Wilderness Planning Using the Limits of Acceptable Change System: A Case Study of the Overnight Caves in the Mlambonja Wilderness Area of the uKhahlamba-Drakensberg Park.

By
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Preface

The research described in this mini-dissertation was carried out at the Centre for Environment and Development, University of KwaZulu-Natal, Pietermaritzburg, under the supervision of Nevil Quinn.

This mini-dissertation represents the original work of the author and has not otherwise been submitted in any form for any degree or diploma at any university. Where use has been made of the work of others it is duly acknowledged in the text.

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Abstract

Human-induced impacts associated with recreational use in wilderness areas have the potential to imperil the wilderness resource and the quality of visitor experiences. One approach to address this problem is the Limits of Acceptable Change System, which helps Protected-area managers determine acceptable levels of resource impacts and social conditions in wilderness areas. This study's objective was to determine the possible applicability of the Limits of Acceptable Change System to the overnight caves in the wilderness areas of the uKhahlamba-Drakensberg Park. Component A of the study discusses the ten steps of the Limits of Acceptable Change system and the management approaches for the wilderness areas and overnight caves in the uKhahlamba-Drakensberg Park. A product of Component A is a procedure manual for inventorying indicators of resource conditions in the overnight caves. During a brief period of field research this procedure manual was applied to four overnight caves in the Mlambonja Wilderness area. Component B of the study summarizes much of the information found in Component A and examines the results from the field research. Recommendations are made to improve the effectiveness of measuring the resource indicators for the overnight caves in the procedure manual. This study's conclusions indicate that the Limits of Acceptable Change System can be applied to the overnight caves and would provide a valid management framework to address visitor impacts.

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Wilderness Planning Using the Limits of Acceptable Change System: A Case Study of the Overnight Caves in the Mlambonja Wilderness Area of the uKhahlamba-Drakensberg Park.

COMPONENT A

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Chapter 1

INTRODUCTION

The uKhahlamba-Drakensberg Park is located in the spectacular Maloti-Drakensberg mountains, which are an inland mountain range approximately 300 kilometres long in the southeastern region of South Africa (Derwent, Porter & Sandwith 2001). The range covers approximately 5,000 km^2 and is characterised by a basalt escarpment wall that rises abruptly from the surrounding plains (Derwent *et al.* 2001). Most of the mountain range is located at high elevations above 3000 meters making them the highest point in Africa south of Kilimanjaro (Derwent *et al.* 2001). In December of 2000 the uKhahlamba-Drakensberg Park was listed as a mixed property World Heritage Site, meeting both natural and cultural criteria (Derwent *et al.* 2001). The World Heritage Convention recognized the uKhahlamba-Drakensberg Park as having a high level of endemic and globally threatened species and of having the largest concentration of and some of the most unique San rock art paintings in Africa, that are of "outstanding universal value" (Derwent *et al.* 2001:9). Variations in climate, geology and geography in the uKhahlamba-Drakensberg Park all contribute to the high level of endemism and biodiversity (Derwent *et al.* 2001). The Afro-Mountain grassland biome located between 1,700 meters and 2,500 meters and the Alti-Mountain biome above 2,500 meters provide habitat for an exceptional level of species that can be found nowhere else (Derwent *et al.* 2001). These two high altitude biomes contain over "2,153 different plant species, 299 bird species, 48 mammal species, 48 species of reptiles and 26 species of frog" (Derwent *et al.* 2001:10). An estimated 51% of the plants are endemic and several of the wildlife species, including the Bearded vulture and the Cape vulture, due to their threatened status, have been listed by the International Union for Conservation of Nature (IUCN) as Red Data species (Derwent *et al.* 2001).

As early as 1903 the uniqueness of the Maloti-Drakensberg Mountains was formally recognized and the Giant's Castle Game Reserve was declared (Derwent *et al.* 2001). Further protection was afforded in 1973 with the establishment of the Mdedelo and Mkhomazi Wilderness Areas and shortly thereafter the Mzimkulu

and Mlambonja Wilderness Areas (Derwent *et al.* 2001). Finally, in 1993 these five areas were consolidated to form the uKhahlamba-Drakensberg Park, which covers approximately 2,428 square kilometres (Derwent *et al.* 2001).

The wilderness areas found in the uKhahlamba-Drakensberg Park are a part of the small percentage of wilderness found in protected areas in South Africa. Wilderness comprises about 2.1% of the existing protected areas in South Africa, while protected areas themselves only constitute about 4.7% of the country (EKZN Wildlife 2003). Furthermore, it is estimated that there is only about 0.1% of the land surface remaining in South Africa that contains wilderness qualities (EKZN Wildlife 2003).

The four wilderness areas; Mdedelo, Mkhomazi, Mzimkulu and Mlambonja, were declared in terms of the 1971 Forest Act to protect the natural communities and the high altitude water catchment areas (Bainbridge 2001). Though the Forest Act does not give explicit details as to how to manage South Africa's wilderness, designated wilderness areas are implicitly managed under objectives derived from the World Conservation Union (IUCN) Guidelines for Protected Area Management Categories (MacDevette 1987). The following list comprises the objectives which guide wilderness management in South Africa (MacDevette 1987):

- Maintain sample ecosystems in a natural state
- Maintain ecological diversity and environment regulation
- Conserve genetic resources
- Conserve watershed condition
- Provide opportunities for resource-based wilderness recreation
- Protect scenic beauty
- Protect sites and objects of cultural, historical and archaeological heritage value
- Stimulate rational, sustainable use of marginal areas and rural development
- Provide for limited sustained use of animal and plant products

Though most of these objectives focus on the preservation of natural resources, the objective to provide for wilderness recreation opportunities has been seen as

an important aspect. It has been recognized that a wilderness recreationist receives personal benefits from wilderness visitation (MacDevette 1990). These benefits range from self-actualisation to skill development and application, and in some instances the healing of the mentally ill (MacDevette 1990). It is also thought that these personal benefits benefit society as a whole in that they increase quality of life with higher production levels at work and less money being spent on physical and mental sicknesses (MacDevette 1990). However, wilderness recreation and its associated impacts often conflicts with the preservation objectives set forth for wilderness areas. As Farrell and Marion (2000:10) point out "even low levels of hiking or camping activity have been shown by research to cause substantial degradation to vegetation and soils". Furthermore, MacDevette (1987:3) states "although visitor usage is relatively low within wilderness areas, plant and animal populations and particularly rare species, may be significantly damaged by visitors. Visitor management is therefore essential".

Visitor management in wilderness areas has been a topic of concern throughout the world, particularly in the United States, where there has been an extensive amount of research undertaken. One of the earliest methods for addressing recreational impacts was "Carrying Capacity", which aimed at discovering the maximum use level an area could tolerate (Manning & Lime 2000). The approach of carrying capacity worked well for curbing resource degradation, however, it did not adequately address visitors' wilderness experience (Manning & Lime 2000). Research discovered that visitors' perception of impacts and crowding varied greatly from one person to another (Manning & Lime 2000).

In 1985 the Limits of Acceptable Change (LAC) System for Wilderness Planning was developed, which differed from the concept of carrying capacity by placing emphasis "on the conditions desired in the area rather than on how much use an area can tolerate" (Stankey, Cole, Lucas, Petersen & Frissell 1985). According to Stankey *et al.,* (1985:398) the LAC System "requires deciding what kind of wilderness conditions are acceptable, then prescribing actions to protect or achieve those conditions".

1.1 RATIONALE AND RESEARCH QUESTIONS

The uKhahlamba-Drakensberg Park, with its vast collection of San rock art paintings and unique biodiversity, is recognized as one of South Africa's, and one of the World's most important protected areas. The Worldwide Fund for Nature (WWF) has even recognized the area as "one of the World's 200 most important ecoregions" (Derwent *et al.* 2001). Besides being an area of significant conservation value, the uKhahalamba-Drakensberg Park is also an important area for outdoor recreation. The area provides visitors with a variety of activities, including fly-fishing, hiking, mountain biking, mountaineering and paragliding (Derwent *et al.* 2001). Another activity enjoyed by many visitors is the camping in caves located in the mountains. These overnight caves, of which there are 58, provide visitors with a unique wilderness experience with views of the surrounding mountains and valleys, and adequate shelter from the weather (http://www.rhino.org.za/) [Accessed 27 January 2003]. Recently, members of Ezemvelo KwaZulu Natal (EKZN) Wildlife, which is the managing agency for the uKhahlamba-Drakensberg Park, have expressed concern that the amount of use the overnight caves are receiving is affecting their wilderness quality (Krueger 2002 *pers. comm.*). EKZN Wildlife personnel have recognized that visitor use in the overnight caves is having significant impacts on the natural resources, including soil erosion, vegetation trampling and unsightly refuse left behind by visitors (Krueger 2002 *pers. comm.*). These impacts are in direct conflict with the IUCN wilderness and EKZN Wildlife's management objectives of ecological preservation and the protection of scenic beauty. To address visitor impacts in the wilderness areas EKZN Wildlife staff under the newly-drafted uKhahlamba-Drakensberg Park Wilderness Management Plan, have proposed implementing the LAC System. As part of an overall LAC System for the wilderness areas, the overnight caves have been selected as one of the specific features that the LAC System would be applied to. The current research that is being proposed will examine the LAC System and its possible application to the overnight caves in the Mlambonja Wilderness Area of the uKhahlamba-Drakensberg Park.

From this rationale for research two critical research questions have been developed, which are:

- Can the LAC System be applied to the management of the overnight caves in the uKhahlamba-Drakensberg Park wilderness areas?
- Are there certain characteristics of the overnight caves that make it difficult or impossible to apply the LAC System?

1.2 RESEARCH AIM AND OBJECTIVES

The aim of this research is to assess the applicability of the LAC System for wilderness planning for the overnight caves in the uKhahlamba-Drakensberg Park and to identify any characteristics of the overnight caves which might influence the application of the LAC System, using four overnight caves in the Mlambonja Wilderness Area as a case study.

The objectives are as follows:

1. To review and describe the ten steps of the LAC System.
2. To describe the application of four of the ten steps of the LAC System process to the overnight caves in the Mlambonja Wilderness of the uKhahlamba-Drakensberg Park.
3. To determine resource indicators for the condition of the overnight caves as step four of the LAC System.
4. To develop a form or procedure manual using the selected resource indicators, and as part of the research the procedure manual will be applied to four overnight caves in the Mlambonja Wilderness.
5. To develop a method for estimating condition classes and an overall level of impact scale, which will be assigned to each overnight cave.
6. To identify any characteristics of the overnight caves that influence or prohibit the application of the LAC System. These characteristics will be determined after the procedure manual has been applied to the four caves in the Mlambonja Wilderness.
7. To draw some general conclusions about the overall applicability of the LAC System to all of the overnight caves in the uKhahlamba-Drakensberg Park.

1.3 LIMITATIONS

This research is to be completed over a six-month period and given this amount of time certain limitations arise. First, the LAC System is a ten-step process, which in previous applications depending on the location took from two to eight years to implement. Therefore, this research will only examine four of the ten steps in the LAC System to determine the applicability to the overnight caves. Though only the first four steps of the LAC System will be examined, insight will be gained about the applicability of the LAC System as a whole, which will direct EKZN Wildlife in the further implementation. More discussion is given to this issue in Chapter 3 Background to the LAC System and Chapter 6 Implementation of the LAC System. Secondly, since the uKhahlamba-Drakensberg Park is such a large area and the overnight caves are spread throughout, it is not possible to examine overnight caves in all regions of the park. So only one wilderness area, the Mlambonja Wilderness in the Cathedral Peak section will be used as a case study area. Finally, with distances between overnight caves in the Mlambonja Wilderness being quite far and having a limited period of time for field research, it is not possible to examine all of the overnight caves. A sample of four of the overnight caves will be directly observed and used as samples in the research. Chapter 2 Research Approach and Methodology outlines this limitation in further detail.

Chapter 2

RESEARCH APPROACH AND METHODOLOGY

This chapter will discuss the research approach and methodology proposed in the research project. For each approach and methodology that will be used a brief description of what they are and how they will be applied will be provided.

The nature of this research is program evaluation or evaluation research (Babbie 1995). According to Monette, Sullivan and DeJong (1990:336) evaluation research involves "the use of scientific research methods to plan intervention programs, to monitor the implementation of new programs and the operation of existing ones, and to determine how effectively programs or clinical practices achieve their goals".

There are three reasons for conducting evaluation research and are listed below (Monette *et al.* 1990:337):

- For administrative purposes- to improve service to clients or to increase efficiency of a program delivery
- To assess the impacts or effects of a program
- To test hypotheses or evaluate approaches

Monette *et al.* (1990:339) also recognize some benefits and potential problems in using evaluation research.

- The results of evaluation research should have immediate practical use
- Decision makers sponsoring the study can shape the form and content of the research
- Evaluation research has a judgmental quality about it
- The results of evaluation research are often not made public

There are two types of evaluation research: formative evaluation research, which aims to provide information of a program and summative evaluation research, which examines a program effects (Monette *et al.* 1990). This research project will be formative evaluation research and will examine the applicability of the LAC

System to the overnight caves in the Mlambonja Wilderness. The information gathered from the research will serve an administrative purpose in that EKZN Wildlife will use it in the development of the Wilderness Management Plan for the uKhahlamba-Drakensberg Park.

2.1 RESEARCH METHODOLOGY

A research approach of two stages will be used for the project. First, a detailed literature review will discuss in detail the LAC System process. All ten steps of the LAC System process will be discussed and recommendations will be provided for EKZN Wildlife on how the LAC System can be implemented. However, only the first four steps of the LAC System will actually be applied to the overnight caves. This is due to the limited timeframe of six months allocated for the research project. Though only the first four steps will be applied to the overnight caves this should determine whether or not the LAC System is applicable to the overnight caves and whether this will make it possible for EKZN Wildlife to implement the LAC System.

The literature review will entail examining documents written by agencies that have applied the LAC System to a wilderness area and research documents that pertain to the LAC System. This part of the research will illustrate how the project fits into the overall concepts of the LAC System and how the LAC System might be applied to the overnight caves. A product of this literature review will be a set of indicators used in assessing the visitor impact levels on the resources in the overnight caves. Once these indicators have been developed and appropriate techniques have been developed for measuring the indicators they will be applied to a form or procedure manual for inventorying the overnight caves. The second stage of the research project will involve field research and the actual implementation of the procedure manual to four overnight caves in the Mlambonja Wilderness Area.

Two methods of field research will be used in the second stage of the research project: the use of a case study and direct observation (Babbie 1995). A case study of four overnight caves in the Mlambonja Wilderness Area will be used. This

case study location was selected using purposeful sampling techniques for several reasons (Maxwell 1998).

First, the Mlambonja Wilderness Area is located in the Cathedral Peak section of the uKhahlamba-Drakensberg Park, and according to a key informant at EKZN Wildlife, receives a considerable amount of visitation as compared to other areas. This is important since the procedure manual will be used to determine impacts on the chosen indicators in four overnight caves, and an area that has been heavily used should have a considerable level of resource impact. Therefore, this will be used as a test to determine if the appropriate indicators have been selected in the procedure manual.

Secondly, in total the Mlambonja Wilderness Area has eight overnight caves (Table 2.2), four of which are relatively easily accessible. These four overnight caves (Xeni Cave, Barker's Chalet, Ribbon Falls Cave and Sherman's Cave) will serve as a representative sample since the characteristics of these four overnight caves that are relevant to the study are quite similar to the other overnight caves (Krueger 2003 *pers.comm.*).

