AN EXTENSION OF THE RECREATIONAL CARRYING CAPACITY CONCEPT: A PROCEDURE FOR RECREATION RESOURCE ALLOCATION IN THE PLANNING OF NATURAL LANDSCAPES

CAROLINE M HENDERSON

Dissertation submitted to the University of Cape Town in fulfilment of the requirements for the degree of Doctor of Philosophy in Environmental and Geographical Science

March 1992

ABSTRACT

Investigating the recreational carrying capacity of a new coastal national park in South Africa was the initial problem to be addressed. However, an examination of the concept and attempts to operationalize it shows clearly that it is illusory. Instead, the problem is conceived of as a process in which decisions about the allocation of recreation opportunities in the landscape must be made. The dissertation examines the complexities of decision-making in the face of multiple objectives, a spectrum of values, the uncertainties of predicting environmental impacts and the influence of the subjective values and preferences of decision-makers. This leads to the conclusion that a framework is required to guide the recreation opportunity allocation decision process. This framework is to be systematic, comprehensive and above all, explicit. The subjective nature of the decision process is given overt recognition, and the role of science in environmental decision-making put in perspective.

A tiered recreation planning system is proposed. At the scale of a single area such as a national park, two levels of planning are seen as necessary. The dissertation is largely concerned with elaborating an area-level procedure for allocating recreation "packages" or opportunities in the landscape. The procedure proposed combines the approach of the Limits of Acceptable Change planning system with techniques from decision analysis, to structure the subjective aspects of the process, and techniques of land evaluation to systematize the ecological basis for recreation planning in landscapes of particular conservation importance. A second, detailed level of planning at the site and recreation activity scale is proposed as being necessary, but is not developed further in the dissertation.

The Limits of Acceptable Change process defines a range of recreation opportunity classes in terms of social and resource conditions and managerial approaches necessary to maintain these conditions. Environmental quality standards for each class are formulated to monitor compliance with the objectives for each class. These recreation opportunity classes must be allocated in the landscape. A decision-tree is constructed to expose the actual process by which recreation opportunity classes are spatially designated. The decision-tree comprises a tiered series of questions, the answers to which are decided by explicitly defined decision rules or criteria. The basis of these decision rules are the analyst's interpretation of the data available on the system.

This decision-making process was tested on the Weskus National Park at Langebaan on the Cape West coast of South Africa. It was found to be effective in allocating recreation opportunities in the landscape, and offers a defensible planning strategy for conservation agencies operating under time and financial constraints in the face of an increasingly environmentally aware and articulate public.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF APPENDICES

PREFACE

The extinction of dinosaurs may prove that they were ill-adapted for life on earth, but they did not **set out** to prove as much. This dissertation has had a similar evolution, ideas evolving as problems were encountered in undertaking graduate research about recreational carrying capacity. It does not therefore set out to test an hypothesis. Rather, in line with Pielou's (1981) discussion of the *investigative* approach to scientific inquiry, a clear question is asked and investigated, by a variety of means, to reach a conclusion. And like evolutionary change, the result is incremental: this is not a whole new animal, but some of the parts have perhaps been streamlined, or new mechanisms added.

Furthermore, the concern is not with science and knowledge as such, but with their use in the rational management of resources. The precision and experimental rigour of the scientific method will be shown to be inappropriate and even ineffective in solving what is as much a socio-political problem as an ecological one. What the dissertation and science do have in common, is a *rational* approach to problem solving, that is, logical progression in argument. The dissertation is thus organized to follow this logical progression: much of the sense of the discussion of complex issues relating to environmental planning and management, and to the recreational sector in particular, will become apparent by degrees. This is as much a philosophical treatise as a scientific inquiry.

For personal reasons the field work for the dissertation was completed several years ago. While the particular conditions may have changed a little (periodic visits to and inquiries about the case study site have indicated the persistence of earlier patterns), the general principles remain equally applicable, and will continue to be applicable to recreation planning and management in the future.

ACKNOWLEDGEMENTS

I am deeply indebted to Professor Richard Fuggle for his unflagging support and encouragement, without which this work may never have seen the light of day. There are numerous other friends and collegues at the Department of Environmental and Geographical Science, University of Cape Town, who have contributed morally and materially to the conclusion of this work. Dr George Robinson of the National Parks Board showed the initial interest which sparked off this endeavour. Roy Stauth's work stimulated many ideas, and Merle Sowman's provided a practical approach at the start.

To all the scientists who have worked in the Langebaan lagoon area, the site of the case study described in the dissertation, and who gave readily of their time and interest in personal communications, I am also grateful. They are listed after the References. In particular, I would like to thank Dr Charlie Boucher, who knows more than anyone about Strandveld vegetation, for access to his expertise amidst a hectic schedule.

To the following organizations I owe thanks for financial support at various times: Council for Scientific and Industrial Research (Masters and Ph D bursaries); South African Breweries (bursary); the Human Sciences Research Council, for bridging finance; the National Parks Board for operating costs and assistance in the field.

My family's support and financial assistance are very gratefully acknowledged. Pat Morant displayed a woman's intuition in his sense of timing with the latest in the Gary Larson *Far Side* series!

Finally, without the assistance of the Institute of Natural Resources, Pietermaritzburg, which gave me "time-out" from normal duties, I could not have completed this task: Thank you.

PART 1

CHAPTER ONE

INTRODUCTION

1.1 STATEMENT OF THE PROBLEM

Recreation and tourism constitute the major land uses of large parts of the South African coast; and recreation is the *raison d'etre* of many Cape coastal towns (Cape Province 1973). As in many other countries during the course of the twentieth century, there has been a tremendous rise in recreational pressure on the coast as affluence, mobility and population numbers have risen (Cicin-Sain 1990; Sowman and Morant 1989; Pearce and Kirk 1986; Capas 1985; Sowman 1984; Ghazanshah, Huchel and Devinny 1983; Pigram 1983; Cook 1979; Jubenville 1976; Clawson 1972). Increased use and associated infrastructural development have proceeded often with little heed for the environmental consequences of such actions (Sowman and Morant 1989).

A further contributing factor has been the emphasis on economic development - necessary in a Third World country - which has brought about other pressures on the coastal zone, of which industrial development has probably had the greatest impact. South African examples of this are the designation of George, a regional center very close to the Southern Cape coast, as an industrial growth point; and the development of a major iron ore loading facility in Saldanha Bay adjacent to the internationally famous conservation area, Langebaan lagoon, on the Cape West coast. It is highly relevant that 90 percent of the population of the Cape Province, which includes two thirds of the country's coastline, live within 100 km of the coast (Heydorn and Tinley 1980).

Concern about the deterioration of the South African coastal environment has been cause for comment for twenty years (Begg 1984, 1978; Heydorn and Tinley 1980; Siegfried 1978; Grindley 1974; Heydorn 1973). The combined effect of development has been varying degrees of environmental transformation which has, in many cases, threatened the quality of natural amenities which attracted recreationists there in the first place.

Calls have been made for co-ordinated planning and management of coastal resources (Begg 1978; Heydorn 1978) in order to ensure preservation of the natural features which attracted people there. This requires the recognition of areas designated specifically for their recreational potential[1]. But the vexatious question remains of how to accommodate increasing recreational use without degradation of the natural resources on which such use depends (Sowman and Morant 1989; Pigram 1983; Clark and Stankey 1979; Jubenville 1976; Tivy 1972). In many respects outdoor recreation[2] planning, and certainly its research arm, has been preoccupied with this problem and various approaches have been developed to solve it, or at least to minimize it (Tivy 1972).

Underpinning the efforts of managers and planners to minimize recreational damage has been an implicit belief that there is an optimal limit to the biophysical environment's capacity to tolerate recreational use without the onset of irreversible ecological degradation. Tivy (1972) goes so far as to say - and I agree with her - that this concept is inherent in all man-land interactions and is related to the notion of sustainable yield (in this case the sustainable supply of recreation resources). If this is indeed the case, then recreation planning would be most effective in achieving its aim of limiting environmental degradation were it able to predict the point at which such irreversible change begins, and to limit use and (by implication) the impacts of such use to a level at which that threshold would not be exceeded.

However, the management of environmental degradation is not the only task of recreation planning and management. Since the nature of recreation concerns the enjoyment and re-vitalisation of people (Pigram 1983; Jubenville 1976; Driver and Tocher 1970), recreation plans and facilities should also aim to provide quality recreational experiences. Recreation planning must thus address both ecological values and social values and attempt to achieve a high quality in both.

In certain situations special values are at issue. This is the case in national parks, because of the high value placed on the preservation of their natural landscapes. As has been repeatedly demonstrated worldwide, the dual functions of national parks,

---

1 To this end a major regional planning exercise, geared to recreation planning of the Cape coast, has recently been drafted (Cape Provincial Department of Local Government 1988).

