The Protected Area Visitor Impact Management (PAVIM) Framework: A Simplified Process for Making Management Decisions

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Ecotourism and protected area visitation in Central and South America have resulted in ecological impacts, which some protected areas managers have addressed by employing visitor impact management frameworks. In this paper, we propose the Protected Area Visitor Impact Management (PAVIM) framework as an alternative to carrying capacity and other frameworks such as Limits of Acceptable Change. We use a set of evaluation criteria to compare the relative positive and negative attributes of carrying capacity, other decision-making frameworks and the new framework, within the context of their actual and potential use in Central and South America. Positive attributes of PAVIM include simplicity, flexibility, cost effectiveness, timeliness and incorporating input from stakeholders and local residents. Negative attributes include diminished objectivity and cultural sensitivity issues. Further research and application of PAVIM are recommended.

Introduction

Ecotourism, protected area visitation and related visitor activities are becoming increasingly popular in developing countries, particularly in Central and South America (Boo, 1990; Boyd & Butler, 1996; De Groot, 1983; Fennel & Eagles, 1990). These activities have resulted in ecological impacts to protected areas, such as the Galapagos Islands in Ecuador, Monteverde Cloudforest Reserve in Costa Rica, and Ambergris Caye in Belize (Boo, 1990; Epler-Wood, 1998; Norris, 1994; Wallace, 1994). Additionally, many areas were initially created for resource protection or scientific research, and were therefore not prepared for the unchecked, intensive visitation that has occurred (McNeil, 1996). Because of this visitation, managers must now address undesirable impacts (Ceballos-Lascurain, 1996).

The purpose of this paper is to propose a visitor impact management framework for selected protected areas in Central and South America to assess visitor impact problems and identify management strategies, recognising the constraints affecting developing country protected area management. This framework may also have wider applicability in managing visitation impacts within protected areas of developed countries.

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Visitor impacts and protected area management

Examples of visitor impacts include trail erosion, wildlife disturbance, water pollution, death of coral reef organisms and visitor crowding and conflict (Ceballos-Lascurain, 1996; Hammitt & Cole, 1998; Manning, 1986; Marion & Farrell, 1998; Shelby *et al.*, 1989). Visitor impact problems require management attention for the following reasons:

(1) impacts may compromise protected area resource protection mandates;
(2) many impacts occur rapidly at initial or low levels of use;
(3) some impacts are cumulative, increasingly degrading resources over time; and
(4) impacts may lead to other undesirable consequences such as diminished visitation, economic benefits or resource protection incentives.

Visitor impact management programmes can minimise visitor impacts before costly restoration and rehabilitation programmes become necessary.

According to the International Union for the Conservation of Nature (IUCN), protected areas are created to protect and promote the enjoyment of our natural or cultural heritage, and to maintain biodiversity and/or ecological life support systems (IUCN, 1991). Many countries recognise and actively promote the benefits of allowing visitor access, thus, they face a difficult dilemma of balancing the dual objectives of visitor use and resource protection. These issues can be difficult to address without a framework to structure and guide decision-making (McCool, 1994; McCool & Stankey, 1992).

Additionally, decision-making frameworks can help to better integrate local resource needs and systems of resource management into protected area management. National or state control over resources has often resulted in the disenfranchisement of indigenous people with resource claims, denying their access to natural resources (Gomez-Pompa & Kaus, 1992; Peluso, 1993; Pimbert & Pretty, 1995). These issues are particularly relevant in South America where indigenous populations reside within the majority of protected areas (Amend & Amend, 1992).

Decision-making frameworks and paper objectives

Decision-making frameworks include carrying capacity and alternative frameworks such as Limits of Acceptable Change (LAC) (Stankey *et al.*, 1985; Wagar, 1964) and Visitor Experience and Resource Protection (VERP) (National Parks Service, 1997a; b). Carrying capacity frameworks are simple and inexpensive to implement and have been widely adopted by Central and South American protected areas, yet they have been misapplied in practice and have often failed to minimise visitor impacts (Lindberg & McCool, 1998; Norris, 1994; Wallace, 1994). Conversely, alternative frameworks address carrying capacity deficiencies, but require substantial staffing, funding and time to implement, and therefore may be less feasible for developing countries (Ceballos-Lascurain, 1996; Haurron & Boo, 1995; McCool & Cole, 1997).

In this paper we critique existing frameworks regarding their utility and feasibility for Central and South American protected areas, propose a new simplified decision-making framework and evaluate its positive and negative attributes.

Methods

We combine a literature review with information from nine semi-structured interviews conducted with protected area managers and managing agency representatives in Costa Rica, Belize and Chile. We also present information from a workshop conducted with managers and staff from three protected areas in Mexico. Interviews and workshop participants described current decision-making frameworks, suggested reasons why some frameworks were favoured over others and compared managers' perceptions of frameworks' effectiveness, utility and feasibility. The workshop was conducted in response to a Mexican protected area managing agency (PROFAUNA) request for advice about assessing impacts and selecting management strategies.