Furthermore, by inventorying four out of the eight overnight caves in the Mlambonja Wilderness Area a multi-site comparison can be developed, which increases the validity of the research (Maxwell 1998). Since the overnight caves vary in size and in the number of visitors who are permitted to overnight in them, this multi-site comparison will help to determine if there are certain characteristics of each individual cave that make it more difficult or impossible to apply the LAC System. Also, case studies and multi-site comparisons have been recognized as being useful in generating "broader policy conclusions" (Platt 1988 cited in Duff 2002:25) and therefore, the inventory of the four overnight caves will be used to conclude whether or not the LAC System is applicable to all of the overnight caves found in the uKhahlamba-Drakensberg Park.

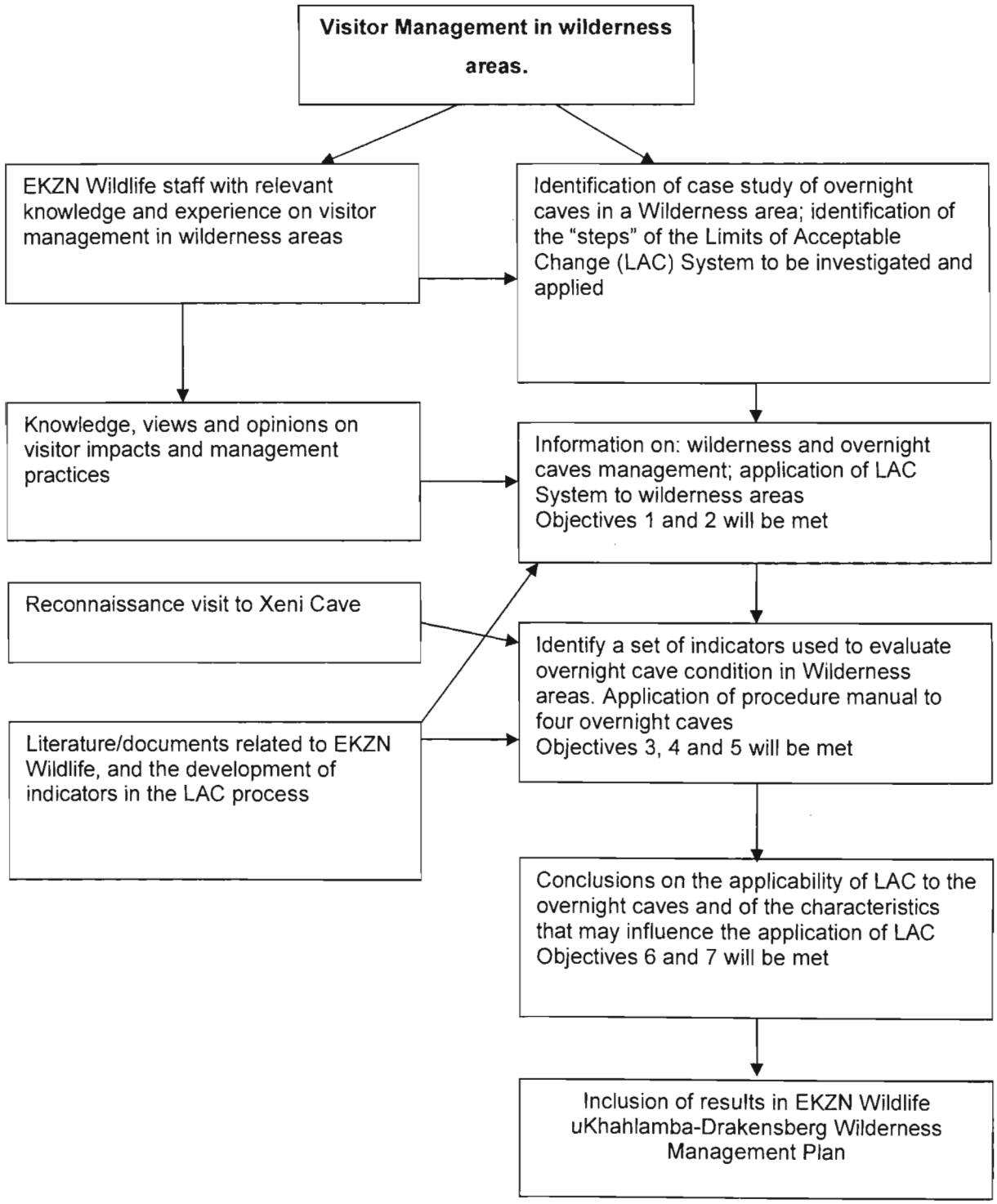
Finally, this area was chosen for financial and transportation reasons. Having an area that is relatively heavily used and contains an adequate sample size of overnight caves, makes travel and expenses more obtainable and manageable.

The application of the procedure manual will involve direct observation of the four selected overnight caves in the Mlambonja Wilderness Area (Neumann 1999). Prior to commencing the field research a reconnaissance visit to one of the selected overnight caves was undertaken. This involved travelling to the Cathedral Peak section, backpacking into the Mlambonja Wilderness Area and spending a night in Xeni Cave. Spending a night in Xeni Cave gave a better understanding of the visitor's experience and it helped to put the case study area into perspective. Xeni Cave, since it is only a short walk in, gets a significant level of use and the impacts of visitors was apparent, this helped to understand the concerns of wilderness degradation the resource managers have (Krueger 2003 *pers. comm.*)

After completing the procedure manual for inventorying the indicators of resource conditions a brief period of field research will be necessary. This field research will require backpacking for approximately seven days into the four selected overnight caves and working through the procedure manual. For safety concerns a colleague will accompany the researcher and will also work through the procedure manual, which will help to assess the appropriateness of the procedure manual. The data obtained from the field research will be in the form of completed procedure manuals and will provide qualitative data that will be used to draw conclusions about the applicability of the LAC System.

Figure 2.1 on the following page is a diagram that represents what concepts and processes will be considered in the research and when each objective will be met during the research process.

Figure 2.1: Conceptual framework for the study



Chapter 3

MANAGEMENT APPROACHES

3.1 WILDERNESS MANAGEMENT

The proposed National Environmental Management: Protected Areas Bill, once promulgated, will provide the first legal definition of wilderness in South Africa:

> "A wilderness area means an area designated for the purpose of retaining an intrinsically wild appearance and character, or capable of being restored to such and which is undeveloped and roadless, without permanent improvements or human habitation" (DEAT 2003:8). Furthermore, "the purpose of designating a wilderness area is for the protection and maintenance of the natural character of the environment, biodiversity, and associated natural and cultural resources, to provide outstanding opportunities for solitude and to strictly control access, which will be by non-mechanized means only" (DEAT 2003:15).

This South African definition of wilderness promotes the protection of the environment and its unique features while providing wilderness recreation opportunities for all South Africans. To gain a further understanding of how this has been accomplished in the past by EKZN Wildlife staff, and how it will be accomplished in the future, this section will examine management policies and practices that apply to the Mlambonja Wilderness Area and to the overnight caves. This will be accomplished by first examining the Cathedral Peak State Forest Management Plan and then examining the newly drafted uKhahlamba-Drakensberg Park Wilderness Management Plan.

3.1.1 Cathedral Peak State Forest Management Plan

The Cathedral Peak section of the uKhahlamba-Drakensberg Park is a State forest and is managed according to the provisions of the Forest Act, Act No.122 of 1984 (Natal Parks Board 1989). The Forest Act provided broad guidelines for the management of State forests; however, to more effectively implement the principles of the Forest Act a policy statement was developed by the Natal Parks Board for the management of the Drakensberg State forests (Natal Parks Board

1989). This policy statement was approved by the Minister of Environment Affairs and Tourism in 1986 and has been "the guiding policy for all management activities in the Drakensberg State forests" (Natal Parks Board 1989: Introduction).

Section 15 of the Forest Act allowed for the creation of nature reserves and wilderness areas (DEAT 1984). However, it was the policy statement that was drafted by the Natal Parks Board and used to develop the Cathedral Peak State Forest Management Plan that has guided the management of the wilderness areas since 1989 (Natal Parks Board 1989).

The Cathedral Peak State Forest Management Plan outlines the primary, secondary and tertiary objectives for the area, which are listed below (Natal Parks Board 1989:2). These general guidelines provided overall management direction, however the Officer in Charge (OiC) determined how each of these objectives was to be met (Natal Parks Board 1989).

Primary objectives:

- Conserve the mountain catchments as a vital water source area, maintain a sustained yield of high quality water
- Conserve the soil mantle, prevent accelerated soil losses and rehabilitate existing eroded areas
- Maintain the mountain ecosystems in their present natural state; conserve existing genetic resources and ecological diversity
- Maintain environmental quality and wilderness character in their largely-unspoiled state
- Promote environmental research and monitoring

Secondary objectives:

- Protect archaeological and cultural heritage sites
- Provide educational opportunities and interpretive services
- Provide opportunities for compatible resource-based outdoor recreation

Tertiary objectives:

- Provide opportunities for, and control, the collection of minor forest produce on a sustained yield basis where and when ecologically acceptable

- Provide opportunities for, and control, trout fishing on a limited basis

Wilderness areas under the Cathedral Peak State Forest Management Plan have been managed as one of four zones; Intensive use zone, Limited use zone, Wilderness area and Special zone (Natal Parks Board 1989). These four zones describe what type of use and how much use will be allowed to occur in which area. For an area to be designated as wilderness by the Minister of Environment Affairs and Tourism it must satisfy the following criteria (Natal Parks Board 1989:3):

- The area must be maintained in a primitive, undeveloped state. No roads, powerlines, etc. or facilities for the comfort of users is permissible
- The area must be large enough to give visitors a feeling of complete isolation
- The ecosystem must be in a natural state, essentially unmodified by man, or capable of being restored to a natural state

To reduce visitor impacts, the Cathedral Peak State Forest Management Plan uses a system of setting limits on visitor numbers. In the Cathedral Peak State Forest Management Plan Chapter 13 titled Visitor Services and Recreation provides a list of objectives to manage visitors in the wilderness area (Natal Parks Board 1989). The following list is a summary of the objectives for visitor management (adapted from Natal Parks Board 1989:41):

- Reduce conflict between wilderness users
- Disperse recreationists throughout the State forest by application of different use zones and better communication
- Provide management guidelines on the limit of the number of people permitted in the State forests
- In overnight sites only one group is permitted per night, regardless of group size with a minimum being two people
- Encounter rate in the wilderness heart zone should not exceed 3 other groups per day
- In the wilderness areas the group size limit is 12 people
- No littering

- Correct methods of human waste disposal must be used
- Limit soil erosions to acceptable levels
- Minimize recreational impact on the vegetation
- Maintain present standards of high water quality

3.1.2 uKhahlamba-Drakensberg Wilderness Management Plan

Recently, in March of 2003, EKZN Wildlife staff completed and released a draft version of the uKhahlamba-Drakensberg Park (UDP) Wilderness Management Plan, which is to be the future guiding policy for all of the wilderness areas in the uKhahlamba-Drakensberg Park. This section will examine how the wilderness areas will be managed under the UDP Wilderness Management Plan, and will explain how the management objectives and techniques differ between the two management plans.

The following list is the sixteen principles of wilderness management found in the UDP Wilderness Management (EKZN Wildlife 2003). These principles, which are similar to the objectives found in the Cathedral Peak State Forest Management Plan, have been developed to direct management objectives and to ensure that the wilderness element of the park is maintained (EKZN Wildlife 2003).

- Manage wilderness as a distinct resource with inseparable parts
- Manage the use of other resources and activities within wilderness in a manner compatible with the wilderness resource
- Produce human values and benefits while preserving the wilderness character
- Favour wilderness-dependent activities when managing wilderness use
- Remove the sight, sound, and other tangible evidence of motorized equipment or mechanical transport within wilderness
- Allow natural processes to operate freely within wilderness
- Preserve highest quality wilderness air and water
- Preserve opportunities for solitude and a primitive and unconfined recreation experience in each wilderness
- Control and reduce the adverse physical and social impacts of human use in wilderness through education or minimum regulation

- Attain the highest level of purity in wilderness character within legal constraints
- Remove existing structures and terminate those uses and activities not essential to wilderness management or recreation
- Accomplish necessary wilderness management work with the "minimum tool"
- Establish specific management objectives, in a plan, for each wilderness
- Harmonize wilderness and adjacent land management activities
- Manage wilderness with interdisciplinary scientific skills
- Monitor wilderness conditions and recreation opportunities as a key to long-term wilderness management

In the list of objectives and principles in the Cathedral Peak State Forest Management Plan and the UDP Wilderness Management Plan, two broad management goals can be extrapolated: the conservation of the natural resources; and the provision of recreational opportunities. In the Cathedral Peak State Forest Management Plan the water, soil, mountain ecosystems and wilderness character are to be conserved, while providing recreational opportunities. While the UDP Wilderness Management Plan is very similar, in that it promotes the preservation of air, water, the wilderness character and solitude, while providing wilderness recreational opportunities. It is these two management goals, preservation of resources and providing recreational opportunities that often conflict, and that the LAC System attempts to resolve.

Whereas wilderness areas are managed as an entire zone under the Cathedral Peak State Forest Management Plan, the UDP Wilderness Management Plan uses the Recreational Opportunity Spectrum (ROS) to divide wilderness areas into opportunity classes (EKZN Wildlife 2003). The ROS was developed in the United States and is divided into six opportunity classes based on the activity, setting, and experiences that are provided or found in the area (EKZN Wildlife 2003). The six opportunity classes are; Pristine, Primitive, Semi-primitive, Semi-primitive motorized, Roaded natural and Rural. ROS classes are defined along a

continuum with the least impacted, unmodified being Pristine to the most impacted and modified being Rural.

Table 3.1 shows the six ROS classes and the setting indicators for each class that will be used by EKZN Wildlife staff to designate an area to an ROS Class.

Table 3.1: ROS classes (EKZN Wildlife 2003).

ROS class	Setting Indicators		
	Activity	**Physical Setting**	**Visitor Experiences**
Pristine	Hiking on un-demarcated routes, no impact camping, no fires, mountain climbing.	Unmodified natural environment, no motorized use, no evidence of human control, no sight or sound of man.	Total isolation from sights and sounds of humans, high degree of challenge and risk.
Primitive	Hiking on demarcated routes, tent camping on non-permanent sites, no fires, mountain climbing.	Essentially unmodified environment, no motorized use, no evidence of human control, sites of man in distance.	High probability of isolation, high degree of challenge and risk.
Semi-Primitive	Use of regular routes, no fires, camping, mountain climbing.	Predominately natural or natural appearing, evidence of human control, impact of adjacent land use evident.	High probability of isolation, closeness to nature, tranquility, self-reliance.
Motorized	4x4 motorized use on trails, mountain climbing.	Predominately natural or natural appearing, evidence of other users, administrative facilities and structures.	Low probability of isolation, closeness to nature.
Roaded Natural	Game viewing, picnicing, self guided trails.	Tar roads, camp nodes, administrative infrastructure.	Contact with other users, nature based experience.
Rural	Resort type development.	Permanent developments for recreation or administrative purposes.	Resort type experience.