2 The term **outdoor** recreation is used deliberately: this work concerns recreation which occurs out-of-doors in natural landscapes (as distinct from urban parks, which are almost completely the products of human design).

namely the preservation of outstanding natural environments and the benefit and enjoyment of the people, do not always make happy bedfellows (Fitzsimmons 1979; Hartzog 1979). The same factors that have resulted in the **general** expansion of outdoor recreation in developed countries have caused the recreational use of parks to increase dramatically. And, of course, a simultaneous deterioration in the quality of those environments has been observed (Brockelman and Dearden 1990; Dustin and McAvoy 1982[3]; Kushlan 1987; Salm 1986; Pigram 1983; Jefferies 1982; Fitzsimmons 1979; Budowski 1977; Lavery 1974; Wagar 1964). This has impaired both the conservation value of those areas and often the quality of the recreational experience (Lime and Stankey 1979). While this trend was extensively commented on at the Second World Conference on National Parks in 1979 (Crowe 1979; Erz 1979; Hartzog 1979), it would appear that the trend has continued unabated. A recent assessment of the world's national parks found 1600 individual threats to the 100 parks surveyed. In 23 percent of these parks "too many visitors" was reported as a threat. Authors Machlis and Tichnell (1985) concluded that national parks face threats to every subsystem - air, water, soil, vegetation, animal life, and management. The pervasiveness of the problem extends from tropical reefs (Rosier, Hill and Kozlowski 1986; Salm 1986,1985) to Himalayan meadows (Jefferies 1982).

These threats come not only from recreational use of the parks themselves, but also from the diffusion of impacts of surrounding or adjacent land uses which are beyond the park authority's control (Brockelman and Dearden 1990; Kushlan 1987; Newmark 1987; Machlis and Tichnell 1985). South Africa would appear to be no exception in its most popular parks: the Kruger National Park is facing acute threats to all its major rivers as a result of land use practices largely beyond its border (Moore, Van Veelen, Ashton and Walmsley 1991). And, with more than 500 000 annual visitors[4], there is concern that the park is becoming overcrowded.

The recognition that parks are not islands to themselves has lead to changes in perceptions of national parks. No longer are national parks seen as the exclusive preserves of wild plants and animals under the exclusive custodianship of park authorities. Many national parks now have resident human populations (the IUCN definition of national parks says they are areas "where one or several ecosystems are not materially altered by human exploitation and occupation" (IUCN 1978), so that, certainly in Africa, large scale removals of usually indigenous people occurred in park establishment). In Third World countries where the establishment of parks frequently halted the access of local peoples to traditional resources, and where parks are often surrounded by dense populations of impoverished subsistence dwellers, these people are demanding access to the resources of, and a say in the management of, the parks (Hough 1988; Tangley 1988; Abel and Blaikie 1986;

---

3 A problem graphically described by these authors as the "despoliation associated with recreationists 'loving the land to death' " (Dustin and McAvoy 1982:343)

4 565 000 in 1987/88 (Joubert pers comm)

Zube 1986). Furthermore, such conflicts of interest are found in developed countries as well: several cases have been reported where the neglect of local community values, needs and aspirations has led to major conflict with national park authorities (Zube 1986). Indeed, the initial approach of the South African National Parks Board to the takeover of the Langebaan lagoon, which provided the case study site for this dissertation, caused considerable resentment and fear in local communities (pers. obs. - see Chapter 5). In another South African case, the recently proclaimed Richtersveld National Park, resident pastoralists won their battle to be allowed to remain in the park and to be included in management structures (Hill 1988).

The upshot of this is that interested and affected parties are demanding greater accountability on the part of conservation agencies to whom the management of parks is entrusted. The need for park authorities to disrupt traditional local patterns of use is being questioned (Zube 1986), local economic and cultural needs are being asserted and park authorities are being called upon to defend their policies and management approaches. Since the late 1970's calls have been made for proper public participation in park planning and even management, to the extent that many authors believe parks are unsustainable unless they have the support and co-operation of the local communities (Mwalyosi 1991; Hough 1988; Tangley 1988; Abel and Blaikie 1986; Zube 1986; Tinley undated).

In summary, even on their own the traditional dual purposes of national parks, conservation and recreation, make the planning and management of parks inherently complex, with managers having to balance the needs of the natural landscapes they are charged with protecting against the demands of leisure seekers. In addition, the traditional view[5] of national parks as being solely for conservation and recreation/tourism, is being questioned. There may be resident human populations whose needs and aspirations must be catered for, interested publics whose demands cannot be ignored, and influences from outside the park boundaries over which they have no control. Clearly, where new parks are concerned, there is a need for defensible planning strategies which will seek to minimize these conflicts without impairing the conservation value of the parks.

In the broadest terms, it is thus to the task of marrying environmental conservation and recreation, particularly in protected coastal landscapes, that this dissertation is addressed. The problem is to find an approach to this task which, in order to protect conservation values, will be ecologically rigorous, as well as being socially meaningful (capable of dealing with recreationists' and others' needs and preferences) and comprehensive (able to deal with extraneous influences). The thesis holds that the establishment of an optimal limit to the recreational use of

---

5 Albeit a Western view, even a peculiarly American one, according to Sax (1982). Sax suggests that Americans view the presence of people in national parks as alien and intrusive because of their history of destructive exploitation of land. The concept is quite foreign to many Third World peoples upon whom national parks were foisted during colonial times (Hough 1988; Zube 1986).

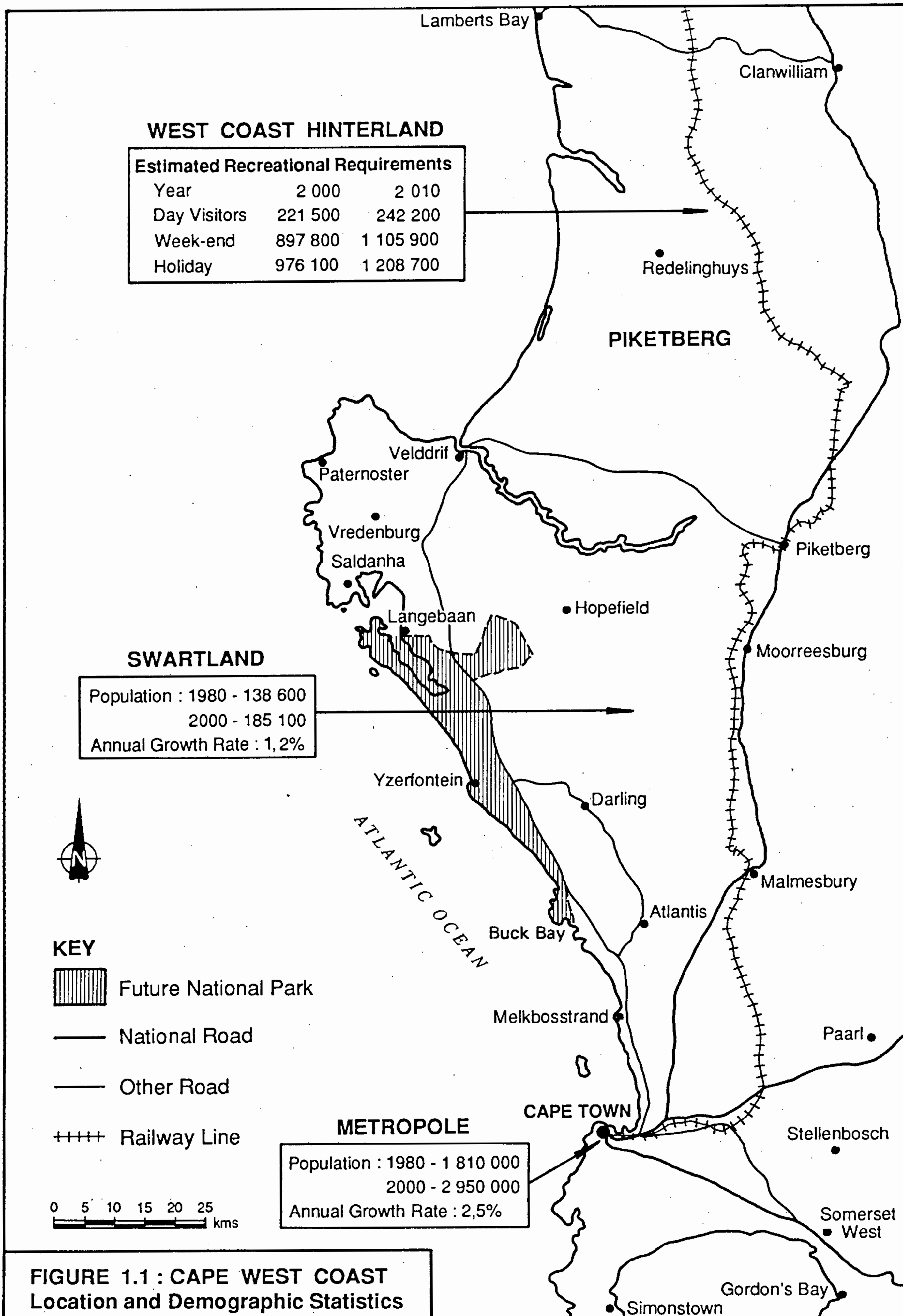


FIGURE 1.1 : CAPE WEST COAST
Location and Demographic Statistics

natural landscapes which will maintain **ecological** quality, must be considered the major objective of recreation planning in protected landscapes.

1.2 BACKGROUND TO THE DISSERTATION

In this context it is hardly surprising that, when the planning of a proposed national park, to be situated in a popular recreation area on the Cape West coast of South Africa and which was increasingly under threat from developers' bulldozers and the "sheer weight of human numbers" (Hey 1977:400), was discussed in 1983/84, the question of its optimal recreational use was raised.