The study sites included Monteverde Cloud Forest Reserve, Volcan Poas National Park, Manual Antonio National Park, and Braulio Carrillo National Park in Costa Rica, Hol Chan Marine Reserve, Altun Ha Mayan ruin, and the Community Baboon Sanctuary in Belize, Torres del Paine National Park in Chile and Cuatro Cienegas, Zapaliname and Maderas del Carmen in Mexico. Belize and Costa Rica were chosen because both countries experience significant protected area visitation, are well-known ecotourism destination areas and because studies have been published on carrying capacity applications. Protected areas within these countries were intentionally selected to represent different levels of visitation, access, types of visitor activities, intensity of management and type of managing agency. Torres del Paine was chosen because of management interest in applying LAC. The three areas in Mexico were chosen by PROFAUNA to reflect significant visitor impact problems.

Description and Critique of Decision-Making Frameworks

Description of decision-making frameworks

Decision-making frameworks provide a structure for organising information and thoughts, and can therefore assist protected area managers in making rational and defensible tradeoffs between resource protection and visitor access to these resources. Frameworks incorporate a means of assessing visitor impacts and determining management actions and strategies to minimise or prevent visitor impacts identified as undesirable. Carrying capacity was the first framework used to address these issues.

Carrying capacity

The concept of carrying capacity was adapted from range management and was applied to recreation management in the early 1960s (Wagar, 1964). For the purpose of this paper, it is defined as the amount of visitor-related use an area can support while offering a sustained quality of recreation, based on ecological, social, physical and managerial attributes and conditions (Stankey & McCool, 1990). The focus is on determining the level of use beyond which impacts exceed acceptable levels specified by evaluative standards (Shelby & Heberlein, 1986). Tourism carrying capacity was later expanded to include development issues and economic and socio-cultural effects on host cultures (Inskeep, 1988; Wolters, 1991).

The traditional carrying capacity approach emphasises setting visitor numbers based on mathematical relationships to variables of concern. For example, quotas were set for rafters on the Colorado and Rogue Rivers based on contact preferences (Shelby & Heberlein, 1986). Thus carrying capacity includes both descriptive components (i.e. management parameters like the type and extent of use-related impacts) and evaluative components (i.e. value judgements about the acceptability of different levels of impacts) (Shelby & Heberlein, 1984). The importance of the evaluative component is often underrated or not made explicit, which masks the subjectivity inherent in the carrying capacity process. Experts may both select and evaluate social and ecological impact indicators based on previous experience and other studies. For example, amount of rainfall per season and area of beach per person have been widely applied to assess carrying capacity throughout Costa Rica (Ceballos-Lascurain, 1996).

Alternative decision-making frameworks

Over time, the original carrying capacity concept has evolved into a number of alternative decision-making frameworks. The Limits of Acceptable Change (LAC) framework, developed by the US Forest Service, incorporates transactive planning (based on shared learning and open dialogue between stakeholders) (Graefe *et al.*, 1990; Stankey *et al.*, 1985). Other frameworks include Visitor Impact Management (VIM), developed by the US National Parks and Conservation Association (Graefe *et al.*, 1990), Visitor Experience and Resource Protection (VERP), developed by the US National Park Service (USDI, 1997) and Visitor Activities Management Process (VAMP), a conceptual planning model developed by Parks Canada to address target markets, appropriate recreation activities and park-related facilities (Graham *et al.*, 1988). These frameworks were developed to identify recreation and tourism opportunities, assess human use–impact relationships, provide managers with specific steps to determine acceptable conditions and identify management strategies to achieve desired resource and social conditions. Such frameworks do not discard the concept of carrying capacity, but rather shift emphasis from fixed resource capabilities and amount of use to achieving desired conditions (Stankey *et al.*, 1985). These frameworks provide a more explicit process for accomplishing this task and recognise that standards are value laden.

Alternative decision-making frameworks use a management by objectives approach and are iterative, continuous processes that can also actively involve the public and other stakeholders (Cole & McCool, 1997). Frameworks provide a formal process for specifying prescriptive management objectives that define desired resource and social conditions, and selecting appropriate indicators and standards that reflect those objectives (Figure 1). Objectives and standards often vary by management zone, as determined by existing conditions, resource sensitivity assessments and evaluations of recreational opportunities (Boyd & Butler, 1996; Butler & Waldbrook, 1991, Clark & Stankey, 1979). Monitoring programmes permit periodic comparisons between actual resource and social conditions and numeric indicator standards. If standards are violated, an evaluation of causes and influential factors is conducted to aid in the identification and selection of effective management responses. Monitoring is used to evaluate the success of implemented actions, providing objective data that can justify the use