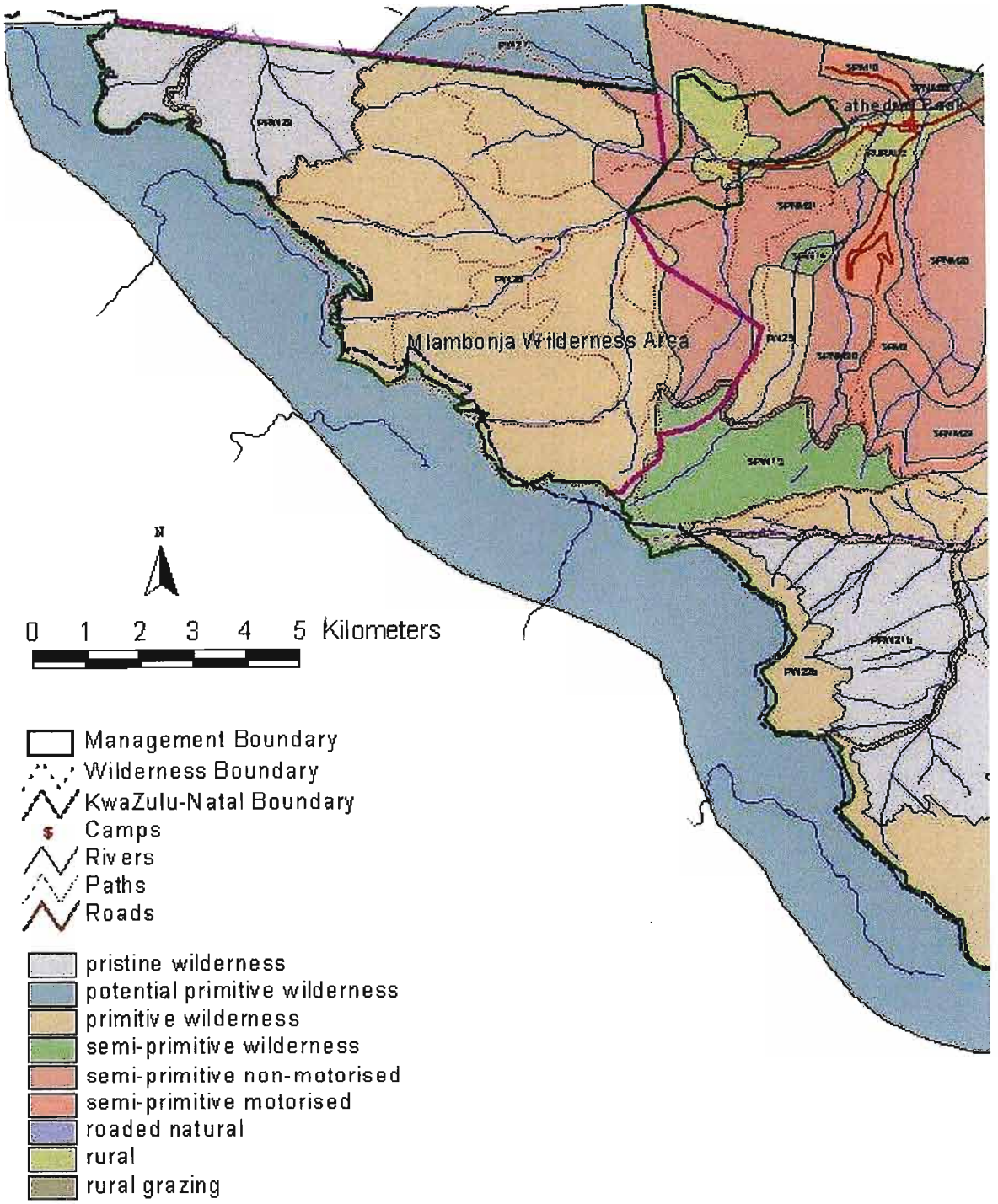
The Mlambonja Wilderness Area has been divided into three ROS opportunity classes under the UDP Wilderness Management Plan: Pristine, Primitive and Semi-primitive non-motorised (EKZN Wildlife 2003). All three of these opportunity classes share several things in common. First, no motorized use is permitted in any of these areas (EKZN Wildlife 2003). Second, only wilderness-related recreational activities such as, backpacking, hiking, mountain climbing and horseback riding, are allowed to occur in these areas (EKZN Wildlife 2003). Finally, in all three of these areas the "minimum tool" concept is applied in management actions, this means that only the minimum tools, equipment, force, regulations, devices, and practices will be applied to accomplish the desired result (Leung & Marion 2000).

The Pristine portion of the Mlambonja Wilderness is the purest form of wilderness possible under ROS with no visual evidence of man's effects on the environment and absolutely no sight or sound of man (EKZN Wildlife 2003). In summary, this area is an unmodified natural environment in which visitors travel on un-demarcated routes and have no contacts with other groups and experience a high level of solitude and isolation (EKZN Wildlife 2003). Management of this area is at the minimal possible level with only the absolute necessary occurring such as, emergency aircraft landings, controlled burning for ecological reasons and law enforcement only occurring on foot or horseback (EKZN Wildlife 2003).

The Primitive portion of the Mlambonja Wilderness Area, which makes up the majority of the area is "characterised by having no evidence of past or present human manipulation of the immediate ecosystem and landscape, although views of human habitation etc. are visible in the distance (i.e. more than 10 km away)" (EKZN Wildlife 2003:18). The Primitive area is very similar to the Pristine area in that it is an essentially unmodified area where visitors have a high probability of experiencing isolation and solitude (EKZN Wildlife 2003). However, visitors primarily travel on demarcated routes and there is a possibility of visitors seeing or hearing signs of civilization (EKZN Wildlife 2003).

Finally, the Semi-primitive non-motorised section of the Mlambonja Wilderness Area can be characterised as a natural area where the past manipulation of man, such as old tracks and settlements, are present (EKZN Wildlife 2003). Essentially, this area acts as a buffer between the Primitive section of wilderness and the Semi-Primitive Roaded and Roaded Natural areas (EZKN Wildlife 2003). Visitors can expect a high probability of experiencing solitude, however, the evidence of other users is present (EKZN Wildlife 2003). Figure 3.2 is a map that shows the proposed ROS classes in the Cathedral Peak section, including the Mlambonja Wilderness Area.

Figure 3.2: Proposed ROS classes (EKZN Wildlife 2003).



To limit and reduce visitor impacts in the wilderness areas the UDP Wilderness Management Plan focuses on visitor education and the use of the "Leave No Trace"

(LNT) principles of outdoor ethics (EKZN Wildlife 2003). LNT is a minimum-impact education program which consists of seven principles "that focuses on camping behaviour and stresses resource impacts and social impacts on other visitors' experiences" (Hendee & Dawson 2002:484). The resource impacts that are

addressed in LNT are litter, vegetation trampling, campfires and soil compaction and the social impacts that are addressed are group solitude experiences, human noise, party size and trail etiquette (Hendee & Dawson 2002). The following list is an abbreviated version of the basic principles of the LNT program (Hendee & Dawson 2002:484):

- Plan ahead and prepare for your wilderness trip
- Travel and camp on durable surfaces
- Dispose of waste properly
- Leave what you find
- Minimize campfire impacts
- Respect wildlife
- Be considerate of other visitors

The two management plans share similar goals in terms of limiting visitor impacts in the wilderness areas. Both plans focus on limiting soil erosion, vegetation trampling, litter, and social impacts between groups, however the plans differ in their management approaches. The Cathedral Peak State Forest Management Plan puts more emphasis on limiting visitor numbers and group sizes whereas the UDP Wilderness Management Plan emphasizes the use of a public education system (LNT) to alter visitor's behaviour.

Finally, to address impacts caused by visitors the UDP Wilderness Management Plan emphasizes the use of the LAC System (EKZN Wildlife 2003). According to the UDP Wilderness Management Plan the LAC System will be applied to paths, roads, caves, toilet areas, peripheral development, roads and tracks and reclaimed sites (EKZN Wildlife 2003). While the activities that will be monitored in the LAC System are horse use, hiking, camping, mountaineering/climbing, fishing, flying, research and monitoring and harvesting (EKZN Wildlife 2003). The use of the LAC System will provide EKZN Wildlife with an explicit procedure to make management decisions with regards to visitor impacts in the wilderness areas (Stankey *et al.* 1985). This will be an improvement since the Cathedral Peak State Forest Management did not provide any actual method for addressing visitor impacts other than the mention of monitoring soil erosion and vegetation trampling

to make sure they were not being excessively degraded (Natal Parks Board 1989).

3.2 CAVE MANAGEMENT

Caves often contain important ecological, evolutionary, and mineralogical resources: including, habitats for endernic, rare and endangered species of flora and fauna, sources of rare minerals, groundwater resources, and sites of religious, spiritual and cultural importance (Huppert & Wheeler 1987). In many countries specific legislation and management techniques have been established to protect the important resources found in caves. In the uKhahlamba-Drakensberg Park many caves contain San rock art and are subject to specific management procedures. Access to most San rock art sites is limited and visitors are required to hire a guide (Natal Parks Board 1989). Overnight camping is prohibited in caves containing San rock art (Natal Parks Board 1989). Also, photographs and periodic examinations are used to determine if any natural or human inflicted damage is occurring (Natal Parks Board 1989).

The 58 caves that are designated campsites for visitors in the uKhahlamba-Drakensberg Park differ from the San rock art sites and those caves found in other locations that contain unique or important resources. The Natal Parks Board acknowledged that the overnight caves "have a high resistance to biological degradation" since there are no fragile ecosystems that can be damaged (1989:45). In some locations similar features are referred to as shelter bluff sites rather than caves and are not managed according to any specific legislation or management procedures (McEwen, Cole & Simon 1996). Since the overnight caves contain no unique or important natural and cultural resources no further discussion will be provided on legislation or management procedures for caves that have been adopted in other locations.

The Mlambonja Wilderness Area contains eight overnight caves that have been managed according to the objectives found in the Cathedral Peak State Forest Management Plan. This section will examine how the overnight caves have been managed under the Cathedral Peak State Forest Management Plan and will

provide an examination of how the overnight caves will be managed under the UDP Wilderness Management Plan.

The primary management strategy that is used to prevent resource degradation and to provide visitors with a quality wilderness experience when visiting the overnight caves is through the use of a permit system (Natal Parks Board 1989). The permit system requires that visitors book an overnight cave in advance and only one group can book an overnight cave at a time (Natal Parks Board 1989). The maximum number of individuals permitted in an overnight cave is twelve, however, this varies depending on the size of the cave (EKZN Wildlife 2001). Table 3.3 shows the overnight caves that are located in the Mlambonja Wilderness Area and the maximum number of individuals allowed to stay in each (EKZN Wildlife 2001). Also, bookings of the overnight caves must be done directly through the EKZN Wildlife station that manages the area, so that adverse visitor impacts can be dealt with immediately (EKZN Wildlife 2001).

Table 3.3: Overnight caves found in the Mlambonja Wilderness Area (Margeot & Forbes 1997).

Name of cave	Maximum number in group
Twins Cave	12
Xeni Cave	12
Sherman's Cave	10
Outerhorn Cave	10
Ribbon Falls Cave	6
Barker's Chalet	5
Bell Cave	5

When using the overnight caves visitors are required to follow several rules that help to limit resource degradation. First, any item that is brought into the wilderness areas, including the overnight caves, is required to be taken out; this

includes candle wax and any litter (EKZN Wildlife 2001). Secondly, no fires are permitted in the overnight caves and visitors are therefore required to use gas camp stoves (EKZN Wildlife 2001). Also, a limited amount of bedding from the surrounding grasses is permitted as long as no trees, shrubs, bushes or forbs are destroyed in obtaining the material (EKZN Wildlife 2003). Finally, visitors are required to relieve themselves at least a five minute walk from any cave, water source, campsite or forested area to prevent contamination (EKZN Wildlife 2001). In the future the UDP Wilderness Management Plan through using the principles of LNT will promote more methods of lessening visitors impacts, however, this is still in the development stage and its is not known what they will be.

In order to determine if the wilderness qualities of the overnight caves is being degraded, monitoring of the natural resources is undertaken. According to the Cathedral Peak State Forest Management Plan, veld condition and footpaths are "carefully monitored" (1989:43) Vegetation around the overnight caves is also monitored on a regular basis (Natal Parks Board 1989). If it is determined through the monitoring that excessive soil erosion occurs or "if the vegetation shows signs of undue stress" the overnight caves will be closed temporarily to allow for recovery (Natal Parks Board 1989:43).

As mentioned previously, under the UDP Wilderness Management Plan the overnight caves will be monitored and managed using the LAC System (EKZN Wildlife 2003). In the LAC System a more explicit procedure for measuring visitor impacts in the overnight caves and determining when and what type management action should occur will be developed.

Chapter 4

BACKGROUND TO THE LAC SYSTEM

As mentioned in the introduction, the LAC System was developed in 1985 to address visitor impacts in wilderness areas (Stankey *et al.* 1985). In the United States, increasing visitation to wilderness areas was resulting in resource degradation, and maintaining wilderness qualities was becoming more difficult (Stankey *et al.* 1985). Protected area managers were confronted with the dilemma of how to provide visitors with wilderness access while protecting the wilderness qualities (Stankey *et al.* 1985). The LAC System aims at resolving this conflict between environmental protection and recreational access by focusing on what conditions are desired in a wilderness area and developing management methods to achieve those conditions (McCool & Cole 1998).

There are four main components of the LAC System (Stankey *et al.* 1985):

- The specification of acceptable and achievable resource and social conditions, defined by a series of measurable parameters
- An analysis of the relationship between existing conditions and those judged acceptable
- Identification of management actions necessary to achieve those preferred conditions
- A program of monitoring and evaluation of management effectiveness

In order to facilitate the application of the LAC System these four components were broken down into nine interrelated steps (Stankey *et al.* 1985). However, after the LAC System had been implemented in numerous locations it was recognized that some modifications were needed (McCool & Cole 1998).

Cole and McCool (1998a) recognized that the LAC System, as it was originally formulated, focused on issues more than goals and desired conditions. Therefore, the addition of a new first step was suggested: one that defined the goals and desired conditions for the wilderness area (Cole & McCool 1998a). Furthermore, Cole and McCool (1998a) suggested some terminology changes and some

clarifications of concepts to increase implementation effectiveness. The following list is the original LAC System developed by Stankey *et al.* (1985) with the proposed modifications and clarifications of Cole and McCool (1998a).

- Define goals
- Identify area concerns, issues, and threats
- Define and describe prescriptive management zones
- Select indicators of resource and social conditions
- Inventory resource and social conditions
- Specify standards for resource and social indicators
- Identify alternative opportunity class allocations
- Identify management actions for each alternative
- Evaluation and selection of an alternative
- Implement actions and monitor conditions

A further discussion of the LAC System steps and their application will be provided in Chapters 5 and 6.

Since its development, the LAC System has been used in a variety of settings to address the biophysical and social impacts of recreation (Manning & Lime 2000). Protected-area managers have used the LAC System to address such issues as; conflict between user groups, crowding in wilderness areas, and resource impacts at campsites (Manning & Lime 2000). Several other countries have developed frameworks based on the LAC concept including, Parks Canada's Visitor Activity Management Process (VAMP) and Australia's Tourism Optimisation Management Model (TOMM) (Manning & Lime 2000). However, according to the available literature it appears that the LAC System has not been applied in KwaZulu Natal or South Africa. According to Cole and McCool (1998b:71), the LAC System is not only useful in addressing recreation issues in protected areas, but in many instances it can be applied to "issues other than recreation management and in places other than protected areas"

Past applications of the LAC System have shown it to be useful in addressing conflicts in diverse situations and locations, however managers have experienced some difficulties in its implementation. The following two sections will examine some of the benefits and barriers protected-area managers have experienced in

implementing the LAC System. The information used in the two sections was obtained from the work of McCool and Cole (1998) that summarised the dialogue that occurred at a workshop of protected area managers who have experience with implementing the LAC System or a similar process.