Langebaan lagoon forms a long, shallow arm of Saldanha Bay, a deep coastal embayment (Figure 1.1) which lies on the Cape West coast approximately 120 km northwest of Cape Town. The lagoon and bay contain a unique complex of coastal habitats and ecosystems which have long been recognized, by scientists and laymen alike, as being of national and international conservation importance. In addition, the area plays host to a rich cultural heritage, from Pleistocene archaeological deposits (Siegfried 1985; Robertshaw 1978; Hendey and Deacon 1977), shipwrecks from the days of piracy and maritime warfare and the relics of whaling stations, to the activities of modern and subsistence fishing industries. Calls for the extension of formal conservation status to the lagoon and its surroundings became strident during the 1970's with the development of a major ore loading jetty at Saldanha, a small port on the northern shore of the Bay.

The lagoon has in recent years also become a mecca for watersport enthusiasts, drawing thousands of visitors during the summer season, the majority of them from the Cape Town metropolitan area. This has brought to the lagoon problems associated with crowding, conflicts between different users and uses and perceived biophysical and aesthetic degradation. At a symposium on the natural sciences at Saldanha Bay in 1976 the issue of recreational pressure on the lagoon area was raised and calls for improved control and management were made (Fuggle 1977; Hey 1977). The lagoon and its surroundings thus presented a host of competing interests which would have to be accommodated in any planning initiatives.

The islands in Saldanha Bay, the lagoon itself and small strips of State land around it (the Admiralty Zone) were proclaimed a National Park, the Weskus National Park, in August 1985 (Government Gazette No. 9904), after the entire area had been declared a *nature area* in terms of the Physical Planning Act (No. 88 of 1967)[6] on 14 December 1984 (Government Gazette No. 9525). Since then the National Park has grown by incremental purchase of surrounding farms and the

---

6 *Nature areas* were designated landscapes in which, from the date of promulgation, development could not be undertaken without a special permit. The consequence was an effective "freeze" on development. *Nature areas* have now been replaced by *limited development areas* under the Environment Conservation Act of 1989.

conclusion of contractual agreements with adjacent landowners[7] (Figure 1.2, overleaf). The principal land uses of the lagoon and surrounding lands are now conservation and recreation, but there is still a small amount of farming activity. (The presence of these diverse interests in the Park suggested the need for a new approach to park planning, one which would depart from the South African authoritarian mould.)

The National Parks Board decided to create, from the start, a master plan for the entire area of the National Park proposed in the long-term (Figure 1.1), as if it were an existing reality[8]. Early management policy guidelines drawn up by the Board in 1984 recognized the central problem to be addressed by the Master Plan of any national park: how to achieve a balance between the conservation/preservation function of the park and the legislated requirement to provide recreation opportunities for the public. Accordingly, these guidelines called for the "formulation of a recreation policy for the lagoon, adjacent land areas and the islands which will *endeavour to be in harmony with the carrying capacity of the area and the recreational needs and desires of visitors*" (National Parks Board (George) 1984). The guidelines also stated that a master plan would be drawn up to provide a framework for the management of the area.

In discussions during early 1985 with Dr George Robinson, Head of Southern Parks, he expressed the Parks Board's interest in an investigation into the lagoon and surrounding lands' human or recreational carrying capacity, as an input to the master planning of the proposed park. In this way work towards this study was initiated. Attention at that stage was focused on one particular beach on the lagoon, Kraalbay, which drew large numbers of people on holidays, but which had severe limitations of space and facilities. The initial study was therefore to concentrate on the carrying capacity of this beach and associated water area, but it was soon realised that Kraalbay could not be isolated from the rest of the lagoon and the land around it. The entire lagoon area and surroundings thus became the object of research.

Sowman's (1984) work on the recreational carrying capacity of the Cape Infanta holiday town on the Cape coast provided a convenient starting point, situated as the study site was in a coastal area. However, during the early research phase it became apparent that there were a number of differences between the two applications. Sowman's study was concerned with the impacts of further residential development on the recreational *milieu* of the town; the assessment dealt only with the activities conducted on the water and the capacity of ancillary facilities to accommodate increased use. The study area was limited to the township and the

---

7 This is a new concept in conservation in South Africa whereby privately owned land is managed as a National Park under contract with the National Parks Board as the managing agent.

8 much of this plan has been realised with the transfer of State land and donations for the purchase of farms in the area, but the long-term plan is to extend the park down the coast as far as Buck Bay (see Figure 1.1).

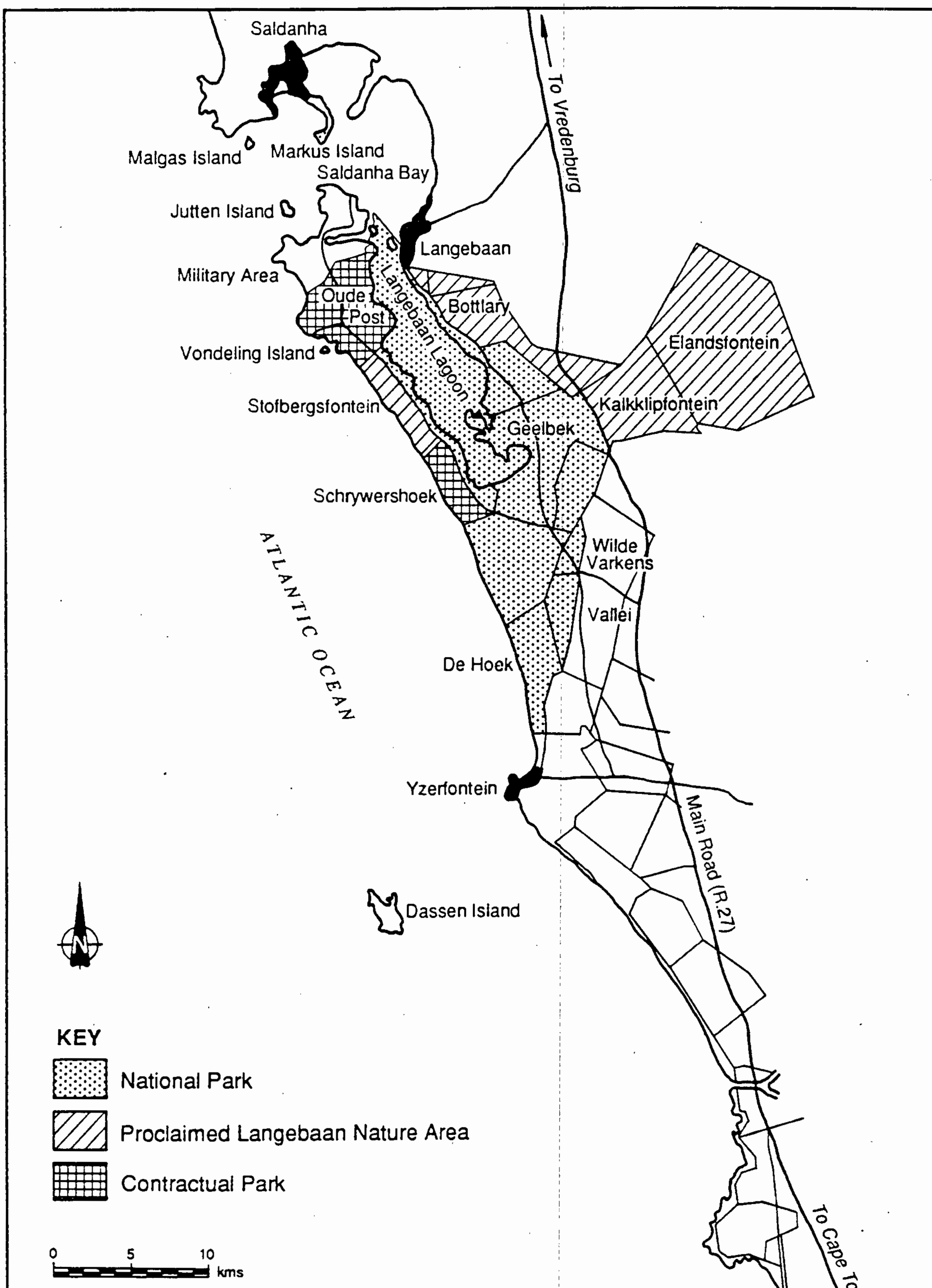


FIGURE 1.2 : LANGEBAAN LAGOON
Conservation Status

body of water adjacent to it. In contrast, the Langebaan environment under scrutiny was spatially far larger and it presented two major systems for analysis.

These were:

1) the lagoon itself, the focus of recreation activities, where the principal concern was its capacity to accommodate a variety of watersports, associated facilities and activities which were already established in the area;

2) the surrounding lands of the eventual Weskus National Park, most of which had not previously been used for recreational purposes because of private land ownership. Here the researcher and planner would have a *carte blanche*, with few precedents for establishing a framework for analysis, since all carrying capacity studies seem to proceed from an existing recreational situation, as was the case in Sowman's Cape Infanta study. In other words, extrapolations into the future are made from observations on the existing use/environment interactions.