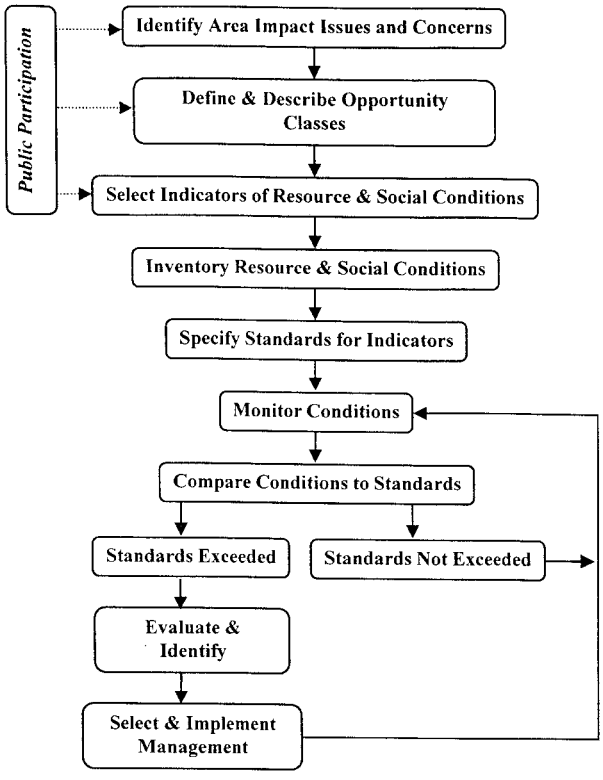

Figure 1 Schematic diagram illustrating LAC, VIM and VERP planning and management frameworks (Adapted from Marion, 1991)

of more restrictive actions. Alternative frameworks do not emphasise use thresholds or restrictions in response to unacceptable levels of visitor impact; but rather view such actions as one of numerous potential responses.

Use of decision-making frameworks in Central and South America

Carrying capacity is the most commonly applied decision-making framework in Central and South America. We speculate that its popularity might be due to its frequent mention in the recreation and tourism literature, attractiveness to protected area managers as a simple means of managing visitation, or its aggressive application in Costa Rica and other destination areas globally recognised for ecotourism. Capacities have already been set for Monteverde, Volcan Poas and Manuel Antonio in Costa Rica. The Protected Areas Tourism Carrying Capacity (PATCC) model has been used in the Galapagos Islands and Costa Rican parks to estimate facility, social and biological capacities, with adjustments for management constraints (Cifuentes, 1992; Haurron & Boo, 1995). Interview information indicated that the Belize Audubon Society (BAS) will soon require protected areas to determine visitor carrying capacities. The BAS is somewhat unique in that it is a non-government organisation with responsibility for managing Belizean National Parks, subject to the authority of the Ministry of Tourism and

the Environment. Conversely, alternative decision-making frameworks have been scarcely applied in Central and South America. In an international 1994 survey of 215 developing country protected areas, less than 10% used LAC and less than 20% used either VIM, VAMP or ROS (Recreation Opportunity Spectrum) (Giongo *et al.*, 1994). Of the areas included in our study, Torres del Paine was the only protected area using an alternative framework. Wallace (1993) and interview subjects suggested that alternative frameworks are not as commonly used in developing countries because protected area managers have fewer financial resources and awareness of newer decision-making frameworks is relatively low.

Critique of existing decision-making frameworks

Criteria were developed to evaluate the various frameworks based on attributes identified as desirable by interview subjects, workshop participants and the literature (Anderson *et al.*, 1998; Furze *et al.*, 1996; Graefe *et al.*, 1990; Haurron & Boo, 1995; Shelby & Heberlein, 1986; Lindberg *et al.*, 1997; Lindberg & McCool, 1998; McCool & Cole, 1997; McCoy *et al.*, 1995; Stankey *et al.*, 1985; USDI, 1997).

This review suggests that an ideal framework would:

(1) be easy, quick, inexpensive and cost-effective to implement;
(2) be able to successfully assess and/or minimise visitor impacts;
(3) consider multiple underlying causes of impacts;
(4) facilitate selection of a variety of management actions;
(5) produce defensible decisions;
(6) separate technical information from value judgements;
(7) encourage public involvement, shared learning, and consensus building; and
(8) incorporate local resource uses and resource management issues.

The critique of carrying capacity, alternative frameworks and the proposed framework is summarised in Table 1.

Positive and negative attributes of carrying capacity

Depending on how it is defined and interpreted, carrying capacity can be simpler, less expensive and more feasible to implement than alternative decision-making frameworks (Haurron & Boo, 1995, Lindberg & McCool, 1998) (*criterion 1*). One interview subject characterised carrying capacity as quick, flexible, based on expert opinion and consistent with current protected area legislation. However, carrying capacity often has been misapplied to set visitor numbers without considering how these numbers meet management objectives, it has sometimes been changed in response to political pressure such as in the Galapagos Islands, and has been set without considering relevant stakeholders (Lindberg & McCool 1998; Wight, 1998) (Table 1).

Carrying capacity numbers often are too simple and based on arbitrary judgements and have therefore sometimes failed to minimise visitor impacts (*criterion 2*). For example, one interview subject at Monteverde indicated that trail capacities of 25 persons per hour had not minimised visitor crowding and conflict. Similarly, another subject at Volcan Poas indicated that carrying capacity numbers at Volcan Poas National Park were set without factoring in biophysical and social impact considerations.