4.1 RECOGNIZED BENEFITS OF IMPLEMENTING THE LAC SYSTEM

Though the LAC System has often been recognized as a difficult process to undertake, protected-area managers have recognized several benefits that have made it a worthwhile venture. As McCool and Cole (1998:73) point out decisions in protected area planning occur in "highly politicised and charged settings", which results in decisions being thoroughly scrutinized and often difficult to make. This is attributed to the fact that many protected areas cover large tracts of land and are viewed and used in various capacities resulting in differing beliefs and biases involved in the decision making process (McCool & Cole 1998). Also, trust between managers and stakeholders is often an underlying issue that complicates decisions (McCool & Cole 1998). The LAC System helps to reduce these difficulties by providing a clear sequence of steps to be taken and a rationale for each management decision made (McCool & Cole 1998). The research by McCool and Cole (1998) observed that the sequence of interrelated steps in the LAC System provide an explicit procedure for decision making, which reduces implicit subjectivity. Essentially, for every management decision made using the LAC System there is a traceable procedure, which provides the opportunity for feedback and clearly informs stakeholders of how and why each decision was made (McCool & Cole 1998). This not only enables managers to defend their decisions more sufficiently, it also allows managers the option of modifying decisions (McCool & Cole 1998).

The LAC System also recognizes that there is diversity in the biophysical and social conditions in each protected area (McCool & Cole 1998). The third step in the LAC System, which requires allocating prescriptive management zones to each area, allows managers to manage an area for a variety of conditions (McCool & Cole 1998). In a protected area there may be some places that are pristine, while other places in the same protected area might receive a considerable amount of use and the resources might be impacted. By using the

LAC System managers are able to implement actions to achieve or maintain different conditions in a protected area (Stankey *et al.* 1985). This helps to achieve a balance between recreational access and resource protection by allocating some areas for recreation and other areas for preservation.

Finally, the LAC System, by requiring managers to compromise between two conflicting goals, makes the cost of wilderness management explicit (McCool & Cole 1998). Financial, social and economic costs are more visible since management actions are identified that leads to reductions in recreational access or unacceptable conditions (McCool & Cole 1998). The discussion of how much the constraining goal will be compromised leads to the development of management actions and from these actions questions involving equity issues arise (McCool & Cole 1998). Such questions as: who or what user group will bear the costs of these management actions? And is there a relationship between impacts caused and costs? (McCool & Cole 1998). These equity issues all relate to some kind of cost, financial, social or economic, and are revealed in the LAC System by examining the consequences of alternatives (McCool & Cole 1998). McCool and Cole (1998:74) explain, "this allows planners and the publics to understand not only the efficiency of management actions, but their distributional effects as well".

4.2 RECOGNIZED BARRIERS TO IMPLEMENTING THE LAC SYSTEM

The LAC System has often been criticized for being too complex and too lengthy a process to implement effectively (McCool & Cole 1998). This section will discuss some of the barriers that protected area managers have recognized in previous attempts at implementing the LAC System.

According to McCool and Cole (1998) many protected-area managers in the United States have expressed that they are being required to implement programs without enough funding to do a quality job. Declining budgets, government downsizing and the privatisation of some functions are increasing in the protected area context, which is resulting in personnel being required to do more tasks with less resources (McCool & Cole 1998). This further results in numerous other

problems including fatigued personnel, lack of training and education for employees, lack of commitment for research and a lack of accountability for planning decisions (McCool & Cole 1998). All of these issues can have an affect on the implementation of programs such as the LAC System.

Though the work of McCool and Cole (1998) focused on protected-area managers in the United States the problem of declining budgets and government downsizing is occurring in many locations around the world. Increasingly, protected areas are being required to fund themselves as government institutions reduce budgets. This can be observed in South Africa where EKZN Wildlife and South Africa National Parks (SANParks) are facing declining budgets and personnel downsizing. For example Duff (2002:20) states "government subsidies to both organisations have decreased or remained stable in recent years, yet the responsibilities of the organisations have increased and there is a continuing desire to see the area of land protected for conservation increase within each of their jurisdictions". As a result of these budget deficiencies EKZN Wildlife and SANParks have had to find other sources for funding. According to Duff (2002:20) the decrease in subsidies "has resulted in a necessity for both organisations to increase the revenue required to finance their activities obtained from other sources, most notably tourism and improved efficiencies of operation". As noted above, these budget shortfalls and personnel downsizing can affect the ability of the organisation to implement such programs as the LAC System.

Another barrier that was described in the research of McCool and Cole (1998) was the issue of compartmentalization of functions in organisations that manage protected areas. Decisions in protected-area management require an integrated approach with input from different departments, however many of these managing agencies are organized along functional lines (McCool & Cole 1998). In any management decision, managers, planners and scientists need to provide their expertise to adequately solve the problem (McCool & Cole 1998). Often gathering information requires confronting numerous obstacles and is difficult to accomplish, and is therefore often not done (McCool & Cole 1998). Inevitably this has led to a lack of accountability and ownership in decisions and plans in protected areas (McCool & Cole 1998). In the LAC System process managers have noted that in

the planning stage the work is the responsibility of higher levels of management, while the actual implementation of the LAC System is done by lower level personnel (McCool & Cole 1998). In some instances during the implementation of the LAC System this has led to a "lack of ownership by field managers in plans developed by others" (McCool & Cole 1998:75).

In the United States one of the more difficult but important responsibilities in the LAC System process is the involvement of public participation (McCool & Cole 1998). Protected-area managers have recognized that public participation is valuable and provides a good forum for determining the goals, values, and standards in the LAC System process (McCool & Cole 1998). However, it is becoming increasingly difficult for protected-area managers to recognize public participation since more members of the public want access to the government decision-making process (McCool & Cole 1998). With the decrease in personnel and funding mentioned previously, it is becoming increasingly more difficult for protected-area managers to accommodate public participation throughout the decision making process (McCool & Cole 1998).

The final barrier that McCool and Cole (1998:76) recognize in their research is that in many instances agencies that manage protected areas lack the "political will" to implement actions. The highly charged and politicised setting in which protected area decisions occur makes it difficult for managers to take controversial decisions (McCool & Cole 1998). Each decision involves the various beliefs, biases and differing levels of information for numerous stakeholders, which creates a controversial and complex decision making situation (McCool & Cole 1998). In the LAC System process this can be a major hindrance since managers are required to compromise between two conflicting goals, which is often seen as bias towards a particular user group and is inherently controversial.

Chapter 5

IMPLEMENTATION OF THE LAC SYSTEM

5.1 THE GENERIC LAC SYSTEM PROCESS

Since the LAC System is a time consuming and costly management framework to implement, Cole and McCool (1998b) suggest a four step "Generic LAC Process" to determine if the LAC System can be usefully applied to a situation. In this section the four step Generic LAC Process will be applied to the overnight caves to help to determine if the LAC System would be useful and if EKZN Wildlife should implement the LAC System.

The first step that Cole and McCool (1998b) suggest is to determine if there are two or more goals in conflict. Again, the LAC System is essentially a means of resolving conflict between management goals or objectives (Cole & McCool 1989).

As discussed in section 3.1.1 the Cathedral Peak State Forest Management Plan states that a primary objective for the area is to "maintain environmental quality and wilderness character in their present largely-unspoiled state" (Natal Parks Board 1989:2). Essentially, this means that resources such as vegetation, soil, water and wildlife are not to be excessively degraded and the solitude and primitive state of the wilderness is to be preserved. The vision for the UDP in the UDP Wilderness Management Plan gives further support for this by stating that a primary focus is "biodiversity conservation and maintaining the wilderness element of the park" (EKZN Wildlife 2003:14).

A secondary objective in the Cathedral Peak State Forest Management Plan is to "provide opportunities for compatible resource-based outdoor recreation" (Natal Parks Board 1989:2). Furthermore, a primary objective for visitor management is to provide "the highest quality [wilderness] experience to as many people as possible" (Natal Parks Board 1989:41). Support for these objectives can also be found in a principle in the UDP Wilderness Management Plan, which states,

"preserve opportunities for solitude and a primitive and unconfined recreation experience in each wilderness" (EKZN Wildlife 2003:14).

Therefore, according to the objectives set forth in the Cathedral Peak State Forest Management Plan and the UDP Wilderness Management Plan there are two management goals that conflict: maintaining the wilderness character and environmental qualities, and providing high quality wilderness experiences for visitors.

The second step in the Generic LAC Process is to determine whether all management goals can be compromised to some extent or determine if there is zero tolerance or ability to compromise one goal (Cole & McCool 1998b).

According to the Cathedral Peak State Forest Management Plan soil erosion is to be limited to acceptable levels and recreational impact on vegetation is to be minimized in the area (Natal Parks Board 1989). The UDP Wilderness Management Plan takes a similar stance on resource degradation and states "human influences should be managed so that the natural conditions of wilderness ecosystems are not altered beyond agreed-upon standards" (EKZN Wildlife 2003:37). Essentially, both of these management plans recognize that the objective of maintaining environmental quality and the wilderness character can be compromised as long as they are minimized or are at acceptable levels.

In the Generic LAC Process the third step is to establish a hierarchy of goals or to decide which goal will constrain the other goals (Cole & McCool 1998b). In the LAC System standards are written only for the constraining goal, so a hierarchy is necessary to resolve the conflict between the goals (Cole & McCool 1998b). If standards were written for all of the goals, situations might arise where when one goal's standard is violated it would be difficult to bring it back to standard without violating the other goal's standard (Cole & McCool 1998b).

Since the focus in this research is to determine what levels of visitor impacts are acceptable in the overnight caves, the goal of maintaining environmental quality and the wilderness character of the overnight caves is the constraining goal that

standards will be written for. Therefore, for the purpose of this research, a hierarchy is established where the constraining goal of maintaining the wilderness character and environmental qualities, such as maintaining acceptable levels of soil erosion and vegetation trampling, overrides the goal of providing wilderness recreation opportunities for visitors.

The constraining goal of wilderness preservation is given further support in the UDP Wilderness Management Plan which states "in most conflicts between biophysical wilderness resource and human desires, the resource and its preservation will be given priority because all wilderness values depend on the natural character of wildernesses" (EKZN Wildlife 2003:37).

Finally, the fourth step in the Generic LAC Process is to determine whether it is possible to write measurable indicators and attainable standards for the constraining goal (Cole & McCool 1998b). It is important to have measurable indicators and attainable standards, since they will be used to monitor resource conditions and determine when management actions will occur (Cole & McCool 1998b).

Since it was determined in step three that the constraining goal was to maintain the wilderness character and environmental qualities of the overnight caves measurable indicators need to be developed for the resource conditions of the overnight caves. Indicators of resource conditions for the overnight caves might include acceptable levels of soil erosion and vegetation trampling and the amount of litter and graffiti. Previous research by Cole (1989) has shown that it is possible to develop quantitative indicators for resource conditions at campsites, therefore, from this research it is expected that measurable indicators can be developed for the overnight caves. This will be examined further in the following section in which indicators of resource conditions will be established and field-tested to determine their applicability.

From this application of the Generic LAC Process it appears that the LAC System may be usefully applied to the overnight caves in the Mlambonja Wilderness Area. This application showed that there are two conflicting goals, maintaining the

environmental qualities and the wilderness character of the area on the one hand and providing wilderness recreation opportunities on the other. Furthermore, that both of these goals can be compromised to some extent, and there is a constraining goal for which measurable indicators can be established.

5.2 APPLYING THE LAC SYSTEM

As mentioned previously the LAC System has recently been updated and now has ten steps in the process (Cole & McCool 1998a). This section will examine in detail the ten steps of the LAC System and will apply the first four steps to the case study area of four overnight caves in the Mlambonja Wilderness Area. The remaining six steps will be discussed in detail and some recommendations will be made in Component B as to how EKZN Wildlife could consider implementation of these steps. A product of this section will be a list of indicators of resource conditions in the overnight caves that will be developed into a procedure manual and field tested on four of the overnight caves. In the future it is expected that the procedure manual will be applied to all of the overnight caves in the uKhahlamba-Drakensberg Park by EKZN Wildlife staff, which will essentially be an inventory that will be used to guide future management decisions.

5.2.1 Step 1

The first step in the LAC System is to "define goals and desired conditions" (Hendee & Dawson 2002:239). According to Cole & McCool (1998a:61), "this step involves assembling the legal and policy mandates that will guide management of the area and developing a perspective on the significance of the area, its uniqueness, and its regional or national "niche". These are broad or general goals for the area and essentially articulate the desired conditions for the area (Cole & McCool 1998a). Some general goals for wilderness areas according to Cole & McCool (1998a) might include preserving natural conditions, providing opportunities for solitude and freedom of behaviour.

For the Cathedral Peak section of the uKhahlamba-Drakensberg Park, which contains the Mlambonja Wilderness Area, the agency policy that has guided the management of the area since 1989 is the Cathedral Peak State Forest Management Plan. However, as mentioned previously, EKZN Wildlife staff has

drafted a new Wilderness Management Plan. For this section of the research the Cathedral Peak State Forest Management Plan and the UDP Wilderness Management Plan will be used to develop the general goals for the Mlambonja Wilderness Area.

General goals for the Mlambonja Wilderness Area can be found in the objectives in the Cathedral Peak State Forest Management Plan. The primary objective for the Cathedral Peak section that relates to wilderness states; "Maintain environmental quality and wilderness character in their present largely-unspoiled state" (Natal Parks Board 1989:2). Therefore, a general goal or desired condition for the Mlambonja Wilderness Area is to preserve the natural conditions or environmental qualities and wilderness character that are found there.

Though not as explicit, the general goals for all the wilderness areas in the UDP Wilderness Management Plan are similar to those found in the Cathedral Peak State Forest Management Plan. The vision statement for the UDP Wilderness areas states: "The values of this unique World Heritage Site and diverse mountain environment are conserved and sustainably used for the physical well-being of all; primarily focusing on biodiversity conservation and maintaining the wilderness element of the Park" (EKZN Wildlife 2003:14). This essentially means that the goals for the wilderness areas are to provide sustainable wilderness-related recreational opportunities and to preserve the wilderness character or elements found in the uKhahlamba-Drakensberg Park.

Finally, the uniqueness of the Mlambonja Wilderness Area and what regional niche it fills is explicitly stated in the Cathedral Peak State Forest Management Plan. According to the Natal Parks Board (1989:40), "the provision of wilderness and wilderness related experiences is of major importance, as there are very few places in Natal (and none in private ownership) where people can still have a true wilderness experience". Essentially, the Mlambonja Wilderness Area is seen as being unique in Natal since it offers visitors the opportunity to backpack for extended periods of time and camp overnight where they prefer, or in overnight caves that provide shelter from the elements.

5.2.2 Step 2

The second step in the LAC System is to identify the area's managerial issues and concerns that relate to the "distinctive features and characteristics of the wilderness area" (Stankey *et al.* 1985:400). This step builds on the first step by identifying existing or potential barriers that might be a hindrance to achieving the goals identified in the first step, which were the preservation of natural conditions and solitude (Cole & McCool 1998a).

In order to help managers to identify the managerial issues and concerns of an area, Stankey *et al.* (1985) provide a list of questions to answer, which are provided below. However, since the LAC System was developed in the United States several of the questions surrounding legal guidelines may not pertain to South Africa (Stankey *et al.* 1985:400).

- Does the area contain outstanding ecological, scientific, recreational, educational, historic, or conservation values that warrant special attention?
- Does the area provide critical habitat for threatened or endangered species?
- Has public input identified areas or issues that merit special attention?
- Do land uses on contiguous areas represent situations requiring special management attention?
- Are there existing or potential nonconforming uses in the area that will require special attention?
- Are there regional and/or national issues that need consideration:
    a. What is the availability of wilderness and dispersed recreation opportunities in the planning region?
    b. What is the regional demand for wilderness and dispersed recreation at the present and in the future?
    c. Are the physical-biological features of the area found elsewhere in the region or does it possess unique features?
    d. Are the types of recreation opportunities offered by the area available in other wildernesses or does the area offer opportunities not found elsewhere?