Two major areas of concern thus presented themselves:

1) **a conceptual problem:** the question of an approach to or framework for the planning of recreational use in a natural landscape which would be equally appropriate for a previously unused area;

2) **a methodological problem:** a methodology for implementing the planning framework in an ecologically important and heterogeneous landscape which would be readily applicable by conservation agencies.

It had to be established whether the concepts of recreational carrying capacity (RCC) provided a viable approach to the resolution of recreation planning problems in areas which had not previously been used for that purpose. Secondly, a methodology for establishing recreation carrying capacity guidelines in a variable landscape had to be investigated. The focus of the study consequently shifted from being an assessment of the the recreational carrying capacity of the Weskus (West Coast) National Park *per se*, to examining the procedures whereby such assessments have been made in the past and how they might be improved. The Weskus National Park became a case study for testing a procedure proposed to deal with some of these difficulties.

1.3 AIMS AND OBJECTIVES OF THE DISSERTATION

The overall **aim** of the research conducted for this dissertation is to

> **develop and apply a procedure for establishing recreational carrying capacity guidelines in natural landscapes.**

The **objectives** of the dissertation are:

> *1) to examine the concept of recreation carrying capacity as a framework for resolving recreation planning problems in natural landscapes;*
>
> *2) to develop a decision-making procedure for establishing recreational carrying capacity guidelines in natural landscapes;*
>
> *3) to test the procedure by applying it to the planning of recreation in the Weskus National Park.*

In order to address these objectives an examination of the problems associated with recreational carrying capacity is a necessary precursor to the description of a procedure developed to address some of the theoretical and practical difficulties alluded to above. A critical review of the literature will show that the recreational carrying capacity concept cannot be directly operationalised, but that it might provide a *framework* for the allocation of recreation resources in natural landscapes. It will be argued that such a framework consists essentially of a sequence of decisions for the allocation of recreation resources. The requirements for such a decision-making framework are explored, and some approaches to the problem discussed. It will be argued that decision-making procedures in environmental planning[9] are in some respects **inherently**, and in other respects practically, subjective. Therefore any planning procedure should be designed to incorporate subjective decision-making by making the bases of subjective decisions explicit.

Finally a procedure is proposed which aims to deal with these problems when applied to recreation resource allocation decisions in natural landscapes. It will be argued that, if the allocation of recreation resources is to protect ecological values in protected landscapes, a tiered planning sequence is required. The tier of plans should, ideally, start with analysis and structure planning at a regional scale. This is to be followed by, and partly overlaps with, a crucial step in the planning of a specific location, that is, the allocation of recreation *opportunities* in the particular landscape. The sequence must continue to a level of detailed planning for specific sites within that location and each appropriate activity. However, since the first step (opportunity allocation) lays the basis for subsequent steps, it must be rigorously undertaken and the planning procedure must be defensible. The

---

9 That is, any planning which involves considering (including forecasting and evaluating) the environmental outcomes of proposed actions

dissertation therefore concentrates on the development of a suitable procedure for accomplishing this primary step. The proposed procedure is explained and illustrated by its application to planning recreation in the Weskus National Park. Because the emphasis of the dissertation is on areas which have not been used for recreation, the land areas surrounding the lagoon are the prime focus of the case study. However, the detailed planning stage is illustrated with one example, a detailed study of recreation on and around the lagoon which was commissioned by the National Parks Board in 1986. The report thereon is included as Appendix D.

1.4 SCOPE OF AND LIMITATIONS TO THE DISSERTATION

1.4.1 Comprehensiveness

The increasing recreational use/deteriorating environment problem outlined above can be classified, according to Fuggle's (1983a:2) definition, as an *environmental* problem, that is, one in which impaired interrelationships between man and his physical surroundings are the central concern. In dealing with environmental problems the need for an *holistic* approach to problem-solving is frequently stressed, because of the complex linkages of environmental interactions (Stauth 1989; Fuggle 1983b). Hence the standard use of multi-disciplinary teams in environmental evaluation procedures.

It might thus be legitimately insisted that environmental planning be holistic and comprehensive; that all types of planning - economic, industrial, tourism, town and city, agricultural, conservation and recreational - be integrated in uniform procedures under the authority of a common planning body. However, this would be too complex and unwieldy to be practical, and the *status quo* of compartmentalisation is likely to persist.

The implication of these comments for the dissertation is that no attempt is being made to develop a fully comprehensive planning approach. The context of the exercise is, unequivocally, recreation. This fact notwithstanding, it does not negate the necessity to consider other land uses and factors beyond the physical boundaries of the recreation setting which may affect the recreational *milieu*[10]. Nor does it contradict the principle that recreation planning should, ideally, be systematically integrated with the planning of other land uses.

10 See Chapter 2

1.4.2 Scale

A further related problem is that of scale: if all influential factors are to be incorporated, where are the boundaries of planning to be drawn? In general, there is broad scale planning, which may be geographically extensive (regional) or conceptually broad, and detailed planning, which usually concerns the particular problems of small geographic areas or individual sites. While many of the problems of recreation planning require a broad scale (regional) perspective[11], this is an aspect which could not be thoroughly undertaken in this study.

Here the spotlight is on the problems of a relatively small geographic area, the boundaries of which would be determined by administrative actions[12]. Furthermore, the emphasis is placed on areas which have been identified as being of conservation importance. While regional factors are considered, they have not been the subject of a specific analytic procedure (for comparison, see Ferrario 1978).

The corollary is that the procedure developed here for recreation planning, while flexible, cannot claim to solve the many other resource problems which may co-exist where multiple land use is the order of the day. The procedure is suitable for use in areas of predominantly natural landscape where conservation and recreation are the dominant land uses - although other land uses are not precluded.

1.4.3 Feasibility

Furthermore, the approach taken to the development of a procedure for recreation planning was circumscribed by two factors:

(1) limited time and money in the first stage of the project, which necessitated the use of existing information as far as possible; and

(2) in working with the National Parks Board on the planning of the proposed Weskus National Park, similar constraints of time and money prevailed, a situation which seems to be common to all public conservation agencies in South Africa[13]. The problem is far from being unique to South Africa; in fact, there is reason to believe that these operating constraints are widespread amongst conservation agencies worldwide. In a survey of decision-making procedures in 18 public agencies responsible for the planning and provision of rural recreation amenities in England (a so-called **developed** country), Curry (1982) found that planning procedures were determined primarily by **constraints** (a negative rather than positive determinant), the universally dominant constraint being financial, followed by political influence. Curry (1982:24) concluded that practical expediency took

11 See Chapter 3 (3.4.3) and Chapter 5, Case Study..

12 Nature reserves or national parks, for instance;

precedence over systematic approaches to planning; he found that the use of clear objectives, input information and formal approaches to evaluation had a low priority in agency operation.

While the need for comprehensive planning approaches will be discussed further in Chapter 3, the information requirements for a truly comprehensive model may be quite unrealistic (McCool and Ashor 1985:141). These authors quote McLaughlin (1977) further on the subject, that this requirement has been replaced by the best available or most affordable information, both of which seem to have become an acceptable end. These matters considered, it thus became a subsidiary objective of the project to develop a method which would be feasible within the operating constraints experienced by conservation agencies in South Africa and, indeed, elsewhere. The implications of this limitation in the methodology are explained further in Chapter 4.

1.5 STRUCTURE OF THE DISSERTATION

The dissertation is divided into two major parts. Part One deals with the theoretical rationale for the proposed procedure (Chapters One, Two and Three). In Part Two (Chapters Four, Five and Six) the proposed procedure is explained and illustrated by its application to the Weskus National Park, namely the lands surrounding Langebaan lagoon. Finally, the conclusions of the dissertation and implications of this work for further research in recreation planning are explored (Chapter Six). The different elements of the dissertation relate to each other as indicated in the flow diagram below, Figure 1.3.

Because of the complexities of the issues associated with taking a recreational carrying capacity approach to recreation planning, the dissertation draws on the literature of several academic fields, including planning (and specifically recreation planning), environmental evaluation[14], recreation carrying capacity, recreation ecology, land evaluation and decision theory. Because of the difficulty of organizing this wide array of material in some **logical sequence**, (parallel chapters would be more effective if they could be read that way), a review of methods of land evaluation, which was a major aspect of the literature review and which was, originally, the subject of a chapter in Part 1, has instead been relegated to the appendices (Appendix A). It remains an important element of the dissertation nonetheless, since it concerns a specific methodological problem within the overall planning framework which is proposed in Chapter 4. Important issues relating to land evaluation are therefore summarised in Chapter 4.

---

13 Government expenditure on conservation (listed as Ecological Services) constitutes 0,45 percent of the national budget (S. A. Department of Finance 1988).

14 "The process of organizing and weighing information the consequences, or impacts, of alternatives" (Stauth 1989: Glossary).

