, 1986). It represents the maximum population who can consume resources of a region without intolerable degradation while keeping the recreational experience at an acceptable level.

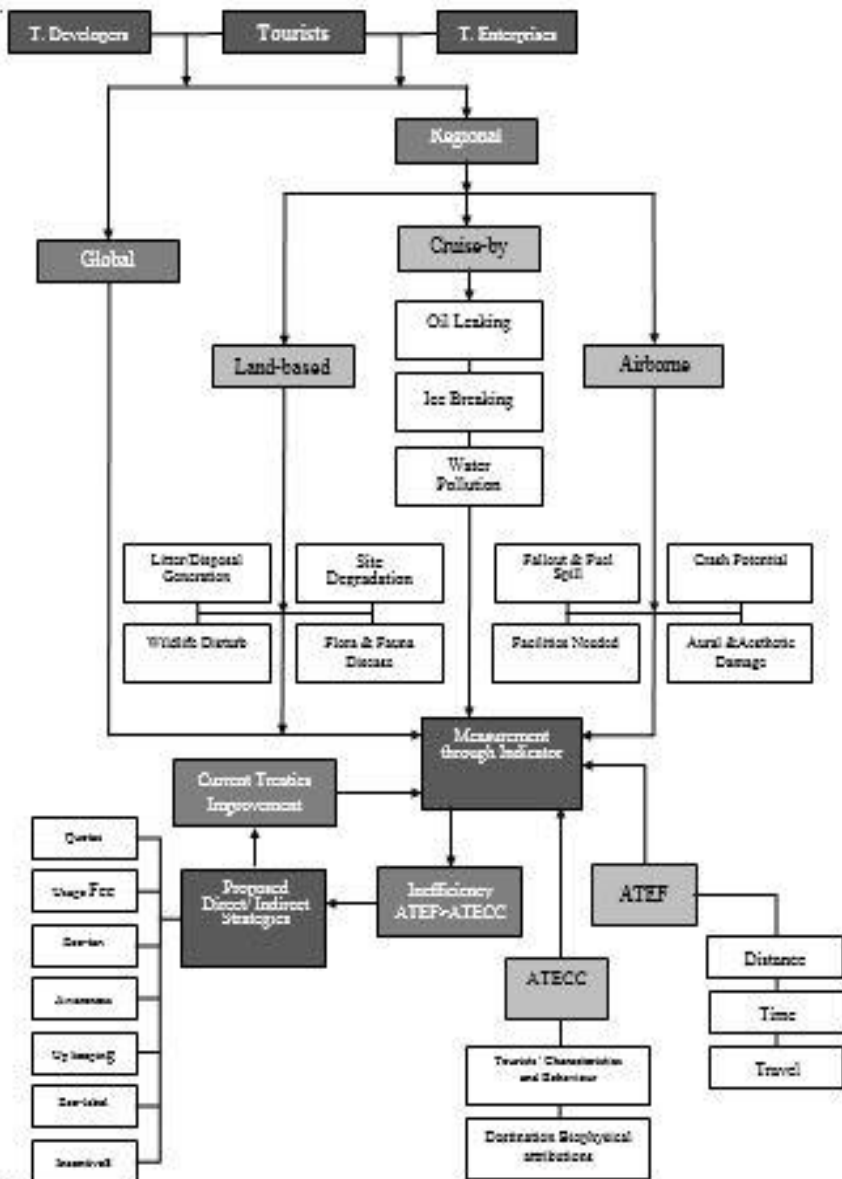


Fig. 3. Antarctic tourism impact, assessment, and management procedure

Hence, to estimate the tolerance of Antarctic environment to contain tourists and related

facilities, a reliable and well-suited tool namely *Antarctic tourism environmental carrying capacity* (ATECC) should be applied. In this case, a well-planned environmental monitoring needs to be conducted. O'Reilly (1986) proposed two aspects that influenced TECC: tourists' characteristics e.g. socioeconomics and forms of behavioural, and destination area characteristics such as natural features, political status and level of tourism development. The TECC should be individually estimated for each case.

For Antarctica region, ATECC can be derived based on a reliable and well-planned data monitoring in terms of the number of tourists, their socioeconomic situations and pattern of activity, current tourism development, available facilities and biological system status. It should be considered that ATEF and ATECC are dynamic measures and responsive to the time and environmental conditions and should be kept updated. Tourism sustainability status can be measured in terms of the tourism footprint and environment carrying capacity correlation (Huiqin & Linchun, 2011). Consequently, once the extent of ATEF exceeds ATECC, tourism status in Antarctica is not sustainable, and the current regulatory system should be improved, and the received impacts need to be managed through appropriate strategies (Fig. 3).

3.2 Management

To manage the tourism environmental pressure, efficient policy instruments including *direct* and *indirect* strategies are required. Basically, direct instruments relate with visitors' behaviour and restrict their choices. They contain enforced guidelines for the public (Needham & Szuster, 2010).