According to Stankey *et al.* (1985) the information needed for this step can be found in legal documents and organisational policy. The information for this step was obtained from the Cathedral Peak State Forest Management Plan and the uKhahlamba-Drakensberg Park Wilderness Management Plan. The purpose of this step is to gain a better understanding of the role of the Mlambonja Wilderness in the regional setting and Stankey *et al.* (1985:400) express that "the inability to perform a comprehensive analysis should not hold up the completion of this step". Therefore, in this research this step will not provide a complete analysis of all the possible issues and concerns for the Mlambonja Wilderness Area. However, it will provide a general understanding of some of the issues and concerns for the area, which EKZN Wildlife staff can expand on in the future.

Since the Mlambonja Wilderness Area is part of the uKhahlamba-Drakensberg Park, which is a mixed property World Heritage Site, it has both cultural and ecological values that warrant special attention (Derwent *et al.* 2001). The cultural values that the World Heritage Convention recognized as being of universal importance were the San rock art paintings (Derwent *et al.* 2001). The World Heritage Convention also recognized the natural values of the uKhahlamba-Drakensberg Park, not only for its "superlative natural beauty and outstanding aesthetic importance", but also for the high level of endemic species and biodiversity resources found there (Derwent *et al.* 2001:9).

The Mlambonja Wilderness Area also provides unique recreational opportunities for visitors. Not only can visitors stay in overnight caves, the Mlambonja Wilderness also offers visitors the unique opportunity to participate in primitive or unconfined recreational activities (EKZN Wildlife 2003). In the Mlambonja Wilderness visitors are able to backpack for an extended length of time on and off demarcated paths while experiencing a high level of solitude in unmodified surroundings. These unconfined wilderness recreational activities provide "great personal benefits, such as emotional and spiritual renewal, improved self-esteem, improved physical or mental health, and a test of their outdoor living skills" (EKZN Wildlife 2003:10). Therefore, since the Mlambonja Wilderness provides visitors with a unique recreational experience with numerous benefits it should be

recognized as having outstanding recreational values that warrant special attention.

All of the values mentioned above for the Mlambonja Wilderness also face numerous threats. As the UDP Wilderness Plan mentions, "wilderness areas do not exist in a vacuum" and the people and resources outside the wilderness areas can have significant effects on the area (EKZN Wildlife 2003:37). Some of these threats are cattle grazing, natural and wild fires, alien plant species, settlement encroachment, tourism developments, poaching, smuggling, and land claims (Derwent *et al.* 2001). All of these threats can have significant effects on the Mlambonja Wilderness Area and need to monitored and controlled to ensure that the wilderness character of the area is preserved.

5.2.3 Step 3

In step 3, the LAC System requires managers to assign opportunity classes or prescriptive management zones to the wilderness area (Stankey *et al.*1985). According to Stankey *et al.* (1985:402) an "opportunity class provides a qualitative description of the kinds of resource and social conditions acceptable for that class and the type of management activity considered appropriate". Opportunity classes are not necessarily field-tested allocations, rather they are the conditions that managers consider likely to be maintained or restored in the area (Stankey *et al.* 1985). In the LAC System, the opportunity classes that are identified in step 3 provide "a rationale against which the appropriateness of indicators (step 4), standards (step 6) and management actions (step 8) can be tested" (Stankey *et al.* 1985:402).

As discussed in section 3.1.2, under the UDP Wilderness Management Plan the Mlambonja Wilderness Area will be managed according to ROS classes. In the Mlambonja Wilderness Area all of the overnight caves can be found in the sections designated as Pristine and Primitive under ROS (EKZN Wildlife 2003). The four overnight caves, Xeni Cave, Barker's Chalet, Ribbon Falls Cave, and Sherman's Cave, that have been selected as case studies in this research are all found in the area designated as Primitive (Margeot & Forbes 1997). Therefore, the indicators (step 4), standards (step 6) and management actions (step 8) that

are developed for the overnight caves must be appropriate for the setting, the experiences and the activities that are found in the ROS Primitive class. Since a Primitive area according to ROS is an unmodified natural environment where the evidence of other users is minimal, the resource impacts attributed to visitors in the overnight caves must be minimal. Vegetation loss, soil erosion, litter, graffiti and campsite development should be minimal and evidence of human manipulation of the ecosystem and landscape should not be present (EKZN Wildlife 2003). The development of resource and social indicators (step 4) and the development of standards for the resource and social indicators (step 6) in the LAC System will determine what amount of impact is occurring and at what level these impacts are acceptable (Stankey *et al.* 1985), thereby establishing what minimal levels of resource impacts in the overnight caves actually means.

5.2.4 Step 4

The fourth step in the LAC System is to "select indicators of resource and social conditions" in the wilderness area (Stankey *et al.* 1985:405). Indicators, also often referred to as specific variables, are measures that reflect or indicate the condition of the overall opportunity classes that were described in step 3 (Stankey *et al.* 1985). For the overnight caves in the Mlambonja Wilderness Area that will be used in this research project, the indicators selected for the resource conditions will reflect or indicate the Primitive opportunity class. Furthermore, since the overnight caves require an advance booking the social conditions, such as solitude while travelling and conflicts over party size, do not necessarily need to be developed. However, since the entire Mlambonja Wilderness has been assigned Pristine and Primitive opportunity classes, where there is a high probability of solitude, EKZN Wildlife staff in the future may need to develop social indicators to ensure visitors experience solitude.

Developing indicators is often recognized as "one of the most critical, and difficult steps in the Limits of Acceptable Change (LAC) process" (Watson & Cole 1992:65). Therefore, Stankey *et al.* (1985) and Watson and Cole (1992) have developed a list of desirable characteristics of indicators to assist in their development, which are presented in the following list (Watson & Cole 1992:66):

- Measurable- Indicators should be quantitative (i.e., subject to measurement)
- Reliable- Indicators should be capable of being measured precisely and accurately (repeatable measures by different personnel)
- Cost-effective and efficient- Indicators should be capable of being measured cost-effectively, generally by field personnel using simple equipment and techniques
- Significant- Indicators must relate to significant conditions or features of the wilderness. A good indicator should be capable of detecting changes that, if they occurred, would be considered serious problems. Examples include changes which would persist for a long time, disrupt ecosystem functioning or reduce the quality of recreational experiences
- Relevant- The types of change that are to be detected through the monitoring of indicators should be confined to changes that result from human activities. This characteristic may not apply outside of wilderness or other places where objectives stress minimal human impact
- Sensitive- Indicators should focus on sensitive components of the wilderness resource – components that provide an early warning system, alerting managers to deteriorating conditions while there is still time to correct things
- Responsive- The types and/or causes of change that are to be detected through the monitoring of indicators should be responsive to management control

The following indicators for the resource conditions in the overnight caves have been developed using information gathered from a reconnaissance visit, a key informant in EKZN Wildlife and relevant literature from protected areas that have implemented the LAC System. The reconnaissance visit helped to put into perspective the visitor impacts that are actually occurring, while the key informant shared some of the concerns that EKZN Wildlife staff have, and the relevant literature provided some ideas of indicators that have been used on campsites in other locations.

A review of the relevant literature on applying the LAC System to campsites in other locations raised the issue of the uniqueness of the overnight caves. In other locations where the LAC System was applied to campsites, the campsites were generally located in open areas either in forests or meadows. The primary indicators for impacts in these campsites were the amount of vegetation trampling and the area of soil compaction in the campsite. When these two indicators are measured using a measuring tape, the data that are obtained indicate the total area of impact in the campsite. However, the situation is quite different for the overnight caves. Impacts on soil compaction and vegetation loss at the overnight caves would occur only ouside of the overnight caves, since the interior of the caves are dirt or solid rock with no vegetation. Since the size of a group permissible to stay in each cave varies according to the size of the caves the amount of impact to vegetation and soil outside of the caves should vary depending on the size of the group permitted to overnight in the cave. If the indicators of vegetation trampling and soil erosion are directly linked to the size of group permissible in the overnight cave it would be difficult to develop standards (step 6) for these indicators that would apply to all of the overnight caves. Therefore, in the event that this is true, standards would have to be developed for each individual overnight cave. This will be determined through the fieldwork and discussed further in the results section of Component B.

Eight indicators of resource conditions in the overnight caves have been identified through the available information sources. A brief discussion of what the indicator is and how it will be measured in the field will be provided and a copy of the field worksheet will be provided in Appendix 1. A clean-up time is provided for some of the indicators since it is expected in some instances that the evaluators who are applying the procedure manual will not be performing any maintenance on the overnight caves. This not only provides a level of impact it also provides EKZN Wildlife staff with information on how much fieldwork is needed in the overnight caves to maintain the wilderness qualities.

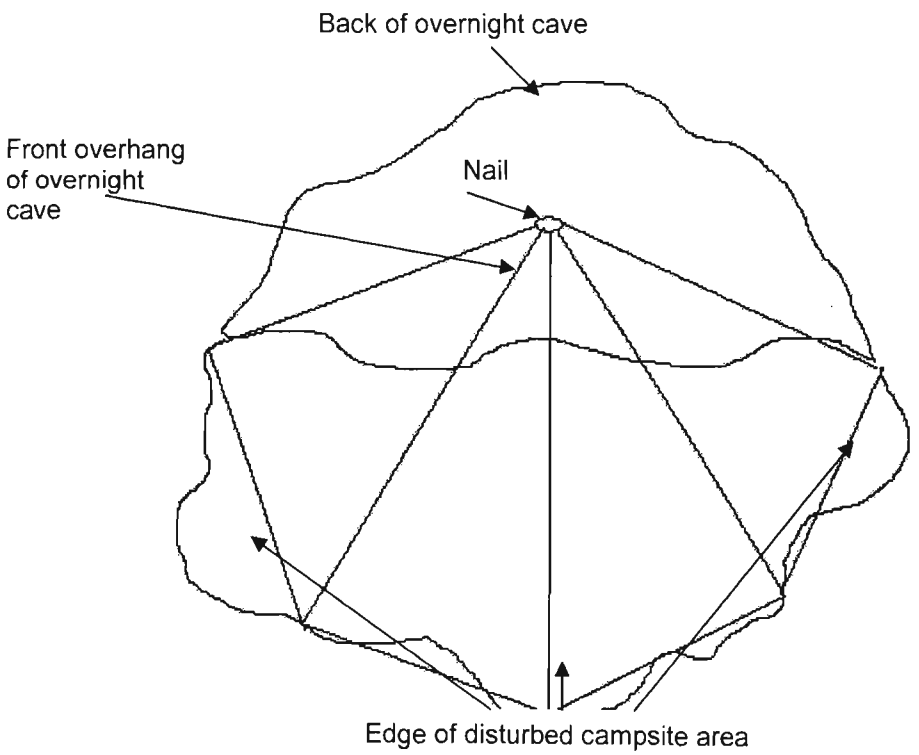
Area of Disturbance

The first indicator that was identified is the area outside of the overnight caves where the vegetation and soil has been denuded (disturbed campsite area). This

is probably the most difficult and time-consuming indicator to measure, however, it also one of the most useful since it is the most likely to change over time and can yield accurate information if done properly (Cole 1989). To increase accuracy of measurement and for future monitoring purposes Cole (1989) suggests the use of a permanent sampling unit.

This procedure would require a large nail to be buried near the centre of the overnight cave, about halfway from the back of the overnight cave and the front overhang. For future monitoring purposes, its location should be well recorded, however, it is possible to find the nail with a lightweight pin locator if one is available (Cole 1989). From this point, the distance to the edge of the obviously disturbed part of the site outside of the overnight cave is measured (with a measuring tape) in five directions. The distances are recorded and then marked with a stone, and then a measurement is taken between each of these distances, forming four triangles. The area of each of the four triangles is then calculated using the formula A=1/2 (base x height), these are then added together to calculate the total disturbed campsite area. The following diagram 5.2 shows an example of how to measure the disturbed campsite area.

Figure 5.2: Disturbed campsite area.



On the field worksheet the actual total disturbed campsite area will be recorded and then a level of severity will be allocated to each overnight cave based on four categories for disturbed campsite area. The four categories for disturbed campsite area are: none, up to a $5m^2$ area, a 6-10 m^2 area, and more than a $10m^2$ area. These four categories were developed from the reconnaissance visit to Xeni Cave and are estimates of what might be encountered when inventorying the overnight caves.

Rock Fire Rings

The second resource indicator for the overnight caves is rock fire rings. According to the UDP Wilderness Management Plan fires are not allowed in the wilderness areas, however, on the reconnaissance visit to Xeni Cave a rock fire ring was encountered. Therefore, rock fire rings represent a significant level of human impact that should not occur in the Primitive ROS opportunity class.

Again, in the fieldwork manual the actual number of rock fire rings will be recorded and then a category of level of severity will be assigned to each overnight cave. The four categories that were developed for the level of severity are: none, 1 small fire ring (< 1 m in diameter) and/ or up to two minute cleanup time, 1 large (> 2 m in diameter) or 2 medium (1-2 m in diameter) fire rings and/ or up to a ten minute cleanup time, and more than 3 fire rings and/ or more than twenty minutes cleanup time. These categories were developed based on literature on campsite conditions, and the time estimates were developed taking into account the researcher's past related field experiences.

Charcoal or Fire Scars

The third indicator is charcoal or fire scars, which are areas either where rock fire rings once occurred or where charcoal from fires has been disgarded. To measure the area of charcoal or fire scars a measurement of the area is taken using a measuring tape. If there is more than one fire scar or area where charcoal has been dumped then the respective areas would be summed. This area will then be recorded on the field worksheet and then the overnight cave will be assigned to a level of severity category. Four categories have been developed for the level of severity of charcoal and fire scars, and are: none, up to 1 m^2 of area, up to 3 m^2 of

area, and more than 3 m^3 of area. The reconnaissance visit to Xeni Cave along with the researcher's past field experience provided the basis for developing the four categories for the level of severity of impact.

Graffiti

The amount of graffiti etched into the walls of the overnight cave is the fourth indicator that will be measured. In the field worksheet the actual number of etchings of graffiti will be recorded. Then a level of severity category will be assigned based on the field visit to Xeni Cave, which are: none, 1-3 etchings of graffiti, 4-6 etchings of graffiti, and 7 or more etchings of graffiti.

Damaged Trees

The number of mutilated trees (cut with an axe or knife and trees with nails in them) and trees stripped of their limbs is the fifth resource indicator that will be measured. Only the trees that can be seen from the overnight caves will be counted and recorded on the field worksheet. Then a level of severity category will be assigned, which consists of four categories and are: none, 1-3 trees in the immediate vicinity, 4-6 trees in the immediate vicinity, and 6 or more trees in the immediate vicinity. These categories were developed from literature on campsite inventorying techniques.

Litter

Litter, which includes plastic, paper and metal, is the sixth resource indicator that will be inventoried. Only the litter that is inside the overnight cave and in the area that can be seen from the overnight cave will be counted and recorded on the field worksheet. Again, the overnight cave will be assigned a level of severity category for litter based on four categories, which are: none, few small pieces of litter and/ or 30 second clean up time, moderate amount of litter and/ or up to 3 minutes clean up time, and widespread litter and/ or over 10 minutes clean up time. The estimated times were primarily developed from the researcher's past field experience and the actual categories were developed from literature on campsite inventorying techniques.

The amount of trash was determined to be an indicator for two reasons. First, research has shown that litter is one of the most critical items that effects visitors' enjoyment in wilderness areas (Cole 1989). Secondly, trash does not have a lasting ecological impact since it is easily removed, making it very responsive to management actions (Cole 1989).