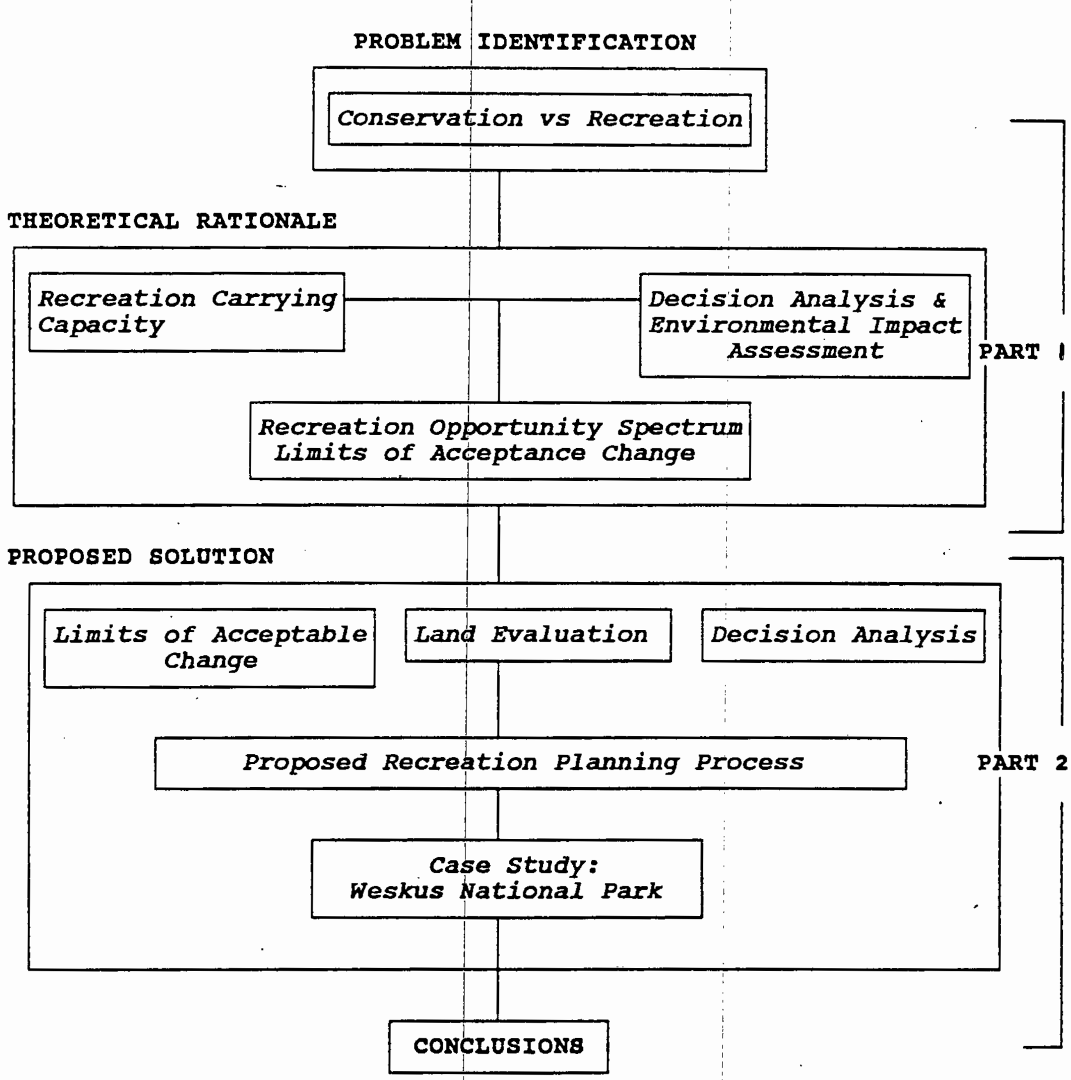


Figure 1.3: Relationships of fields of study in, and structure of the dissertation.

Chapter Two discusses concepts which are fundamental to understanding the nature of and difficulties associated with recreation planning. The chapter then gives a broad outline of approaches to recreation planning, followed by a detailed consideration of the concept of recreational carrying capacity.

The rationale for the approach taken in the proposed procedure is developed further in Chapter Three by an analysis of decision-making procedures and problems in environmental planning, and the development of approaches to dealing with these problems in recreation planning. The chapter concludes with a discussion of the conceptual framework, the Recreation Opportunity Spectrum and Limits of Acceptable Change Planning System, for the proposed procedure.

There follows the description and step-by-step discussion of the procedure in Chapter Four, a task which is accomplished by illustrating each methodological step in the procedure as it was applied in the case of the Weskus National Park at Langebaan lagoon. The results of applying the procedure, the precursor of a master plan for recreation in the Weskus National Park are laid out in Chapter 5. For a variety of reasons this dissertation succeeds by several years the fieldwork conducted at Langebaan lagoon during 1985 and 1986. While some trends will have continued, increases in recreational use for instance, periodic visits and checks have revealed few fundamental changes.

Conclusions about the viability of recreation carrying capacity as a practical approach to resolving the "increasing use leading to increasing degradation" conundrum, are made in Chapter Six. The implications thereof and recommendations for further research conclude the dissertation.

CHAPTER TWO

RECREATIONAL CARRYING CAPACITY: THEORY AND PRACTICE

2.1 INTRODUCTION

Carrying capacity has been applied both in resource management and in planning (Mitchell 1979). In this discussion the distinction between recreation planning and recreational carrying capacity (RCC) is frequently blurred. The procedures and methods employed may be common to both, while recreational carrying capacity relates more to an end product, an objective, than to the specific procedures used to reach it. As Sowman (1987) has observed, there are in any event no standardised procedures and methods for assessing RCC.

A broad outline of developments in the field of recreation planning pertaining to RCC (section 2.2) will follow this introduction. A preliminary requirement for any discussion of this subject is to be clear about what is meant by *recreation* and how this relates to the definition of recreation resources, since the identification, classification and evaluation of resource potential are essential steps in recreation planning (Pigram 1983).

2.1.1 The nature of recreation and recreation planning

The complex subject of what precisely constitutes recreation or leisure is not the topic of this study. For the purposes of this dissertation, the generally accepted definition of recreation as "activity voluntarily undertaken, primarily for pleasure and satisfaction, during leisure time" (Pigram 1983:3) will stand. The important characteristics of such activities are that they are normally free from obligation, compulsion or economic incentive, they occur outside of normal working time[1], participants have freedom of choice in the pursuit of them (Pigram 1983), and there may be multiple motivations for the choice of leisure activities (Stankey and McCool 1984; Brown, Driver and McConnell 1978; Driver and Tocher 1970). They also frequently involve notions of escape from routine (Driver and Tocher 1970). Note also that *recreation* is distinguished from *leisure*: the former is closely associated with *activity*, while the latter carries connotations of *time* (Pigram 1983). But activity alone does not constitute recreation: the attitude with which it is conducted is equally important, hence the contrast between amateur and professional sport, for instance (Pigram 1983).

In this study the concern is furthermore with outdoor recreation, that is, active, informal pursuits which are carried on beyond the confines of a building or home (Pigram 1983; Lavery 1971). The focus for the resource manager is thus the allocation and use of extensive areas of land and water for outdoor recreation (Pigram 1983:15).

The question of motivation is important, since it has some implications for recreation planning. The motivation for participation in recreation arises from the drive to fulfill certain physiological and psychological needs. These needs generally correspond with the higher order, or creative and self-actualising needs, of Maslow's (1954) hierarchy of needs (Driver and Tocher 1970). Experiences which achieve these motivational goals are then the object of recreation activities (Turner 1988). *Satisfaction* is gained when the recreational opportunity delivers the anticipated experiences. Understanding these desired experiences and the characteristics of the places and circumstances in which the activity is preferred, suggest behaviourists, will equip recreation planners with the information essential for designing opportunities and facilities capable of satisfying those needs (Turner 1988; Stankey and McCool 1984; Brown, Driver and McConnell 1978; Murphy and Howard 1977). The key products of management efforts become the experiences obtained from recreation engagements[2] (Glavovic 1988; Turner 1988). An additional advantage of this orientation, says Turner (1988:7), is that it provides planners and managers with more useful measures of the benefits visitors are seeking. It is in seeking benefits from activities pursued in natural landscapes that

1 What Clawson and Knetsch (1966), called discretionary time

2 Anticipation before and recollection after the event are also important components of the recreation experience.

recreationists generate *demand* for recreation resources. The landscape and its attributes constitute the *supply* of resources.

The task of the resource manager and planner is to match the demand for outdoor recreation and the supply of recreation opportunities. In terms of recreation resource analysis and planning, difficulties arise from the enormous range of activities which can be considered recreational, their diverse environmental requirements and the subjectivity of recreational experiences (Pigram 1983).

Recreation demand is a function of demographic and socio-economic characteristics of the user population, their preferences and perceptions. Recreational *opportunity* can be seen as the total package which goes to making up a recreational experience, while a recreational *activity* is just one activity undertaken within that package. Recreation opportunity is in turn determined by resource characteristics[3], by user perceptions of those characteristics and by their apparent accessibility (Pigram 1983; Lavery 1971). Recreational opportunity implies access to the supply, developed to meet a particular demand. Thus a wild mountain area to which the public has access, but which has no built facilities such as hotels, will provide an opportunity for wilderness lovers, but will not be seen as offering any recreational opportunities to hotel lovers.

It is thus apparent that demand and supply in this context have both socio-economic and biophysical components. A clear understanding of these terms, supply and demand, as they apply to recreation, is essential to the evaluation of recreation resources for planning purposes.

2.1.2 The supply of recreation resources

While it is demand for recreation which creates recreation resources (see definition of *resource* below) the supply of these resources depends on our definition of them. The term natural resources is frequently confused in the literature with the terms natural attributes\elements\components: with respect to **evaluating** resources the distinction is important.