Table 1 Critique of carrying capacity, alternative decision-making frameworks and the proposed framework using criteria developed from interview information and the literature

Evaluation criteria	*Positive (+) and negative (–) attributes*		
	Carrying capacity	*Alternative frameworks*	*Proposed framework*[a]
1. Easy, quick, inexpensive and cost-effective to implement.	+	–	+
2. Able to successfully assess and/or minimise visitor impacts.	–	+	+/–
3. Considers multiple underlying causes of impacts.	–	+	+/–
4. Facilitates selection of a variety of management actions.	–	+	+
5. Produces defensible decisions.	–	+	+
6. Separates technical information from value judgements.	–	+	+
7. Encourages public involvement and shared learning.	–	+	+
8. Incorporates local resource uses and resource management issues.	–	+	+

[a] *+/– indicates both positive and negative evaluation.*

Carrying capacity numbers overemphasise the importance of amount of use and fail to consider other potential underlying causes of impact (Graefe *et al.*, 1990) (*criterion 3*). For a variety of biophysical and social impacts the amount of use is only one factor contributing to impact; the type of use, party size, visitor behaviour, management actions, developer practices and environmental characteristics may be more important (Cole, 1987; Ceballos-Lascurain, 1996). Similarly, visitor experiences are affected not only by the amount of use but also by the type of use, visitor behaviour and level of expertise and expectations (Shelby & Heberlein, 1986).

By focusing on the amount of use, carrying capacity numbers draw attention away from the broader range of management strategies available to resource managers (criterion 4). Managers may overlook more appropriate, effective or less regulatory management actions (Stankey & McCool, 1990). For example, several workshop participants perceived that the only way to protect resources was to restrict use, and did not recognise the value on effectiveness of other actions. Limiting visitation also may unnecessarily restrict visitor freedom, and can be difficult and expensive to implement (Gunn, 1979; Lindberg & McCool, 1998). Use reduction and other heavy-handed visitor restrictions also are perceived as a potential threat to generating tourist income, a high priority for many developing countries (Getz, 1983; Western, 1986).

Carrying capacity limits are difficult to defend and often are exceeded due to pressure for economic gain from visitation (Williams, 1994) (*criterion 5*). Notable

examples include the Galapagos Islands and several Costa Rican parks (Norris, 1994). Similarly, some protected areas may be concerned about the political unfavourability of limiting visitor use. For example, workshop participants indicated that the Mexican government is strongly promoting use of Cuatro Cienegas.

A major limitation is that carrying capacity 'magic numbers' are subjective. However, the subjectivity of setting capacities is often hidden under the guise of scientific objectivity (Stankey & McCool, 1990) (*criterion 6*).

Finally, interview information revealed that carrying capacity implementation has not typically included public participation or involvement, or considered local resource uses and management (*criteria 7 and 8*). Harroun and Boo (1995) suggested that local resource needs have not been considered because carrying capacity has been largely implemented in protected areas that lack inhabitants within their boundaries. However, many protected areas either directly or indirectly support local communities.

In summary, carrying capacity has been oversimplified in practice, places too much emphasis on limiting visitor use when other management parameters could be manipulated, has in some cases failed to successfully minimise visitor impacts and has not actively incorporated public involvement or local resource needs.

Positive and negative attributes of alternative decision-making frameworks

Alternative decision-making frameworks assess visitor impact problems, interpret and consider multiple underlying causes of impacts, provide support for informed, defensible decisions, and coordinate planning, research and monitoring efforts (McCool & Cole, 1997). Unlike carrying capacity, they recognise the complicated nature of visitor impact issues without oversimplifying them and are flexible, continuous and iterative processes identifying salient issues to determine what impacts are acceptable (Borrie *et al.*, 1998; Lindberg *et al.*, 1997; Stankey *et al.*, 1985) (Table 1).

However, experience implementing alternative decision frameworks in developed countries has revealed several potentially formidable barriers, including time constraints, substantial costs, and extensive financial and personnel resource requirements (e.g. employee training and data collection and the need for highly competent protected area planners, meeting facilitators, and technical and scientific experts) (Ceballos-Lascurain, 1996; Haurron & Boo, 1995; McCool & Cole, 1997) (*criterion 1*). Such constraints may represent even greater barriers for developing countries.

Alternative frameworks monitor site conditions, assess management effectiveness, and increase emphasis on zoning to protect more remote or pristine areas, all of which potentially improve managers' ability to assess, manage and minimise visitor impacts (McCool & Cole, 1997) (*criterion 2*).

However, in developed countries, protected area managers have experienced difficulties selecting indicators, specifying standards and implementing monitoring programmes (McCool & Cole, 1997; USDI, 1997). Additionally, insufficient scientific knowledge is available for a variety of visitor impacts, subjective judgements are still required to set standards and management actions have not

always been implemented when standards are exceeded (Hof & Lime, 1997; McCoy *et al.*, 1995; Ritter, 1997; USDI, 1997). Again, access to recreation and tourism researchers familiar with alternative frameworks, monitoring programmes, and other trouble-shooting expertise is likely to be even more problematic in developing countries.

Alternative frameworks address multiple underlying causes of impact, emphasise the understanding of impacts and impact processes, and facilitate selection from a diverse array of management strategies and actions (thereby avoiding an unnecessary emphasis on visitor use restrictions and regulations). (McCool & Cole, 1997) (*criteria 3 and 4*).

Alternative frameworks provide more defensible decisions since the process offers a systematic and cohesive context for making decisions, integrates public involvement and consensus building, and includes monitoring to support management decisions and evaluate the success of implemented actions (McCool, 1994; McCool & Cole, 1997) (*criterion 5*).

Alternative frameworks also attempt to separate technical decisions from value judgements (McCool & Cole, 1997) (*criterion 6*). These frameworks stimulate discussion on how much human induced change is acceptable based on legislative mandates and other factors, clarify trade-offs between competing goals, identify the importance of area resources and values, and explicitly show how human values and judgements are incorporated into decision-making.