Candle Wax

The number of locations of candle-wax leftover from burning candles in the overnight caves in the seventh indicator that will be inventoried. The locations of candle- wax refer to the areas where candles have been burned and the wax has dripped onto the rocks and has not or cannot be removed. Again, the actual number of locations of candle wax will be recorded in the field worksheet and then a level of severity category will be determined for each overnight cave. The four categories for the level of severity of candle-wax are: none, 1-3 locations of candle-wax, 3-6 locations of candle-wax, and 7 or more locations of candle-wax. These categories were based on estimates from the reconnaissance visit to Xeni Cave.

Toilet Paper

The final indicator that will be inventoried is the amount of visible toilet paper within 100 m of the overnight cave. Toilet paper was selected as a resource indicator; since EKZN Wildlife staff has expressed the opinion that the amount of toilet paper found around the overnight caves is a problem (Krueger 2003 *pers. comm.*). To measure the amount of toilet paper the investigator will examine the area surrounding the overnight cave in all directions for approximately 100 meters. An allocated time is difficult to develop for this indicator since evaluators walk at different paces.

In the field worksheet the actual number of pieces of toilet paper will be recorded and then the overnight cave will be assigned to one of four categories of severity of impact. These four categories, which were based off information from literature on campsite inventorying techniques, are: none, 1-2 pieces present, 3-4 pieces present, and 5 or more pieces present.

5.3 CONDITION CLASS ESTIMATES

Once the overnight caves have been inventoried using the eight indicators of resource condition it would be useful to assign each overnight cave to a condition class category based on the level or types of impact (Cole 1989). A condition class system usually consists of descriptions of five states based on certain conditions, such as vegetation loss, tree damage, litter, and soil erosion (Cole 1989). Each campsite or overnight cave is then assigned to one of the five condition classes. Cole (1989:4) states that condition classes are a good choice for areas with little funding and provide "a gross estimate of impact levels and distribution".

One of the most popular condition class systems is Frissell's system (1978), which is essentially based on ground vegetation, soil erosion and tree damage and does not take into account litter and graffiti (Cole 1989). Cole (1989) states "Frissell's system works well in coniferous forests with conspicuous ground cover vegetation and thick organic horizons, it does not apply to many other environments, such as areas above timberline, grasslands, or desserts. Therefore, for the purposes of this research a summary rating will be used (Cole 1989).

In the summary rating each of the four categories for each indicator will be assigned a number, which relates to the level of impact. A higher number is assigned to a higher level of disturbed campsite area, rock fire rings, charcoal and fire scars, graffiti, mutilated trees, litter, candle-wax and toilet paper. For the first category, which is none, a zero is assigned since there is no impact. For the second level of severity of impact a 1 is assigned, the third level a 3, and for the highest level of severity of impact a 5 is assigned. Since there are eight indicators for resource conditions that will be inventoried the highest level of impact would be 40 (8 indicators x 5 highest level of impact), with the lowest being zero. From this an impact index is developed that takes into account all eight of the indicators, and is (Cole 1989):

- Light level of Impact (0-10)
- Moderate level of Impact (11-20)
- Heavy level of Impact (21-30)

- Severe level of Impact (31-40)

Each overnight cave can then be assigned to one of these categories depending on its score. From this EKZN Wildlife staff will be able to determine relative impact levels in each wilderness area and the relative impact levels in each overnight cave. Though this scoring system helps to determine management priorities and requires little training and time, it does have limitations and may need to be modified. Further discussion of the scoring system and possible alterations will be provided in Component B.

5.4 PHOTOGRAPHS

Another useful tool for monitoring and inventorying the overnight caves would be the use of repeated photographs from permanent camera points (Cole 1989). Photographs if taken properly can provide useful data about conditions and trends in campsites (Cole 1989). However, research has shown that photographs are best used to support field measurements since the amount of information that is gathered is low (Cole 1989). Actual impacts, such as tree scars and charcoal scars, are difficult to record unless numerous photos are taken for each indicator or impact. Therefore, it is suggested that photographs be used to enhance the field measurements of impacts that are easier to capture in photographs, such as the disturbed campsite area (Cole 1989).

Overall the accuracy and precision of photographs can be high, however, photographs can be subjective depending on who is taking the photograph and where and when the photograph is taken (Cole 1989). To reduce the subjectivity of photographs they should be taken in the same location each time during approximately the same time of day and year and the same type of film and camera should be used (Cole 1989).

Another reason to use photographs is that they can increase the effectiveness of the field measurements in reports and presentations (Cole 1989). Trends and conditions of impacts, such as the disturbed campsite area, can be easily seen in photographs, which can increase the effectiveness of written reports and documents (Cole 1989).

In the overnight caves it would be most useful to take a photograph of the disturbed campsite area, however, depending on management objectives, photos of all of the selected indicators might also be useful. If the length of time between field inventories is quite long then photographs of all the indicators should be used to illustrate long-term trends in impacts and support field data.

The field worksheet contains an area to record the photograph number for all the indicators, and photographing the impacts of all the indicators would be useful since this is the first inventory of the overnight caves.

Chapter 6

STEPS 5-10 OF THE LAC SYSTEM

Due to the time constraints of this research project the remaining six steps of the LAC System will not be applied to the four overnight caves in this case study. However, this chapter will examine in more detail steps 5-10 of LAC System than what was presented in Chapter 4 and Component B will provide some recommendations on how EKZN Wildlife might go about applying these steps.

6.1 Step 5

The fifth step in the LAC System is to "inventory existing resource and social conditions" (Stankey *et al.* 1985:407). This entails applying the procedure manual of indicators for the resource conditions that was developed in step four to all of the overnight caves in the uKhahlamba-Drakensberg Wilderness areas. This is an important step since it not only tests the applicability of the procedure manual it also provides managers with the range of conditions of the indicators for resource conditions in the overnight caves (Stankey *et al.* 1985).

Since the data from this step will be used in future monitoring processes the information from the completed procedural manuals should be entered into an Excel spreadsheet or database. This will prevent data from being lost and will allow for easy retrieval when it is needed.

6.2 Step 6

Step six in the LAC System is one of the most time consuming, difficult and crucial steps to accomplish since they essentially "determine the future character of the wilderness" (Stankey *et al.* 1985:410). In step six standards are specified for the resource and social indicators for each opportunity class (Stankey *et al.* 1985). For the overnight caves in the Mlambonja Wilderness Area standards or highly specific measures will need to be developed for the indicators of the resource conditions (Stankey *et al.* 1985). These standards for the resource conditions in the overnight caves should essentially be the conditions that EKZN Wildlife

managers feel that can be achieved over a reasonable period of time (Stankey *et al.* 1985).

Since the Mlambonja Wilderness Area is located in Pristine and Primitive opportunity classes the standards that are specified must reflect the resource and social conditions that are acceptable for these classes. These standards will determine what the acceptable and appropriate levels of resource impacts in the overnight caves are (Stankey *et al.*1985). Furthermore, standards will help clarify what the term "minimal" amount of impact means in a Primitive opportunity class, which was discussed in step 3. The work of Cole and McCool (1998a:64) explains that "minimally acceptable conditions are the best possible conditions, given the constraints imposed by the need to compromise several goals simultaneously".

As Stankey *et al.* (1985:408) state the "setting of standards is a judgmental process; however, the process is logical, traceable, and subject to public review". In this step EKZN Wildlife personnel should develop standards for the indicators of resource conditions in the overnight caves then allow a period of time for public comment. Allowing public comment leads to better acceptance of management decisions and can also reduce the likelihood of adopting inappropriate management decisions (McCool & Cole 1998).

6.3 Step 7

Managers in step seven "identify alternative opportunity class allocations reflecting area issues and concerns and existing resource and social conditions" (Stankey *et al.* 1985:410). This involves analysing the inventory data collected in step 5 and the areas issues and concerns identified in step 2 (Stankey *et al.* 1985). From this analysis managers, with input from the public, then decide what resource and social conditions should be maintained or achieved in each opportunity class found in the wilderness area (Stankey *et al.* 1985). Specific standards should be developed that take into account the realities that exist, which is identified in the analysis of the inventory data, and what the agency can accomplish in terms of available resources (Stankey *et al.* 1985).

Stankey *et al.* (1985) suggest that the managing agency develop a map that shows the alternative opportunity classes identified as a result of the analysis of inventory data and the areas issues and concerns. This map essentially identifies what resource and social conditions will be provided in different parts of the wilderness area (Stankey *et al.* 1985).

6.4 Step 8

In step eight managers "identify management actions for each alternative" (Stankey *et al.* 1985:412). Essentially, in this step managers identify any differences that exist between the data that was collected in step 5 (current conditions) and the standards that were identified for the indicators (step 6) (Stankey *et al.* 1985). If problems exist between the current condition and what has been determined as acceptable, managers then need to determine what management actions will need to be implemented to achieve the desired or acceptable conditions (Stankey *et al.* 1985).

In deciding what management action will be used EKZN Wildlife managers should not only consider the minimum tool principle, but should also decide between direct and indirect management techniques. Direct management techniques, such as closing campsites, regulate or restrict individual choices and can increase costs due to the need for law enforcement (Cole 1995). Indirect management techniques, such as education materials, still allow visitors the freedom to choose their actions and aim to manipulate or alter visitor behaviour (Cole 1995).

6.5 Step 9

Step nine, is the "evaluation and selection of a preferred alternative", should also occur after EKZN Wildlife has applied the LAC System to all the features mentioned in section 2.1 Wilderness Management (Stankey *et al.* 1985: 414). In this step the managers, along with public comment, finalize the opportunity classes and the associated resource and social conditions for all of the wilderness areas (Stankey *et al.*1985). This can only be accomplished after step 7, which determines if the resource and social conditions for all the features in the wilderness area do or do not reflect the assigned ROS opportunity classes.

6.6 Step 10

The final step in the LAC System is to "implement actions and monitor conditions" (Stankey *et al.* 1985:415). Essentially, this step is the application of the management action that was determined in step 8 and the future monitoring of conditions to determine if the action is working or if another management action may need to be implemented. For the overnight caves, if it was determined in step 8 that a management action is immediately necessary to prevent serious further degradation, then it may be appropriate to implement the management action while the LAC System is being applied to the other features.

In monitoring campsites, Cole (1989) has recommended that monitoring occurs every five years to determine if there are any changes in conditions. However, this estimate of time (five years) is based on North American ecosystems and may need to be altered to meet the South African environment. Stankey *et al.* (1985) provide a list of situations where monitoring should be a priority (Stankey *et al.* 1985:415).

Where:

- Conditions were very close to standards at the time of the last assessment
- Rates of resource or social change are judged to be the highest
- The quality of the data base is poorest
- The understanding of management action effects is poorest, or
- There have been unanticipated changes in factors such as access, adjacent land uses

This step will require EKZN Wildlife staff to apply the procedure manual for measuring the indicators of resource conditions in the overnight caves to all of the overnight caves in the wilderness areas of the uKhahlamba-Drakensberg Park on a periodic basis.

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Personal Communications

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APPENDIX 1

Field Worksheet for Indicators of Resource Conditions in the Overnight Caves

Name of Overnight Cave:_____

Date Surveyed:_____

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area

	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.			
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.			
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.			
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.			
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.			
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.			
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.			
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.			
					Total = Condition Class Estimate		

Developed by Brian Long

Condition Class Estimate

Or

Overall Level of Impact

_____

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

_____
_____
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Comments

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Wilderness Planning Using the Limits of Acceptable Change System: A Case Study of the Overnight Caves in the Mlambonja Wilderness Area of the uKhahlamba-Drakensberg Park.

COMPONENT B

By
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Wilderness Planning Using the Limits of Acceptable Change System: A Case Study of the Overnight Caves in the Mlambonja Wilderness Area of the uKhahlamba-Drakensberg Park.

Abstract

The purpose of this study was to determine the possible applicability of the Limits of Acceptable Change System to the caves designated for overnight camping by users in the wilderness areas of the uKhahlamba-Drakensberg Park. The Limits of Acceptable Change System is a ten- step management framework that addresses the biophysical and social impacts of recreation in wilderness areas. As a step in the Limits of Acceptable Change System a list of resource indicators for the overnight caves and methods to measure the resource indicators was developed into a procedural manual. Four overnight caves in the Mlambonja Wilderness Area of the uKhahlamba-Drakensberg Park were selected as a case study and were examined using the procedural manual of resource indicators. The findings indicate that the resource indicators chosen for the overnight caves were adequate for measuring the resource impacts associated with recreational use. Furthermore, the findings indicate that the Limits of Acceptable Change System can be applied to the overnight caves and is therefore proposed for management purposes. No insuperable problems which might prevent the application of this management tool were encountered.

Introduction

The uKhahlamba-Drakensberg Park

The uKhahlamba-Drakensberg Park was listed as a mixed property World Heritage Site by the World Heritage Convention in December of 2000 for its outstanding natural beauty and high concentration of unique San rock art paintings (Derwent, Porter & Sandwith 2001). The uKhahlamba-Drakensberg Park not only contains high levels of biodiversity and cultural resources, but it also provides exceptional opportunities for outdoor recreation (Derwent *et al.* 2001). Visitors to the uKhahlamba-Drakensberg Park can participate in a variety of outdoor activities, including mountain biking, fly fishing and backpacking (Derwent *et al.* 2001). One of the most unique and significant recreational opportunities for

visitors is the camping in caves located in the mountains. Visitors to these overnight caves, of which there are 58, are provided with a unique wilderness experience with high levels of solitude, naturalness, and outstanding views of the surrounding mountains and valleys (EKZN Wildlife 2001). These caves which are designated on maps do not contain rock art resources.

All 58 of the overnight caves are located in the four wilderness areas of the uKhahlamba-Drakensberg Park: Mdedelo, Mkhomazi, Mzimkulu and Mlambonja. These wilderness areas are an important resource and are a part of the 2.1% of wilderness found in protected areas in South Africa (EZKN Wildlife 2003). Since these areas are designated as wilderness they meet and are managed according to the following criteria (Natal Parks Board 1989):

- The area must be maintained in a primitive, undeveloped state. No roads, powerlines, etc. or facilities for the comfort of users is permissible.
- The area must be large enough to give visitors a feeling of complete isolation.
- The ecosystem must be in a natural state, essentially unmodified by man, or capable of being restored to a natural state.