O'Riordan (1971) has defined a *resource* as

> an attribute of the environment *appraised by man to be of value* over time, within constraints imposed by his social, political, economic and institutional framework.

In other words, it is **utility** which distinguishes resources from attributes. Natural resources are then to be seen as functions rather than as concrete, tangible characteristics (Pigram 1983), which is what attributes are: the biophysical properties of the environment, such as soils, vegetation and climate. Attributes

---

3 Of the activities themselves and of the environments in which they occur,

become resources by virtue of society's subjective evaluation of their potential to satisfy human wants relative to resource capabilities. Clawson and Knetsch (1966:7) have put the case eloquently:

> The ability and desire of man to use natural features makes a recreational resource out of what might otherwise be a more or less meaningless collection of rocks, soil and trees.

Taylor (1984) gives perhaps the most generic definition when he describes recreation resources as any resource that man uses to fulfill his recreational demands. This definition of resources makes them dynamic and capable of changing in response to changing socio-economic, cultural and technological conditions.

But what are the actual entities concerned in the term recreation resources? They can be defined from several different points of view. Firstly, as Hogg (1977) has pointed out, recreation covers such a wide spectrum of activities with very diverse characteristics and requirements - from driving for pleasure to wilderness hiking and rock climbing - that, given the appropriate circumstances, most landscapes are in some sense recreational. Outdoor recreation resources thus include an enormous variety of natural attributes. But while natural attributes or elements are generally understood to be more or less discrete, concrete properties of the environment, recreational resources may also include natural processes, such as river flow or wave motion on beaches. Difficulties arise in the evaluation of resources when comparisons of such disparate entities with different units of measurement are required.

Perhaps the most critical recreation resource is simply **space** and, associated with it, the intangible variables of location and access (Pigram 1983). For example, wilderness demands isolation while scenic driving requires ease of access via roads. At the same time, the availability of resources may be very different for different groups of society as a function of the opportunities associated with different income levels. Thus the wealthy automatically have greater opportunity for and access to outdoor recreational pursuits.

The spatial dimensions of recreation resources vary enormously and may make comparisons difficult. Hence resources for rock climbing, which has very specific requirements for vertical rock faces not less than 20 m high, cannot easily be evaluated alongside the diffuse landscape requirements for scenic driving. This has led Hogg (1977) to pre-define - as it were - recreation resources in the environment and map them before evaluating the suitability of that environment to support those activities: while this circumvents some of the spatial problems mentioned above, it does seem to be tautological, because he has defined the suitable environmental attributes before assessing their suitability. Nevertheless, some general spatial trends have been identified and many authors describe the generalised recreation environment as consisting of nodes (of activity) connected by a network of linear links (Lavery 1974).

Besides the physical characteristics of recreation resources, their complexity is compounded by the social requirements for different activities which may constitute a vital element of the leisure environment and the recreational experience. For example, solitude is essential to wilderness, but crowding and frequent social contact is an integral part of the jet set coastal resort or fun park. Likewise, technological considerations must also enter into the definition of recreation resources.

The complexity of the concept of recreation resources has resulted in the loose use of the term in the literature in as much as purely natural attributes are spoken of as recreation *resources* along with less tangible, complex descriptors which include social and technological qualifications (Moss 1985). It thus becomes almost meaningless to evaluate a landscape in terms of its physical suitability for particular activities. In Chapter 3 the necessity to consider large areas of landscape in terms of their suitability to deliver certain types of recreational **opportunity**, rather than focusing on the resource requirements of specific activities, will be discussed.

2.1.3 Recreation demand

The nature of recreational demand and its measurement are particularly complex. Pigram (1983), Stankey (1974) and Lavery (1971), commenting on the general lack of clarity in the application of the term demand in recreational writing, note that most workers equate demand with **current activity participation rates** (Lavery 1971). This is what Lavery calls *effective demand* and it is only one component of overall or *aggregate demand* (Lavery 1971). Generally aggregate demand is equated with an individual's desires or preferences for recreational opportunities quite independent of any constraints there may be on supply (Pigram 1983:16).

Note the connection between desires or motivations and demand. This supply-independent demand is supposedly dependent only on demographic characteristics of the potential user groups - age, income, education, psychological preferences and cultural biases. However, some authors have pointed out that although there may be a statistical correlation between these variables and recreation behaviour and preferences, this does not mean that there is a causal relationship (Owens 1984; O'Leary, Napier, Dottavio, Yoesting and Christensen 1982). People's needs and wants partially, at least, depend on their knowledge of what is possible or available

(Brooks 1976)[4]. The wealthier sectors of society may not have any greater desire than poor people to undertake more diverse and interesting outdoor pursuits. They may merely, by virtue of better access to the media, be more aware of the range of possibilities, and have the means to pursue them (Owens 1984; Pigram 1983; Lavery 1971). Other variables which have also been correlated with demand are available time and travel behaviour (Pigram 1983; Mitchell 1979).

Both Pigram (1983) and Lavery (1971) note that actual participation in leisure activities or consumption of leisure opportunities is a function of the supply of these opportunities, and may conceal frustrated demand. Constraints may be placed on actual participation by limitations of income, relative accessibility, the capacity of existing facilities, or the non-availability of desired opportunities. This is what Glavovic is saying in commenting on Taylor's (1984) use of participation as an indicator of recreation demand in the Western Cape area of South Africa: Glavovic shows how the present, relatively low use of Cape mountain areas as compared with coastal areas is probably more a function of the distribution of existing opportunities, than of preference for coastal areas. Taylor, on the other hand, had concluded that, because of the low levels of current use, mountain areas are unlikely to become crowded (Glavovic 1988:68). Similar assertions were made by Fesenmaier and Lieber (1985) as result of a survey of households conducted in Oklahoma, USA. These authors found accessibility of recreation opportunities (measured as the travel time from home to most frequently visited park) to be one of only three variables which showed a consistent relationship with recreation participation. The other two reliable predictive variables were the age of the head of the household and size of the family. Other commonly gathered variables, such as income and education of the decision-maker, showed extremely variable correlations across the state with participation, from strongly positive to strongly negative. This instability led the authors to conclude that these variables were not independent determinants of recreation participation. Their findings concur with the observations by Owens (1984) and O'Leary *et al* (1982) alluded to above. Drake (1982), however, states that education *is* commonly correlated with recreation preferences.

This discussion serves to point out the shortcomings of assessments based on present participation rates. Participation rates must not be confused with recreation preferences. A reliance on participation rates as a measure of demand may result in distortions in the supply of recreation opportunities, by the provision of increasing "amounts" of existing opportunities, because existing demand appears to warrant such action (Clawson and Knetsch 1966).

The opposite side of the coin, however, is that estimating *potential or deferred* demand is an almost impossible task. In surveying public opinion, what would be the target population: the entire country? one district? which socio-economic

---

4 This lead Brooks to conclude that attempts to uncover people's needs and wants by means of surveys were doomed to failure!

groups within these areas? What would be the focus of demand-related questions - particular activities, particular localities, presently available or future desired opportunities? and so on. The sheer magnitude and expense of such an exercise has made it logistically intractable here, and does so for many agencies. This task would be best handled at regional and super-regional scales using computer techniques for developing sophisticated models. It is generally beyond the scope of the single site planner, though every effort should be made to incorporate information on this subject in any evaluation of recreation resources. The analysis of national or regional trends may aid this process, but it has been found that in a situation of rapidly growing demand, changes in patterns of participation can be so rapid that predictions of future demand become highly unstable (Rodgers 1969). This is indeed likely to be the case in South Africa, where recent political changes have opened up a vast range of recreation opportunities to the majority of the population which had previously been excluded, under apartheid laws, from using many public amenities.

It has been said that carrying capacity is the link between supply and demand (Yapp and Barrow 1979; Lavery 1971), but in areas where the conservation of unspoilt natural resources is paramount, one could argue that carrying capacity primarily concerns supply and, specifically, the natural limitations to supply. However, because of the **social** dimensions of supply (such as apparent accessibility) and the potential for manipulation of the resource base in increasing supply to satisfy demand (see section 2.3), demand considerations must enter into the provision of opportunities for recreation and into the assessment of recreational carrying capacity. Glavovic (1988) has analysed in some detail the implications, for the supply of recreation opportunities and for conservation values, of planning as a response to demand in areas set aside specifically for conservation. This topic will be raised in greater detail in Chapter 3, in section 3.4.

The relationship between supply and demand in conservation areas is thus an awkward one, particularly since supply is controlled by the conservation authority while demand is generated by forces beyond the control of the conservation interest (Usher 1973:275). An assessment of current and projected future demand is necessary in order to predict if and how the capacity will be exceeded. In addition, most, if not all, attempts at estimating recreational carrying capacity, including the Limits of Acceptable Change System (Stankey *et al* 1985), use as their starting point the existing conditions of recreational participation in the relevant area. In this study, effective peak demand or "recreation pressure" (Sowman 1984) is estimated from participation and visitation rates and, in combination with other indicators of demand, is projected to establish estimates of future demand.