Another key component of alternative frameworks is public involvement and the potential to incorporate local resource needs (*criteria 7 and 8*). Currently, no extensive public involvement has occurred in LAC in developing countries, possibly because these countries do not have formal legislation requiring it or because of management reluctance to yield control over decisions (Giongo *et al.*, 1994; Pimbert & Pretty, 1995). Workshop participants indicated that historical relationships between local residents and protected area managing agencies were also important. However, alternative frameworks readily accommodate such participation, which could enhance local influence in decision-making, increase management use of local knowledge and experience, improve relationships between local residents, managing agencies and other stakeholders, and increase local support and compliance with regulations and laws (McCoy *et al.*, 1995; Pimbert & Pretty, 1995; Pretty, 1994).

Justification for developing a new framework

Carrying capacity and alternative frameworks could be adapted to better suit management constraints and needs in both developing and developed country protected areas. Carrying capacity has been difficult to implement in practice, often the product of a questionable series of equations and calculations. It also tends to overemphasise restricting visitor numbers. Alternative frameworks are also problematic; interview subjects and workshop participants stated that constraints on funding, staffing levels and staffing expertise would prevent their full implementation. Also, that developed countries' strict planning guidelines do not conform to the reality of work in developing countries and that greater creativity and input from local experts is needed. Alternative frameworks assume that managing agencies have sufficient funding and personnel, staff skilled in the areas of visitor impact management, monitoring programmes

and data analysis, and require a 5–10 year planning horizon. Park managing agencies in Central and South America are often structured so that the manager making visitor impact management decisions is located in an agency office far from the park. Interviews revealed differences in perceptions about visitor impact problems and appropriate decision-making frameworks between on-the-ground staff and office staff. Other parks are staffed only by three to five people, most of whom lack impact management training. Finally, sharp visitation increases have occurred in many protected areas, creating the need for a relatively fast and adaptable decision-making framework. The obvious compromise is a scaled-down and simplified version of these alternative frameworks.

This new framework would incorporate desirable carrying capacity attributes of simplicity, timeliness, cost effectiveness and consideration of management constraints, with beneficial alternative framework attributes of flexibility, understanding of multiple underlying causes of visitor impacts, defensibility of decisions, and integration of local people into decision-making. Such a framework could be more feasible to implement than alternative frameworks, and recognise developing country protected area management constraints, while providing a logical and defensible decision-making process that includes public input and impact problem analysis.

Proposing the Protected Areas Visitor Impact Management (PAVIM) Framework

The PAVIM Framework

The Protected Areas Visitor Impact Management (PAVIM) framework, like carrying capacity, recognises management constraints, but like LAC, also incorporates impact problem analyses, the flexibility of multiple strategy selection and public involvement. PAVIM identifies management opportunities and visitor impact problems, includes a problem analysis step employing an expert panel to replace indicators, monitoring and standards, and results in the selection, implementation, and evaluation of visitor impact management actions (Figure 2).

Public participation and the expert panel

PAVIM includes public participation and an expert panel because management decisions are ultimately social and political, rather than technical (McCool & Cole, 1997). The 'public' includes local residents, visitors and other stakeholders wanting to participate in decision-making. Public participation is particularly relevant during the first three steps, to identify protected area values and purposes, management objectives and impact problems, and acceptability of impact problems, but can also occur throughout the remainder of the process. The forum depends on the number of people involved and the contentiousness of the issues being considered. Protected area managers play a significant role in developing public participation programmes since they are charged with balancing the needs and interests of visitors and stakeholders with resource protection mandates and management constraints (Ceballos-Lascurain, 1996).

The expert panel works with protected area managers and staff to analyse impact problems, select management actions and assess strategy effectiveness.

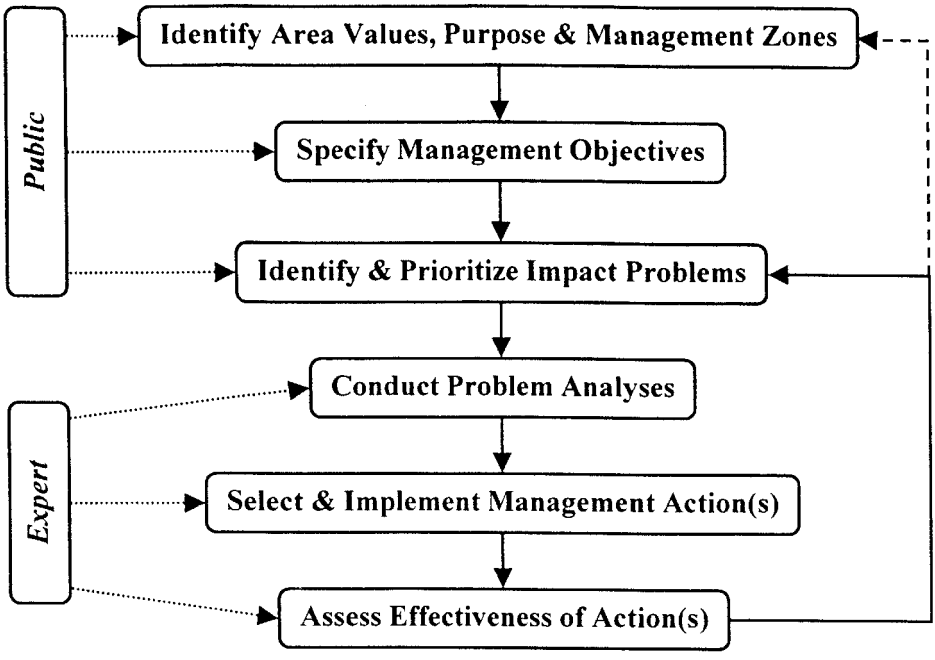

Figure 2 Protected Areas Visitor Impact Management Framework (PAVIM)