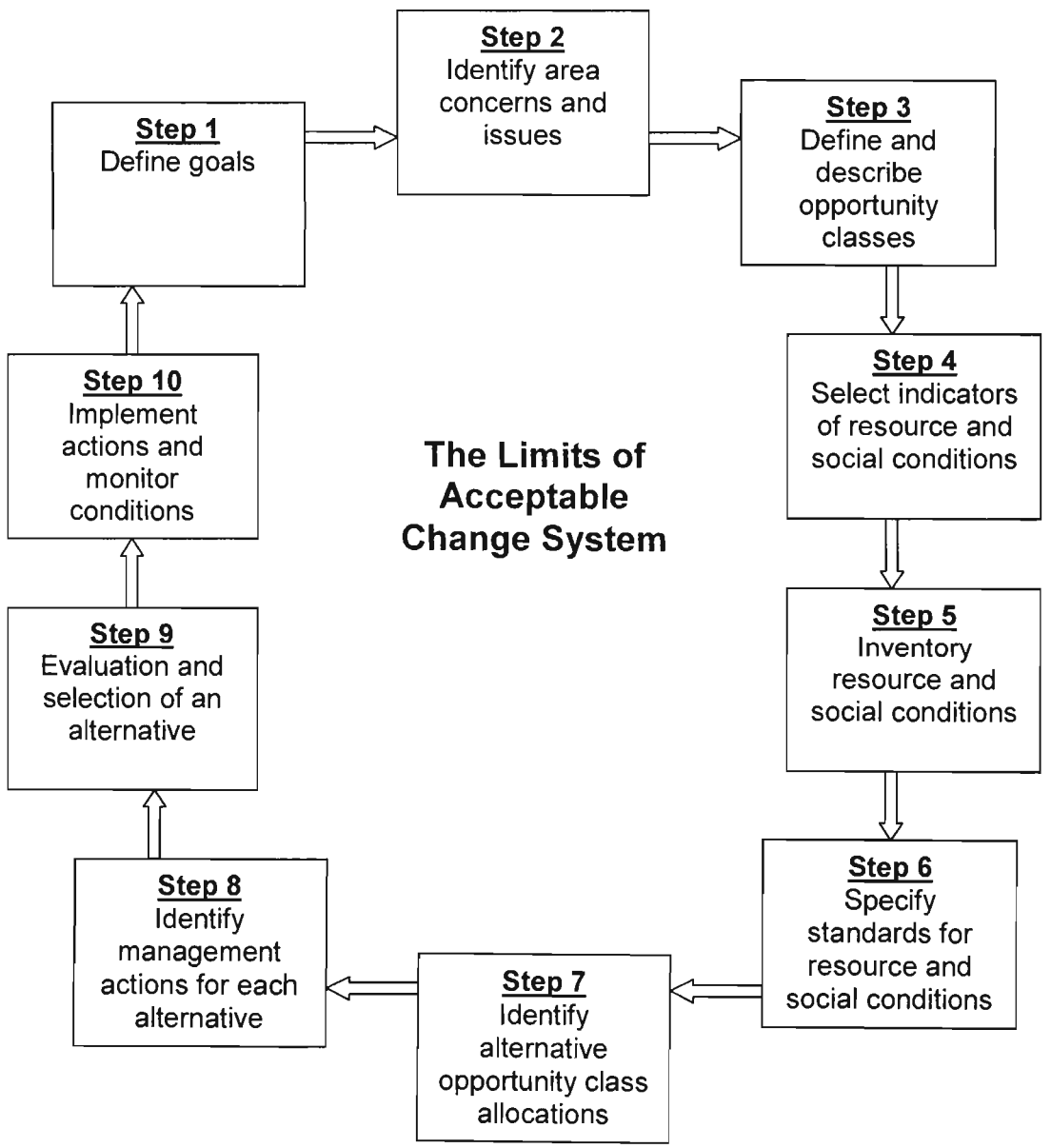
All of these wilderness areas have been managed under different management plans; however Ezemvelo KwaZulu Natal (EKZN) Wildlife is currently developing the uKhahlamba-Drakensberg Park (UDP) Wilderness Management Plan. The UDP Wilderness Management Plan will be a comprehensive management plan for all of the wilderness areas and will increase the effectiveness of management decisions and conservation strategies. One of the primary tools in the UDP Wilderness Management Plan that will be employed to conserve the wilderness resource is the Limits of Acceptable Change (LAC) System. Under the UDP Wilderness Management Plan the LAC System will be applied to roads, paths, caves, toilet areas, peripheral development, roads and tracks and reclaimed sites (EKZN Wildlife 2003).

The LAC System

Resource and social impacts associated with increasing visitation to wilderness areas in the United States led to the development of the Limits of Acceptable Change System (LAC) in 1985. The LAC System is a framework that helps protected area

managers to establish "acceptable and appropriate resource and social conditions in recreation settings" (Stankey, Cole, Lucas, Petersen & Frissell 1985:395). Originally the LAC System had nine inter-related steps; however after implementing it in several locations a tenth step was added (Cole & McCool 1998). The following diagram shows the ten inter-related steps of the LAC System.

Diagram 1: Ten steps of the LAC System.



1998). In wilderness areas these might include such goals as preserving solitude and natural conditions.

Step two requires managers to identify any existing or potential barriers to achieving the goals that were identified in step one (Cole & McCool 1998). Potential barriers might include critical habitat for endangered species, existing or potential nonconforming uses, and outstanding historic or cultural resources.

Managers in step three assign opportunity classes or prescriptive management zones to the area (Stankey *et al.* 1985). Essentially, opportunity classes are a description of the resource and social conditions and the type of management activity that will be allowed to occur in the area (Stankey *et al.* 1985).

In step four managers select indicators of resource and social conditions for the area (Stankey *et al.* 1985). Indicators, which are often referred to as specific variables, are measures that reflect or indicate the condition of the overall opportunity classes that were described in step 3 (Stankey *et al.* 1985). In this study eight resource indicators were identified for the overnight caves, which are discussed later in the paper.

The fifth step in the LAC system is to "inventory existing resource and social conditions" (Stankey *et al.* 1985:407). This entails measuring the resource and social conditions in the area that were identified in step four.

Step six, which is often described as the most time consuming and difficult, requires managers to develop standards for the resource and social indicators for each opportunity class (Stankey *et al.* 1985). Essentially, standards are conditions that managers feel that can be achieved over a reasonable period of time (Stankey *et al.* 1985).

Managers in step seven "identify alternative opportunity class allocations reflecting area issues and concerns and existing resource and social conditions" (Stankey et al. 1985:410). This involves analysing the inventory data collected in step 5 and the areas issues and concerns identified in step two (Stankey et al. 1985). From

this analysis managers, with input from the public, then decide what resource and social conditions should be maintained or achieved in each opportunity class found in the area (Stankey et al. 1985).

In step eight managers determine if problems exist between the current resource and social conditions found in the area and what has been determined as acceptable (Stankey *et al.* 1985). If there are problems, managers then need to determine what management actions will need to occur.

In step nine opportunity classes and the associated resource and social conditions for the entire area are finalized (Stankey *et al.* 1985).

In step ten the management action that was determined in step eight is applied and future monitoring occurs to determine if the management action is effective (Stankey *et al.* 1985).

Protected area managers in the United States have recognized several benefits from implementing the LAC System. First, the LAC System provides managers with a clear sequence of steps to be taken and a rationale for each management decision made (McCool & Cole 1998). Second, the LAC System helps to achieve a balance between recreational access and resource protection by allocating some areas for recreation and other areas for preservation (Stankey *et al.* 1985). Finally, the LAC System makes the financial, social and economic costs of wilderness management explicit by requiring managers to examine the intrinsic tradeoffs being competing goals (McCool & Cole 1998).

Protected area managers have also recognized several barriers to implementing the LAC System. First, the LAC System is a long and complex process and in many instances there is not enough funding and personnel to effectively implement it (McCool & Cole 1998). Second, the LAC System requires an integrated approach with input from different departments, which is oftentimes difficult to accomplish (McCool & Cole 1998). Third, the LAC System requires public participation throughout the process, which can be expensive and time consuming (McCool & Cole 1998). Finally, since the management decisions that

stem from the LAC System are often controversial and difficult to implement, agencies often lack the "political will" to implement them (McCool & Cole 1998).

The LAC System has been useful in addressing the biophysical and social impacts of recreational use in a variety of settings and locations (Manning & Lime 2000). Protected area managers have used the LAC System successfully to address such issues as; crowding in wilderness areas, conflicts between different user groups and resource impacts in wilderness areas (Manning & Lime 2000). The concept of the LAC System has also been developed into frameworks in other countries, including Canada and Australia, to address conflicts in protected areas (Manning & Lime 2000).

Given that the LAC System has been used successfully to address conflicts in diverse situations and locations, this research aims to assess the applicability of the LAC System to the overnight caves in the uKhahlamba-Drakensberg Park. Two critical research questions have been developed that the research intends to answer:

- Can the LAC System be applied to the management of the overnight caves in the uKhahlamba-Drakensberg Park wilderness areas?
- Are there certain characteristics of the overnight caves that make it more difficult or not possible to apply the LAC System?

To achieve the overall aim of the research seven objectives have been developed:

- To review and describe the ten steps of the LAC System.
- To describe the application of four of the ten steps of the LAC System process to the overnight caves in the Mlambonja Wilderness of the uKhahlamba-Drakensberg Park.
- To determine resource indicators for the condition of the overnight caves as step four of the LAC System.
- To develop a form or procedure manual using the selected resource indicators.
- To develop a method for estimating condition classes and an overall level of impact scale for the overnight caves.
- To identify any characteristics of the overnight caves that influence or

prohibit the application of the LAC System.

- To draw some general conclusions about the overall applicability of the LAC System to all of the overnight caves in the uKhahlamba-Drakensberg Park.

Research Methodology

A two-staged approach to the research was used which consisted of a detailed literature review, and a short period of field research. The literature review examined national and international literature on the LAC System and the current and impending management strategies for the wilderness areas in the uKhahlamba-Drakensberg Park. This part of the research examined the concepts of the LAC System and illustrated how the LAC System might be applied to the overnight caves. A detailed examination of all ten steps of the LAC System was provided, however, due to time constraints, only the first four steps of the LAC System were applied to the overnight caves.

From the literature review a list of eight resource indicators for the overnight caves and methods for measuring the resource indicators was developed. The eight indicators of resource conditions in the overnight caves that were identified from the literature review are: area of disturbance, rock fire rings, charcoal or fire scars, graffiti, damaged trees, litter, candle wax, and toilet paper. The methods used to measure these resource indicators were developed primarily through literature on applying the LAC System and developing resource indicators. However, some of the categories and time periods for measuring the resource indicators were developed taking into account the researcher's past work experience in campsite inventories. These resource indicators and the methods for measuring them were then developed into a procedural manual, which was applied to four overnight caves during the field research. The following table is a summary of the eight selected resource indicators for the overnight caves used in the procedural manual and how they were measured.

Table 1: Summary of resource indicators.

Indicator	Measurement
1. Area of disturbance	In m^2 of area.
2. Rock fire rings	Number of fire rings or estimated clean up time.
3. Charcoal/ fire scars	In m^2 of area.
4. Graffiti	Number of etchings of graffiti on walls.
5. Trees scarred or limbs removed	Number of trees damaged in immediate vicinity.
6. Litter	Estimated amount of litter or clean up time.
7. Candle-wax	Number of candle wax locations in cave.
8. Toilet paper w/ in 100 m of overnight cave	Number of pieces in 100 m outside of cave.

During the literature review a reconnaissance visit to one of the selected overnight caves also occurred. The reconnaissance visit involved backpacking into the Mlambonja Wilderness Area and spending a night in Xeni Cave. This not only put the case study area into perspective, but it also helped to gain a better understanding of the visitor's experience and the concerns of managers surrounding resource degradation. Information gathered during the reconnaissance visit was also instrumental in identifying and developing the resource indicators for the overnight caves.

The field research occurred over the course of a week and involved backpacking into the Mlambonja Wilderness Area and applying the procedural manual to the four selected overnight caves: Xeni Cave, Barker's Chalet, Ribbon Fall's Cave and Sherman's Cave. To help assess the appropriateness of the resource indicators

and methods of measurement a colleague also applied the procedural manual to the four overnight caves. This was done at the same time, however to prevent overlap during the application one evaluator would start with the first indicator and work forward while the other evaluator would start with the eighth indicator and work backwards. Having two evaluators apply the procedural manual to the four overnight caves also helped to test the reliability of the procedural manual. The completed procedural manuals from the field research can be found in Appendix 1.

Discussion on Procedural Manual

According to the work of Stankey *et al.* (1985) and Watson and Cole (1992) indicators should be: measurable, reliable, cost-effective and efficient, significant, relevant, sensitive and responsive. To determine their appropriateness, each resource indicator has been analysed to determine how well they meet these desirable characteristics.

Table 2 on the following page illustrates how each of the eight selected indicators in the research meets the criteria for indicators proposed by Stankey *et al.* (1985) Watson and Cole (1992).

CRITERIA FOR INDICATORS	SELECTED INDICATORS							
	Disturbed Area	Rock Fire Rings	Charcoal/ Fire Scars	Graffiti	Scarred Trees	Litter	Candle Wax	Toilet Paper
Measurable (Quantitative)	Yes, in m^2	Yes, # of rings	Yes, # of scars	Yes, # of incidents	Yes, # of trees	Yes, # of pieces	Yes, # of locations	Yes, # of pieces
Reliable (Yield similar results)	Difficult to get similar results	Yes, yield similar results	Yes, yield similar results	Difficult to count	Yes, yield similar results	Yes, yield similar results	Difficult to count	Yes, yield similar results
Cost-effective (Simple Measurements)	Yes, minor measurement	Yes, simple count	Yes, simple count	Yes, simple count	Yes, simple count	Yes, simple count	Yes, simple count	Yes, simple count
Significant (Detects changes)	Difficult to get similar results	Yes, but easily removed	Yes, persist for a long time	Yes, persist for a long time	Yes, persist for a long time	No, can be removed	Yes, persist for a long time	No, can be removed
Relevant (Result from human activity)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sensitive (Early warning sign)	No, long term changes	Yes, can alert managers	Yes, can alert managers	Yes, can alert managers	Yes, can alert managers	No,changes over time	Yes, can alert managers	No,changes over time
Responsive (Affected by management)	Difficult to change	Yes, can be removed	Difficult to remove	Difficult to remove	Difficult to remove	Yes, can be removed	Difficult to remove	Yes, can be removed

Table 2: Criteria for indicators.

Measurable

To measure each resource indicator a quantitative method of measurement has been developed. All of the resource indicators are measured by a simple count or by an estimation of the area of damage, though the area of disturbance indicator does require some simple calculations. Therefore, all of the resource indicators are measurable according to the criteria of Watson and Cole (1992).

Reliable

According to Watson and Cole (1992:66) a reliable indicator should produce "repeatable measures by different personnel". While all of the resource indicators are measured quantitatively, the field research revealed that some of the resource indicators where slightly more difficult to measure and the results varied between the evaluators. The resource indicators, rock fire rings, charcoal/ fire scars, trees scarred, litter and toilet paper, all produced similar results between the evaluators. However, there were varying results in measuring the area of disturbance, graffiti and candle wax, as discussed below.

The area of disturbance is difficult to measure since it is difficult to distinguish exactly where visitors have trampled the vegetation outside of the overnight cave. On Ribbon Fall's Cave it was quite easy to determine the disturbed area since the area in front of the cave was elevated and there was not much vegetation to trample. The results for the disturbed area for Ribbon Fall's Cave only varied by 2 m^2 between the evaluators. However, on Xeni Cave where the vegetation is thick it was hard to determine what was the natural vegetation line and what vegetation visitors had trampled. For Xeni Cave the disturbed area measurements varied by 27 m^2 between the evaluators. In order to develop categories that adequately reflect the calculated area of disturbance it would be difficult since there is such variance between overnight cave size and topography.

Since each overnight cave has a different topography and the vegetation thickness outside of the overnight caves varies, determining a reliable method to measure the area of disturbance is difficult. All four of the overnight caves that were examined in the case study were located in steep terrain and the area directly in front of the cave was minimal before dropping downhill. So, the actual

topography of the overnight caves might limit the area of disturbance and, therefore the use of area of disturbance as a resource indicator may not be necessary or appropriate.

The number of graffiti etchings was difficult to measure since in many of the locations visitors have etched repeatedly one on top of another. This makes it difficult to distinguish an actual number of graffiti etchings and an alternative method of measurement may be necessary.

The research also produced varying results among the evaluators for counting the number of candle-wax locations. In the case study overnight caves visitors have placed candles at numerous locations which made it difficult to distinguish and count exactly how many candle-wax locations there were. To adequately measure the candle-wax locations the categories for measurement that were used in the procedural manual need to be increased.