2.2 HISTORICAL DEVELOPMENT OF RECREATION PLANNING

Recreation as an aspect of lifestyle worthy in its own right of planning attention, began to be recognized in the United States of America during the 1950's; the USA has remained a center of innovation ever since. Early approaches reflected the attitude that recreation was a by-product of the more important issues of economic development (Mercer 1980); these approaches (eg., McClellan and Medrich 1969; Clawson and Knetsch 1966) were thus concerned with the manipulation of supply and demand to produce a socially optimum result (Glavovic 1988). In a generic sense, this remains the objective of all recreation planning, but the application of economic theory to its achievement has taken its place alongside a host of other approaches.

These approaches have been reviewed extensively (Glavovic 1988; Pigram 1983; Sutcliffe 1981; Mitchell 1979; Van Doren, Priddle and Lewis 1979; Baud-Bovy and Lawson 1977; Mercer 1980, 1977; Miles and Seabrooke 1977; Lavery 1974; 1971). The field has had the benefit of cross-fertilisation from the general field of planning, and many approaches are not exclusive to recreation planning. In fact, recreation has increasingly come to be seen as part of an integrated whole: the necessity to plan recreation in the context of multiple and adjacent land uses has been raised, and is addressed further in later chapters.

The last two decades have seen a worldwide explosion in recreation and leisure research. The first major salvo on the field was made by the publication in 1962 of 27 official study reports by the Outdoor Recreation Resources Review Commission of the USA Federal Government (ORRRC 1962). These reports put recreation firmly on the agenda for serious government policy. The ORRRC was charged with developing approaches to the nationwide planning of recreation resources which would meet the spiralling demand for outdoor recreation at the same time as maintaining the quality of the supply, namely, the natural resource base.

It is worth reiterating that this is the central problem facing recreation planners (Pigram 1983; Sutcliffe 1981; Lime and Stankey 1979). It applies both at a broad scale - national or regional - and at a local level, as in the management of individual recreation areas. A useful framework for analysing the plethora of work on the subject is given by Sutcliffe (1981) who sees recreation research as studying various aspects of the outdoor recreation system, namely, the people involved, the environments and locations concerned and the institutional constraints placed on outdoor recreation areas (planning aspects) (Sutcliffe 1981:14). In Sutcliffe's analysis, graphically shown in Figure 2.1 overleaf, carrying capacity is only one of a number of approaches to the environmental aspects of outdoor recreation research.

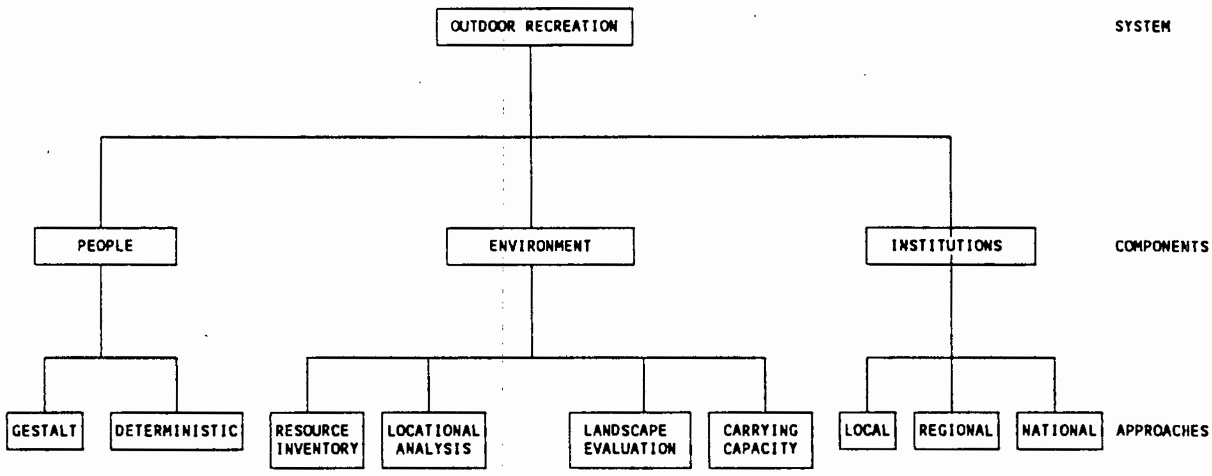


Figure 2.1: Classification of the fields of outdoor recreation research (Sutcliffe 1981).

Sutcliffe points out the importance of this multi-faceted approach in producing collectively related studies which can provide planners with complementary research findings. While this analysis provides a coherent, holistic framework within which recreation research and its planning applications can be carried out, I would dispute Sutcliffe's conceptualisation, to the extent that the other approaches to analysing environment, namely resource inventory, locational analysis and landscape evaluation may, in fact, be important inputs to an holistic appraisal of carrying capacity, rather than operating in parallel with it.

Certainly the so-called differences in approach are more a matter of scale, focus and emphasis, than of offering complete solutions. Behavioural geographers tend to stress the importance of user preferences and attitudes as determinants of the types of recreation facilities which should be provided, while ecologists and physical geographers might see planning in terms of procedures and methods for ecological land evaluation. Locational geographers use an analysis of travel behaviour to predict the focii of demand for different recreational opportunities. Economists regard an assessment of the relative costs and benefits of recreational excursions[5] as the most valid analytical framework for understanding recreational choice and behaviour (Mitchell 1979). Increasingly, however, holistic appraisal is being applied, with the principal players being the capabilities of the biophysical environment to withstand the impacts of recreation, and the attitudes and preferences of recreational users.

Glavovic (1988) in tracing the development of recreation planning, shows how it has developed from a reactive response to increasing demand at individual sites (single-site demand-centered approach), to attempts to define the inherent capability of such sites (single-site inherent-capability approach - Glavovic includes

5 Clawson and Knetsch's (1966) willingness-to-pay postulate

recreational carrying capacity here) and, finally, to an integrated appraisal of recreation resources on a hierarchy of spatial scales, taking into account both demand and limitations on supply, that is, ecological capacity (comprehensive demand-capability approach)[6].

In South Africa research on the initial phases of a procedure for national comprehensive recreational planning - the National Outdoor Recreation Plan (NORP) - is almost complete (Glavovic 1988). This procedure seeks to identify and relate *demand core* areas and *resource core* areas. However, the information generated by it is of such a general nature that it will be of little use in planning and managing individual areas. Attempts at projecting regional recreational demands of the Western Cape by Taylor (1984) and Taljaard (1984) suffer the limitations either of being confined to one race group or of failing to demonstrate a rigorous analytical approach.

In North America and Britain the concept of recreational carrying capacity (RCC) quickly captured the imagination of planners and managers as a potential solution to the increasing use/degrading environment problem (Owens 1984; Lime and Stankey 1979; Tivy 1972). The concept has been the subject of a considerable body of research in North America and Australia, in particular, since the early 1960's, most of which has been directed at the management of wilderness areas[7]. Stankey and Lime (1973), in an annotated bibliography, listed 200 publications which related directly to carrying capacity.

However, very few actual estimates of recreation carrying capacities have been incorporated into management strategies for natural environments (Washburne 1981); and most of these have applied to interior wilderness areas or rivers. Applications to coastal environments are rare, probably because of the complexity of the coastal environment and the diversity of recreation activities undertaken there (Pearce and Kirk 1986). Theoretically the concept is well suited to application in coastal areas, since, as Briggs and Hansom (1982:114) have said, environmental management in coastal areas is chiefly about conflicts of interest and usage.

It will be necessary to discuss the shortcomings of earlier approaches to RCC in some detail in succeeding sections. Suffice it to say here, that the concept has evolved along the lines of Glavovic's historical development in recreation planning. Conceptual complexities, practical difficulties, the problems inherent in reacting to increasing demand at individual sites and the increasing influence of adjacent land uses (McCool, Cole, Lucas and Stankey 1988) forced the re-thinking of the

---

6 Nevertheless, the approaches described by Glavovic (1988) and others (Pigram 1983; Rogers and Steinitz 1969) as comprehensive demand-capability approaches - such as the Canadian Outdoor Recreation Demand Study, Michigan RECYS and Coppock and Duffield's (1975) Scottish study - place greater emphasis either on the demand **or** the capability variables. They also fail to relate the two terms of the equation in any rigorous way. This is perhaps not surprising, considering the difficulties of assessing recreation demand (See section 2.1.3).

7 Stankey and McCool (1984:454) report a quip made by an English colleague at a conference, that the amount of carrying capacity research in the USA justified its classification as a growth industry!

concept. The single-site capability approach has been extended to include comprehensive appraisals of recreation opportunities over large geographical regions[8], in combination with detailed area assessments made in terms of the Limits of Acceptable Change (LAC) planning system (Stankey, Cole, Lucas, Petersen and Frissell 1985).

To date recreation carrying capacity concepts have received very little attention in South Africa, the major works in the field being Sowman's studies of the recreational carrying capacities of two Cape coastal townships (Sowman 1984; Sowman and Fuggle 1987). Sowman developed a detailed procedure for assessing the RCC of coastal resort townships (Chapter 5, Figure 5.2) which provided the initial model for this study. Her procedure attempted to assess the impacts of additional development in an existing recreation resort. The procedure proved to be inadequate for addressing the allocation of recreation resources in landscapes not previously used for that purpose.