The panel is composed of individuals with expertise relevant to the highest priority management problems. For example, impacts identified by an interview subject at Volcan Poas included trail erosion, crowding and illegal hunting and fishing. Therefore, the panel may include persons with social science and visitor impact management backgrounds and individuals knowledgeable about local hunting issues. Experts can include local residents, agency representatives, scientists, non-government organisation staff and other persons of local, national or international origin. Experts differ from the public since they are nominated or otherwise selected by protected area managers for their expertise regarding specific problems. There may be an overlap between the public and experts selected as public representatives.

Similar uses of expert panels have been suggested elsewhere. Lawrence (1992) suggested surveying a panel of experts to select indicators of environmental and social impacts related to tourism. Chamberlain (1997) proposed meetings with representatives from tourism industries, local residents, conservationists, and government officials to guide monitoring projects and assess the effectiveness of carrying capacity decisions. Hof and Lime (1997) suggested forming an expert panel to examine current resources and resource conditions, and work with protected area staff to generate recommendations on indicators and standards, monitoring programmes, and management actions.

PAVIM steps

PAVIM is an iterative, flexible, six-step process in which participants can simultaneously consider the consequences of zoning options, the acceptability of

different impacts, and the implications of selecting various management tactics, all of which have been identified as important decision-making framework attributes (McCool, 1994).

Step 1: Identify area values, purpose and management zones

The intent of this step is to characterise natural, cultural, recreational and other resource values, to describe the protected area purpose and significance and to designate management zones (Figure 2). Issues affecting zoning are discussed, including facilities, access and infrastructure, location of attraction features, resource and social conditions, local community resource uses and other requirements, recreation activities, management intensity, and other economic, political and social considerations. Public input is initiated to develop a common understanding between land managers and the public on the protected area's purpose and management zoning. For example, zoning may be used to separate potentially conflicting types or levels of visitation or to match types or levels of visitation with resource capabilities (Leung & Marion, 1999).

Step 2: Specify management objectives

The intent of Step 2 is to specify management objectives for each zone based on existing legislation, managing agency policies, and stakeholder and management input (Figure 2). This step is explicitly differentiated from Step 1 to emphasise the importance of clearly defining and stating prescriptive management objectives. Objectives must be specific, realistic, achievable, time-bounded, and should reflect compromises between competing resource uses. Desired resource, social and managerial conditions should be characterised and reflected in the objectives identified for each zone. For example, social condition objectives that define desired visitor experiences for zones may be characterised in terms of interaction with park staff, amount or type of visitor use, contact with or proximity to natural environments and level of knowledge, effort or risk needed to experience the area. Greater specificity in these management objectives are needed to support assessments of the acceptability of human impacts and to guide the selection of appropriate management responses. For example, resource objectives specifying desired trail tread conditions can be assessed for degree of compliance, while managerial condition objectives regarding level or type of facility development can guide selection of corrective actions.

Step 3: Identify and prioritise impact problems

The purpose of Step 3 is to identify and prioritise visitor-related impact problems that are judged to violate the desired social, resource and managerial conditions expressed in management objectives for each zone (Figure 2). Problems refer to specific undesirable resource and experiential visitor impacts such as wildlife disturbance, trail erosion, attraction feature degradation, litter, and crowding and visitor conflicts. A range of problems is identified by protected area staff and the public as part of a brainstorming process. A prioritised list is then created in recognition of limited available management resources. The list is based on the types of resources affected, the costs incurred by not addressing the problem, management ability to address the problem, as well as the effects on visitor experiences, local residents and natural and cultural resources. This process is used to determine the relative acceptability of impacts and helps guide the expert panel in analysing those impacts. Priorities can also be assigned using

risk management techniques, which consider the severity, duration, areal extent of impact and vulnerability of the resource affected (Cole & Landres, 1996).

Step 4: Conduct problem analyses

The purpose of Step 4 is to conduct problem analyses involving the expert panel and protected area staff (Figure 2). Panel members are selected on the basis of their knowledge of the impact problems and/or experience in resolving similar problems in other protected areas. The problem analysis includes site visits to view and discuss the impact problems in the context of the site, their evolution over time and the effectiveness of any prior management interventions. Panel members may also identify other impact problems for evaluation and proactive actions. A recommended problem-analysis process is outlined in Table 2. This process emphasises the careful consideration of the causes of impact problems (e.g. inappropriate visitor behaviour) and other influential factors (e.g. fragile vegetation) and the role of facility location, design and maintenance. A thorough understanding of the impact process is critical to the identification of effective management responses. Panel members may also consider available monitoring or research.