Cost-effective and efficient

To be cost-effective and efficient means that personnel can effectively measure the resource indicators using simple equipment and techniques and that the length of time it takes to measure each is not too onerous (Watson & Cole 1992). The only equipment that is required to measure the resource indicators is a measuring tape, which is used to measure the area of disturbance. All of the other indicators are measured by a simple count or an estimated area of damage. However, to test the overall cost-effectiveness of the procedural manual the length of time it took both evaluators to work through the procedural manual in all four overnight caves was calculated during the field research. For Xeni Cave, which is the largest of the four overnight caves in the case study, it took each evaluator approximately 45 minutes to work through the procedure manual. While Barker's Chalet, which is the smallest of the overnight caves in the case study, took approximately 35 minutes.Therefore, based on the information gathered during the research it would take personnel approximately 40 minutes to work through the procedure manual for each overnight cave. This is a short period of time, which suggests that the procedure manual is a cost effective method of measuring the selected resource indicators in the overnight caves.

Significant

A significant indicator is one that is capable of detecting serious changes in the wilderness condition or features of the area (Watson & Cole 1992). These might include changes that persist for a long time, that disrupt ecosystem function or that reduce the quality of the recreational experience (Watson & Cole 1992). Of the eight selected resource indicators in the research five would persist for a long period of time: area of disturbance, charcoal/ fire scars, graffiti, trees scarred, and candle-wax. Not only are these five resource indicators recognised as significant indicators since they persist for a long period of time, they are also significant since they can reduce the quality of the recreational experience. Being in wilderness areas the overnight caves should be natural and have little or no human disturbance, so these resource indicators should be minimal to retain the naturalness and solitude of the wilderness and to provide visitors with quality recreational opportunities.

The remaining three resource indicators: rock fire rings, litter, and toilet paper, can be readily removed in a short period of time. However, research by Cole (1989) has shown that litter is one of the most critical items that effects visitor's enjoyment in a wilderness area. Since litter and toilet paper have been shown to reduce the quality of recreational experiences, they are recognized as significant resource indicators. Finally, rock fire rings if used repeatedly by visitors leaves fire scars, which are not only another resource indicator, but have also been determined to be significant long lasting impacts.

Relevant

According to the work of Watson and Cole (1992) an indicator is relevant if it detects changes that result from human activity. This applies primarily to wilderness areas since one of the primary objectives of a wilderness area is to minimize human impact. All eight of the resource indicators selected in the research are relevant since they are directly linked to, or result from, human activity in the overnight caves.

Sensitive

An indicator should focus on sensitive components of the wilderness resource that will alert managers to deteriorating conditions while there is still time to take corrective action (Watson & Cole 1992). Overall, the overnight caves are a sensitive component of the wilderness areas in the uKhahlamba-Drakensberg Park since there are only a limited number of them open to overnight camping. With only a limited number of 58 overnight caves available for visitors to camp in, changes due to human activity can occur quickly. The eight resource indicators used in the research aim to measure specific impacts on the resources found in the overnight caves in order to alert managers of deteriorating conditions so they can take action. The primary sensitive component found in the overnight caves that the resource indicators attempt to measure is naturalness or the absence of human activity. Research by Cole (1995) has shown that resources, such as vegetation and soils, which reflect the naturalness of an area are substantially degraded by low levels of camping or hiking. Since the naturalness of the overnight caves is sensitive to visitor use the eight resource indicators have been selected to respond to or reflect what levels of impact are occurring in the overnight caves.

Responsive

Watson and Cole (1992) suggest that indicators should measure changes in resources that are responsive to management control. All eight of the resource indicators used in the research can be influenced by management actions; however, some will be more difficult than others to address. In order to address visitor impacts in the overnight caves a combination of indirect and direct management techniques should be used.

Discussion on Condition Class Estimates

To provide an overall level of impact in the overnight caves a summary rating system was developed. Each indicator was assigned a level of severity based on impact, with 0 being no impact, 1 being minimally impacted, 3 being moderately impacted and 5 being severely impacted. While this method does provide valuable information on the level of impacts found in the overnight caves, it may

need to be modified to better reflect the importance of each indicator. Some of the indicators have longer lasting impacts that are difficult for management to address. For instance, graffiti, charcoal scars and candle-wax are difficult or impossible to remove and therefore should be assigned a higher level of severity. On the other hand, litter, toilet paper and rock fire rings can be easily removed and should be assigned to lower levels of severity.

Results

The previous discussion examined and attempted to determine how well the list of eight resource indicators developed for the overnight caves met the desirable characteristics of indicators proposed by Watson and Cole (1992) and Manning and Lime (2000). From this discussion the majority of the resource indicators met the desirable characteristics adequately, however, some of the measuring techniques for the resource indicators need modification. Recommendations on how to improve the measuring techniques will be provided in the Management Recommendations and Conclusions section and should improve the application of the procedure manual. Since the research demonstrated that the selected resource indicators are specific enough that they can be measured, the remaining steps of developing standards and management actions of the LAC System can be applied. Therefore, it is submitted that the research has shown that the LAC System can be applied to the management of the overnight caves in the uKhahlamba-Drakensberg Park wilderness areas.

From this research it also appears that there are no characteristics of the overnight caves that make it more difficult or that prevent the application of the LAC System. While the topography of the overnight caves might prevent or complicate the measuring of the resource indicator of area of disturbance, it does not prevent the overall application of the procedural manual and the LAC System.

Management Recommendations and Conclusions

Applying the procedural manual to the four overnight caves exposed some minor defects in how the indicators are measured. Before proceeding with inventorying all 58 of the overnight caves EKZN Wildlife should refine the measuring

procedures for several of the indicators. First, EKZN Wildlife needs to determine if measuring the area of disturbance or disturbed campsite area is necessary. The field research illustrated that measuring the area of disturbance was difficult and resulted in varying measurements between evaluators. Though there were some discrepancies between the evaluator's measurements, the area of disturbance if measured consistently overtime might provide useful data on soil and vegetation erosion and how well vegetation recovers under different management strategies.

Secondly, the measurement categories for graffiti etchings and candle-wax locations need to be modified. For graffiti etchings, it might be more appropriate to determine the overall area that has graffiti etchings, rather than attempting to count the actual number of graffiti etchings. In this method the categories for measuring the graffiti etchings might be: up to 1 m^2 of area, up to 3 m^2 of area and more than 3 m^2 of area.

Similarly, since all of the case study overnight caves received the highest level of severity for candle-wax locations the categories used to measure candle-wax locations could be significantly increased. More adequate categories for measuring candle-wax locations might be: 0-15 locations of candle-wax, 16-30 candle-wax locations, and 31 or more candle-wax locations.

Finally, the method for calculating condition class estimates needs to be altered to better reflect the significance of each indicator. As discussed previously, the measurements for some indicators should be modified to indicate the long lasting impacts associated with them. Since graffiti etchings, candle-wax locations and charcoal scars have long lasting impacts when calculating the level of impact for these indicators their score should be multiplied by a factor of two.

Once these alterations have been made to the procedural manual EKZN Wildlife staff should perform a complete inventory of all of the overnight caves (step 5 of the LAC process) using the procedural manual. Also, in the future the overnight caves should be assessed on a regular basis. The work of Cole (1989) suggests that campsites be monitored every five years, however this is based on North American ecosystems and may need to be modified to meet the requirements of

EKZN Wildlife staff.

LAC Recommendations

Component A of this research provided a more thorough discussion on the LAC process. However, there are a few areas that need to be expanded upon to help improve the implementation of the LAC System and, in turn, the management of the overnight caves.

Step two of the LAC System requires managers to identify the unique characteristics and features of the area and to identify the managerial issues and concerns. Due to the limited timeframe allocated for the research this step was unable to be completed thoroughly. However, these are two areas that should be expanded upon by EKZN Wildlife staff. In the future EKZN Wildlife staff should continue to work on developing a list of all the rare, threatened and endangered species that inhabit the wilderness areas. Knowing the location of the rare, threatened and endangered species will allow managers to determine if the recreational use of the overnight caves is affecting these species and could be used to support management decisions.

Also in step 6, which is the development of standards for the resource and social conditions of the overnight caves, it might be useful for EKZN Wildlife staff to hold a workshop with relevant stakeholders prior to the public comment period. Relevant stakeholders such as Berg Watch, the Wilderness Action Group, the WILD Foundation and Protected-Area Management students from the University of Natal could attend and may be able to provide some insight on adequate and obtainable standards for the overnight caves. A workshop such as the one proposed will help to eliminate some of the bias and subjectivity that is often associated with developing standards.

Finally, EKZN Wildlife staff should use a combination of indirect and direct management techniques on the overnight caves. Indirect management techniques such as educational materials including signs, pamphlets and field personnel should be used to alter visitor behavior. While direct management techniques should be used to eliminate the impacts that are already present in the overnight

caves. To eliminate the litter, toilet paper, charcoal scars, rock fire rings, and graffiti found in the overnight caves field personnel will need to visit the overnight caves and perform the necessary actions to eliminate the impacts. This includes picking up and removing the litter and toilet paper, scrubbing the charcoal scars and graffiti and removing the rock fires rings. To help reduce new locations of candle-wax permanent fixtures where candles can be placed should be used. Finally, if management decides that the area of disturbance exceeds the standards that are developed some caves may need to be closed temporarily to allow for the vegetation to recover.

In conclusion, applying the LAC System to the overnight caves in the wilderness areas of the uKhahlamba-Drakensberg Park should provide EKZN Wildlife staff with an explicit procedure for making management decisions. Once the LAC System is in place EKZN Wildlife staff should be able to employ appropriate management actions to achieve a balance between recreational access and wilderness preservation. A clear rationale with the necessary steps to be taken for each management action will provide for a better decision-making process. Each management decision that is made will have a traceable procedure and will provide information on why and how each decision was made.

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APPENDIX 1

Completed Procedure Manuals of Resource Indicators in the Overnight Caves

Name of Overnight Cave: Barker's Chalet
Date Surveyed: 2003/05/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	30.4	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	0	0	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	1	1	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	28	5	
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	8	5	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	10	3	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	34	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	8	5	
					Total = Condition Class Estimate	29	

Developed by Brian Long

Condition Class Estimate Barker's

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Comments

May need wider ranges

Toilet paper which is 3 pieces (Level 1or 3)?

Name of Overnight Cave: Barker's Chalet
Date Surveyed: 2003/05/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	46.9	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	0	0	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	1	1	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	23	5	
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	7	5	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	8	3	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	28	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	3	3	
					Total = Condition Class Estimate	29	

Developed by Brian Long

Condition Class Estimate Barker's

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Comments

Name of Overnight Cave: Ribbon Falls Cave
Date Surveyed: 2003/02/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	31.57	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	0	0	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	1	1	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	31	5	
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	5	3	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	16	5	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	17	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	1	1	
					Total = Condition Class Estimate	25	

Developed by Brian Long

Condition Class Estimate RibbFalls

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Contains rock art (6 eland, 2 people) that is fire scarred

Comments

Roof very scarred from fires
Count fire scars on ceiling, walls and ground?
Difficult to differentiate litter from toilet paper

Name of Overnight Cave: Ribbon Falls Cave
Date Surveyed: 2003/02/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size	Rating	Photo
Indicators	0	1	3	5	of Incidents	(1-5)	Number
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	29.8	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	0	0	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	3	3	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	21	5	
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	4	3	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	9	3	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	8	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	1	1	
					Total = Condition Class Estimate	25	

Developed by Brian Long

Condition Class Estimate RibbFalls

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

A large cave that is not to deep, very open, almost a rock with small areas of bedding. Large fires scars on ceiling 15 square meters.
Rock art eland and people fire scarred

Could note: bedding,rock art, fire scars on ceiling and whether or not fire rings are present

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Comments

Graffiti is difficult to distinguish-it appears that individuals scratch one on top of another. Which makes it hard to count numbers-maybe calculate area.
1-2 m2, 3-4m2, 5-6m2.
Disturbed campsite area should be measured starting from same side-right or left
Candle wax difficult to calculate- is where candle was placed or where it dripped down rock-what about candle burn areas?

Name of Overnight Cave: Sherman's Cave
Date Surveyed: 2003/05/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	37.75	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	0	0	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	0	0	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	9	5	
5. Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	No Trees	0	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	10	3	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	54	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	8	5	
					Total = Condition Class Estimate	23	

Developed by Brian Long

Condition Class Estimate Sherman's

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Comments

Name of Overnight Cave: Sherman's Cave
Date Surveyed: 2003/05/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	30.75	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	0	0	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	0	0	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	12	5	
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	0	0	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	9	3	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	38	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	9	5	
					Total = Condition Class Estimate	23	

Developed by Brian Long

Condition Class Estimate Sherman's

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Large open cave overlooking valley
plenty of bedding, shallow back 5-6 meters

Comments

Fire scar on the ceiling 2-3 square meters

Name of Overnight Cave: Xeni Cave
Date Surveyed: 2003/01/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	186.8	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	1	1	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	2	3	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	2	1	
5.Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	7	5	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	8 to 10	3	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	47	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	32	5	
					Total = Condition Class Estimate	28	

Developed by Brian Long

Condition Class Estimate Xeni

Or

Overall Level of Impact

Heavy

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Comments

Started Inventory at 12:25 to 1:10. Inventory time 55 minutes.
Am I supposed to pick up litter?
Over what area to count litter, disturbed area, cave or wider?

Name of Overnight Cave: Xeni Cave
Date Surveyed: 2003/01/04

Selected Limits of Acceptable Change Indicators for Overnight Caves in the Mhlambonja Wilderness Area							
	Level of Severity				Number or Size of Incidents	Rating (1-5)	Photo Number
Indicators	0	1	3	5			
1. Distubed Campsite Area	None	Up to 5 m^2 area of trampled or denuded vegetation.	6- 10 m^2 area of trampled or denuded vegetation.	More than 10 m^2 area of trampled or denuded vegetation.	222	5	
2. Rock Fire Rings	None	1 small (<1m) fire ring and/ or up to 2 min. clean up time.	1 large (> 2 m) or 2 medium (1-2 m) fire rings and/ or up to 10 min. clean up time.	More than 3 fire rings and/ or more than 20 min. clean up time.	1	1	
3. Charcoal/ Fire Scars	None	Up to 1 m^2 of area.	Up to 3 m^2 of area.	More than 3 m^2 of area.	2	1	
4. Graffiti	None	1-3 etchings of graffiti on walls.	4-6 etchings of graffiti on walls.	7 or more etchings of graffiti on walls.	11	5	
5. Trees Scarred or Limbs Removed	None	1-3 trees in the immediate vicinity.	4-6 trees in the immediate vicinity.	6 or more trees in the immediate vicinity.	7	5	
6. Litter	None	Few Small pieces and or 30 sec. clean up time.	Moderate amount of litter and/ or up to 3 min. clean up time.	Widespread litter and/or over 10 min. clean up time.	47	5	
7. Candle-wax	None	1-3 locations of candle-wax.	4-6 locations of candlewax.	7 or more locations of candle-wax.	44	5	
8. Toilet Paper w/ in 100 m of Overnight Cave.	None	1-3 pieces of TP present.	3-4 pieces of TP present.	5 or more pieces of TP present.	22	5	
					Total = Condition Class Estimate	32	

Developed by Brian Long

Condition Class Estimate Xeni

Or

Overall Level of Impact

Severe

Level of Impact Scale

Light	**(0-10)**
Moderate	**(11-20)**
Heavy	**(21-30)**
Severe	**(31-40)**

Description

Deep cave, difficult to find with waterfall coming over front. Plenty of space , some bedding wood and rock sitting bench.

Comments

Started inventory at 12:25 PM finished at 1:05. Inventory time is 50 minutes.