On the other hand, indirect strategies aim to influence tourists' decisions based on their behaviours. Indirect strategies normally contain incentive or education programmes. The design and implementation of the management mechanisms are complicated due to the diverse and complex nature of tourism. Any tourism venture creates environment pressures and impacts. Thus, future tourism might pose new challenge in current Antarctic regulation system.

In the near future, technical advancement, new travelling approaches and additional destinations will soon render current instruments inadequate. The new trends suggest the need for precise prediction, regulations and management strategies. The following section proposes direct and indirect instructions that are appropriate for future management of tourism impact in Antarctica. The strategies should be updated frequently in response to impact assessments results (Fig. 3).

3.2.1 Direct Strategies:

Restrict use (quotas) (Needham & Szuster, 2010): Many researchers have proposed a set limit on the number of visitors (Gössling, 1999). It controls environment overcrowding, enhance visitors experience, raise the quality of destination environment and provide a competition for enterprises to improve their services. The efficiency and benefit of the strategy vary largely with the uniqueness, attractiveness and sensitivity of the visiting place and associated with the carrying capacity of the environment. Related parties can prioritise it. The number of acceptable tourists for a particular area is estimated through the presented

ATECC methods. However, limiting the number of visitors could lead to increased illegal travel to Antarctica. Thus, it should only be implemented once overcrowding occurred.

Zoning: to limit the activity conducted by tourists at individual areas. Zoning is the level of sensitivity of an area including its ecosystem status, tourism history of presence and pattern of activity, and socio economic characteristics of the target population. The updated data have to be collected to classify different environmental status and sensitivity.

Service fee: to manage a particular payment system on the tour operators conducted by related parties. Service fee varies in terms of seasonal tourism dimensions and the operators' economic benefit.

Dynamic eco-taxes: to levy a tax on tourism, which is earmarked for environmental purposes. It is estimated on the attributions of the destination that tourists visit i.e., sensitivity and attractiveness and the time of usage. It can improve the quality and enhance the image of the destination (Logar, 2010).

Site up keeping: related stakeholders should provide an in-situ protection plan. The staffs that accompany the visitors at different sites can conduct site up keeping. They can control over tourists' behaviours during the visit. Rubbish generation, littering, sewage disposal and wildlife disturbance level can decrease under this plan.

3.2.2 Indirect Strategies:

Enhance visitors' awareness: to enhance tourists' awareness of the effects of their activities to the environment and the consequences of this effect on global warming and diseases. All the related stakeholders can participate in this program.

Eco-label: to administer a labelling system on the services and facilities provided for the tourists that are compatible with the ecosystem under the supervision of an impartial organisation. It even covers vessels, construction materials and the products which tourism activities use. Eco-labelling can increase competitions between the operators and enhance their services. It also encourages the illegal operators to register to receive the eco-label.

Financial incentives: to encourage tourists and stakeholders to contribute towards environmental protection through financial incentives. Subsidising certain services, such as registration, encourages illegal operators to register and follow the regulatory system. It includes increasing payment for threatening activities and reducing the payment for neutral activities. Furthermore, the responsible parties can introduce and provide cheaper, environmental friendly equipment for the tourists (Logar, 2010).

The consequences of implementing the strategies vary in different situations for future changes at the site (Needham & Szuster, 2010) and the characteristics of the tourists. The management process has to be under a dynamic plan, to cope with different impacts. Normally, tourists do not favour direct instruments. To evaluate the efficiency of the instruments, their level of acceptance and feasibility of implementation should be analysed.

4.0 Conclusion

To cope with the environmental impact of tourism in Antarctica, a three-step process i.e. impact analysis, assessment and management strategies should be conducted. A well-

planned analysis procedure highlights the potential risk to the ecosystem as a result of tourism activities. Regular impact assessment on stakeholders involved in Antarctic tourism, namely tourism developers, tourists and enterprises must be accomplished. A reliable in-situ data collection needs to be conducted to achieve this aim. A complete procedure of travel including transition areas should be considered for a comprehensive analysis covering regional and interregional impacts.

Antarctic tourism ecological footprint (ATEF) assesses the regional and global aspects of tourism in Antarctica. It varies individually for different distances, time and travel approaches. Antarctic tourism environmental carrying capacity (ATECC) evaluates the ability of an Antarctic environment to accommodate a population. This indicator represents the level of visitors' usage that a region can support. The measure varies in terms of behavioural experiences and biophysical aspects. Environmental sustainability status is not a static value as it depends on tourism development, patterns of tourists' activities and technical enhancements. Hence, a dynamic assessment and management system should monitor the conditions of the environment and the population it contains. This paper proposes nine direct and indirect management strategies namely: quotas, zoning, service fee, eco-tax, site up keeping, awareness enhancement and eco-label. The procedure is useful for policymakers to provide a reliable view of Antarctic environment sustainability in terms of tourism pressure.

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