Step 5: Select and implement management action(s)

The intent of Step 5 is to select and implement management strategies and tactics to address prioritised visitor impact management problems (Figure 2). The full spectrum of available strategies includes reducing use of the entire area, reducing use of problem areas, changing the location of use within problem areas, changing the timing of use, changing the type of use and visitor behaviour, changing visitor expectations, increasing the resistance of the resource and

Table 2 Problem analysis for managing resource and social impacts related to visitation

Problem analysis steps		
I.	IDENTIFY AND EVALUATE THE PROBLEM	
	A.	Statement of the problem(s): Concise summary describing the primary resource and/or social visitor impact problems.
	B.	Description of problem(s): Brief descriptions of each impact.
	C.	History and context of the problem(s): Summary of how the problem developed, previous management interventions and their effectiveness.
	D.	Causes and influential factors: Causes and influential factors – evaluation of the underlying causes and influential factors that may intensify impacts. Consideration of user-related factors (e.g. type and amount of visitor use, visitor behaviour and use density), environmental factors (e.g. topography, soil and vegetation type) and managerial factors (visitor management and the siting, design, construction and maintenance of facilities).
II.	IDENTIFY AND EVALUATE STRATEGIES AND TACTICS	
	A.	Develop a comprehensive list of appropriate and potentially effective management strategies and tactics for each impact.
	B.	Evaluate the potential effectiveness, management feasibility (cost, staffing, long-term maintenance), costs to visitor freedom-satisfaction and expected visitor compliance for each strategy and tactic.

maintaining or rehabilitating the resource (Cole *et al.*, 1987; Hammitt & Cole, 1998). Tactics are means of achieving strategies, e.g. developing educational messages to encourage low impact visitor behaviors or providing facilities and trails to increase the resistance of the resource (Anderson *et al.*, 1998). A principal advantage of using expert panels to identify and evaluate alternatives is their deeper knowledge of impact processes and of successful management actions employed in other areas.

Alternative strategies are discussed by the panel and protected area staff in generic terms to evaluate their applicability. The appropriateness of any given strategy depends on the management zone and its objectives, management feasibility, public acceptability, potential effectiveness, effects on other impacts and consequences for visitors (Loomis & Graefe, 1992). For example, indirect strategies, like education, tend to be more heavily favoured by visitors when compared to restrictive strategies, like designated site camping (McCool & Christiansen, 1996). Specific management tactics or actions are then identified for implementing each selected strategy. Managers may elect to consult with public representatives before finalising the selection of strategies and tactics. Selected actions are then implemented by managers.

Step 6: Assess effectiveness of action(s)

The purpose of Step 6 is to assess the effectiveness of implemented strategies and tactics (Figure 2). The expert panel and protected area staff review previously implemented management actions and their success in resolving targeted resource or social problems. Costs, such as funding and staffing requirements, and the restrictiveness of the action to visitors, are also evaluated. It may be desirable to involve public representatives in this step to assist with defining the problems and alternative solutions and to gauge public acceptance regarding preferred solutions. Recommendations for continuing or modifying previous actions or switching to alternative actions are then developed. If sufficient funding and staff time is available, managers may elect to conduct visitor impact monitoring surveys (e.g. assessing trail width and depth or recreation site soil exposure and size) (Marion & Leung, 2001; Marion, 1991). Managers can also gather qualitative data (e.g. reports or logs kept by staff documenting specific problems and the success of actions taken to address those problems).

Critique of the PAVIM framework

Like other frameworks, PAVIM is evaluated in terms of the eight desirable criteria identified earlier (Table 1).

Positive and negative attributes of PAVIM

PAVIM is more complex than carrying capacity but is simpler, more flexible, less expensive and faster to implement than alternative frameworks (*criterion 1*). One interview subject indicated that the extensive research, inventories and monitoring studies required by other frameworks were not feasible within their limited budgets. Primary PAVIM costs are related to public participation programmes and the expert panel, though experts may be available locally, and costs may be somewhat defrayed by non-government organisations.

The removal of steps involving indicators, monitoring and standards somewhat limits PAVIM's ability to assess and determine the underlying causes of impacts compared to alternative frameworks (*criteria 2, 3*). Without data, impacts may be incorrectly prioritised, misjudged in severity or magnitude, or other impacts may be neglected. Understandings of impact causes may be insufficient to select effective management actions or to justify their implementation. Additionally, as with other frameworks, managers may only react after degradation has become severe or lack sufficient management direction to act, which may result in resource conditions deteriorating due to unmanaged visitor use (Shindler, 1992).

However, the science required for alternative frameworks is sometimes unavailable or insufficient to assess and manage visitor impacts, does not necessarily assist managers who have to make politically popular decisions and does not remove the need for public and expert judgement to determine what is acceptable (McCool & Cole, 1997). Conversely, the expert panel still utilises quantitative and qualitative data as a decision-making tool, but ultimately relies on professional and personal experience and opinion. Experts are sometimes more objective and independent from managing authorities and are extensively trained. They provide expertise that may be unavailable within managing agencies and are able to apply experience from other areas, disseminate new decision-making and management tools, diagnose and analyse problems, and can be instrumental in finding optimum solutions (Bower, 1982; Canback, 1998).

However, managers also must realise that experts can be biased by thinking appropriate to their background and experience, which may not translate or apply well to situations in other countries or regions. They may also be expensive, unavailable when needed, they may disagree with each other about the nature or significance of problems or how to best address them, or they may be biased or otherwise unable to make informed contributions (Kelley, 1979; Smith, 1994). Therefore, protected area managers need to preferentially recruit experts within the country or region, or at least acquire foreigners familiar with the country and/or managing agency. Alternatively, persons with expertise in local culture and other relevant interpretations of local conditions and impact problems could work with experts in impact assessment and management. Managers may also need to inform experts about pertinent management issues or constraints, convey other crucial contextual information, and moderate panel discussions to facilitate agreement. Ultimately, managers must balance the panel recommendations with other management information regarding implementation constraints and other considerations.

PAVIM, unlike carrying capacity, does not emphasise use thresholds but rather utilises an expert panel to review impacts, evaluate the effectiveness of past management actions, consider an array of alternative measures and recommend a preferred set of potential actions (*criterion 4*). The panel encourages an interactive process and exchange of ideas between scientists and other researchers, local residents and protected area staff. The workshop permitted this open exchange of ideas between scientists, environmental educators and outdoor skills instructors, and protected area managers.

PAVIM's problem-analysis step can generate pertinent management related information and provide justification for implementing certain strategies

(*criterion 5*). An interview subject stated that expert opinion and information often results in greater agency support for management actions.

The PAVIM process, like alternative frameworks, can result in documentation of how impacts were identified and assessed, who was involved in the process, what criteria were used to determine the acceptability of impacts, and why certain management strategies were recommended over others (*criterion 6*).

Compared to carrying capacity, the role of public participation is greatly expanded in PAVIM, and may also better incorporate local resource needs and management systems (*criteria 7 and 8*). Local residents not only participate in public involvement programmes but may also be selected as experts. The public therefore helps to determine the types and amounts of impacts that are acceptable during the impact identification and prioritisation step, with selected public representatives also involved in the problem-analysis step. PAVIM may avoid the historical trend of allowing foreign experts to decide where, when and how much of the natural resources are extracted by local communities without input from local people, and may better incorporate local decision-making and resource management systems into protected area decision-making (Pimbert & Pretty, 1995).

Although guided by public input, the expert panel in the PAVIM process still yields tremendous power over defining what represents an impact, why it is significant, and what should be done about it. However, with the successful integration of public input, PAVIM could also empower local residents, reduce conflict between interest groups, expose multiple perspectives related to natural resource management, improve the quality of decisions, and better incorporate local informal networks and political or social institutions (Davis & Whittington, 1998; Turner, 1999). Managers have the difficult task of achieving this integration and fostering a timely and productive decision process that ensures participation by the public, their staff and the expert panel. The assistance of facilitators or conflict resolution experts may also be necessary, both of which may be available through non-government organisations.

Conclusion

This paper proposed a decision-making framework for protected areas in Chile, Costa Rica, Belize and Mexico to manage visitor related impacts and recommend appropriate management strategies. The Protected Area Visitor Impact Management, or PAVIM, framework provides a professional impact identification and evaluation process, represents cost effective and timely means of managing visitor impacts, and may also better integrate local resource needs and management capabilities and constraints into decision-making. PAVIM permits rapid implementation and management of visitor impact problems, as a form of triage, if necessary, but may also be used to identify management opportunities and prevent visitor impacts, and can be used in combination with pre-existing frameworks like carrying capacity.

PAVIM may be useful for other developing and developed country areas beyond the scope of this study, particularly if they receive substantial visitation, perceive the existence of visitor impact problems and have established means of receiving funding, a clear managing authority and sufficient management

structure and agency support to ensure successful implementation. Other issues such as differing political systems, conflicts between local people and protected area managers, and cultural constraints also influence the potential utility and effectiveness of PAVIM.

As initially conceptualised and applied, PAVIM only addresses visitor impact problems affecting natural resources and visitor experiences. However, PAVIM may also be useful for managing economic and socio-cultural impacts related to visitation and in addressing other specific protected area management issues. For example, an expert panel of local people and tourism businesses could meet with protected area staff to discuss target markets, set management objectives permitting greater economic opportunities, identify barriers to economic earnings, analyse those barriers and brainstorm potential solutions to increase earnings. PAVIM may be employed to solve a variety of clearly specified management issues related to visitation and visitor impacts, but is not intended to address larger planning and management issues such as protected area designation and boundary definition or managing impacts related to infrastructure and visitor facility development.

The primary disadvantage of PAVIM is the loss of impact information and diminished defensibility of management decisions due to the omission of monitoring and clear standards. However, PAVIM can incorporate impact data and information into decision-making, but in a less formal manner, permitting management flexibility and reducing costs. The expert panel can be instrumental in assessing visitor impact problems and proposing potential solutions, relying upon scientific and expert information, as well as the knowledge and experience of protected area staff. The PAVIM process also results in written documentation of problem analyses and management recommendations, guiding management actions and enabling managers to justify decisions.

PAVIM is proposed in this paper as a more desirable option than carrying capacity and alternative frameworks but it has not yet been tested in the field. It would be useful to apply it in a variety of developing and perhaps developed country protected areas, to compare its positive and negative attributes to those identified for carrying capacity and alternative frameworks.

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