2.3 RECREATIONAL CARRYING CAPACITY (RCC)

Recreational carrying capacity (RCC) has been reviewed elsewhere (Sowman 1984; Stankey and McCool 1984; Mitchell 1979). While Sowman (1984, 1987) in the only other South African applications, used the concept as a framework for analysing the impacts of additional development in already developed coastal resorts, this study focuses on planning recreational developments in largely undeveloped, rural and natural environments. Some repetition is thus necessary here to highlight problems relating to this focus.

The concept of carrying capacity is borrowed from animal population dynamics in which it is recognized that animal populations reach a stable population size which is limited by various environmental factors (Stankey and McCool 1984; Igbozurike 1981; Tivy 1972). In such studies it is theoretically a relatively simple exercise to calculate the point at which population growth becomes limited by the depletion of essential resources.

When applied to the interaction of human recreational activities with ecosystems, the term *carrying capacity* hides a wealth of complexities (Washburne 1981; Lime and Stankey 1979; Bury 1976; Barkham 1972; Tivy 1972). In Barkham's (1972) words, "carrying capacity is a phrase delightful in its simplicity, complex in its meaning and difficult to define".

A number of definitions have been put forward[9] (Lime 1977; Barkham 1976; Brotherton 1973; Lime and Stankey 1971; Wagar 1964) most of which include

8 The Recreation Opportunity Spectrum (Clark and Stankey 1979), discussed in Chapter 3

9 There are those who declare that there is no generally accepted definition of the term (Jaakson, Buszywski and Botting 1976).

essentially the same parameters, though they may be differently expressed. A widely used definition is that of Lime and Stankey (1971, cited by Bury 1976, Lime 1977, Lime and Stankey 1979). They define recreation carrying capacity as

> **that amount and character of use that can be supported over a specified time by an area developed at a certain level without causing unacceptable change to the physical environment or to the experience of the user.**

Wagar's (1964) earlier definition is essentially the same: the level of recreational use an area can withstand while providing a sustained quality of recreation. Other definitions sought more rigorous descriptions of a use unit, and use *irreversible* change as the criterion rather than *acceptable* change (Tivy 1972). Other attempts concerned the elaboration of the term into a number of components, eg. Brotherton (1973), Bury (1976).

The clearest exposition of the concept was provided by the Countryside Commission in England in 1970 (cited by Pigram 1983; Igbozurike 1981). This commission identified four possible components of the concept: ecological, social, physical and economic carrying capacities. The first three components will be discussed below; economic capacity has not been considered in this work because it is largely a theoretical construct with very few, if any, practical applications. But even these components are not monolithic: they have been split by Bury (1976) into a number of different facets, namely, edaphic, topographic, sanitary, social/psychological, aesthetic, spatial and temporal.

2.3.1 Ecological carrying capacity

Ecological capacity is concerned with **the maximum level of recreational use, in terms of numbers and activities, that an area or ecosystem can sustain before an unacceptable or irreversible decline in ecological values occurs** (that is, before ecosystem functioning is impaired) (Pigram 1983).

This obviously requires an investigation of the relationship between recreational use and environmental impact. It is *the* critical component when nature conservation is paramount. However, it is probably the most difficult limit to establish because:

1) Of the methods available to investigate the use-impact relationship - after-the-fact-analyses, monitoring of environmental change through time, simulation experiments and mathematical modeling - only the last two have predictive ability (Wall and Wright 1977). The comment is made elsewhere that most ecological models remain unvalidated by real data (Scholes 1989), and that the complexity of natural interactions renders most models crude approximations of reality. The accuracy of their predictions therefore also remain questionable. Nevertheless, their sophistication is improving all the time.

2) Studies of recreation impacts reveal that environmental response to use is highly complex and poorly understood. Many studies have been concerned with the effects of trampling on soils and vegetation (Kuss and Graefe 1985; Goldsmith 1983; Nickerson and Thibodeau 1983; Wall and Wright 1977; and see Cole and Schreiner 1981), but only rarely can the results of experimental studies be extrapolated to solve practical problems. Simple numerical measures of recreation use are inadequate predictors of change (Frissell and Stankey 1972). Helgrath (1974) found that use as such was poorly correlated with trail deterioration in the Selway-Bitterroot Wilderness. Frissel and Duncan (1965) showed that only light use of camping sites in a wilderness area resulted in 80 percent loss of groundcover at those campsites. Garland (1988) showed that hiking paths in the Natal Drakensberg increased the rate of soil erosion from those paths by several orders of magnitude, but the models used to make predictions of anticipated soil loss were so inaccurate that the author concluded they were unreliable.

A major challenge to the notion of ecological thresholds was presented by the results of Wagar's early experiments. In simulating the impacts of trampling on sandy substrates, he found that no threshold was discernible beyond which **additional** foot traffic caused rapid deterioration. On the contrary, while the initial tramping caused pronounced changes, subsequent deterioration occurred at a very reduced rate (Wagar 1964). These results correspond well with Frissell and Duncan's (1965) and La Page's (1967) and were again confirmed in a montane setting (Weaver and Dale 1978), and in an alpine environment by Bell and Bliss (1973). Similar results were reported recently for coastal environments by Carlson and Godfrey (1989) (see also Ghazanshahi, Huchel and Devinny 1983; Nickerson and Thibodeau 1983; Bowles and Maun 1982; McDonnell 1981)[10]

Carlson and Godfrey (1989), in reviewing a number of papers on the effects of human and vehicular passage in coastal environments, state that a common finding is that **low** levels of human trampling cause reduced total plant cover and species diversity in coastal dunes. They found in a Massachusetts coastal dune community that the "natural" human carrying capacity was extremely low, a few visitors per day. Ghazanshahi *et al* (1983) found that impacts on a Southern Californian rocky shore were small below use levels of about 2 persons per 100 m of shoreline. While making no claims that this represented a threshold or carrying capacity, they suggested such use levels to be "ecologically acceptable".

Clearly, under modern recreation pressure in areas which are mandated to provide for recreational use, such use levels are quite unrealistic. Methods other than use limitations must be sought to maintain environmental quality. Nevertheless, not all

10 These results are not incompatible with recent findings by theoretical ecologists, referred to by Scholes (1989), that gradual changes may accumulate until sudden jumps (irreversible change) occur. So far this is a largely a theoretical possibility uncovered in modelling ecological processes, but Scholes (pers comm) has indicated that it has been empirically demonstrated in simple, experimental ecological systems (for instance, sodic soils). Such work may have important implications for carrying capacity research.

systems are so vulnerable to mechanical damage. Wolcott and Wolcott (1984) found filter-feeding infauna in a high energy sandy beach to be virtually immune, even at a depth of 5 cm, from the impacts of off-road vehicle (ORV) passage. Burrowing macrofauna were similarly unaffected when in the substrate, but were highly vulnerable when emerging to feed. Management responses in a dune ecosystem should thus be quite different from those for a dynamic sandy beach: while in the former use limitations and the construction of boardwalks might be needed to mitigate mechanical damage, on the sandy beach zoning (banning ORV's at night) might be sufficient to limit impacts on the biota.

Many studies attempt to use past interactions as a guide to future impact management. However, cause-effect relationships in retrospective studies are difficult to demonstrate. Apart from the problems of identifying which of a large number of contributing factors are the controlling variables, such analysis requires detailed information on the nature of use, the numbers of users, and the conditions under which use occurred. Thus Sowman's (1984) correlation of the growth in Cape Infanta's township population numbers with path proliferation and alien vegetation spread in the vicinity of the town, may show parallel increases (she did not *statistically* correlate them), but this correlation cannot be considered proof of a causal relationship between them.

3) Environmental response is a function of the physical, spatial and temporal distribution and of the technological nature of use. A number of factors internal to the ecosystem affect responses, particularly of vegetation. For instance: if a system is highly diverse, there is a greater chance that intraspecific competition (which is a stress on plants, thereby diminishing their resistance to other stresses) will be reduced and a greater number of resistant species will be present, but these advantages may be neutralized if the habitat is a physically unstable one (Kuss and Graefe 1985). The issue of time has been largely neglected in RCC studies (Catton 1983). Time affects an ecosystem's ability to assimilate deleterious impacts (its resilience), and its regenerative capacity once impacts have occurred. The cumulative effects over time are therefore often neglected. Factors external to the ecosystem include behaviour and education: impacts of differential severity will result from even the same activity undertaken by users with different behaviour patterns (Turner 1988; Pigram 1983), and behaviour patterns may be modified by education..

In examining the use-impact interaction it is, of course, nonsensical to speak of "recreation" as some sort of monolithic entity. There are scores of outdoor activities which are recreational and they take place in, and therefore affect to varying degrees, different parts of the landscape. Figure 5.4 in Chapter 5 shows some of the activities undertaken at the case study site, Langebaan lagoon, and a subjective rating of the severity of each activity's impact on environmental components[11]. A proper determination of ecological carrying capacity at this locality would at the very least require investigating the use-impact relationship for each of the co-existing activities (many activities overlap in their spatial distribution and resource requirements), calculating individual capacities, then combining these into some sort of composite capacity limit, if this could be done at all.

This means, in terms of establishing capacity limits, that the same amount of use under different conditions may or may not violate standards of acceptability (Washburne 1982) - this leads Washburne to the observation that simple carrying capacity standards cannot protect ecological standards under all circumstances. Thus Kuss and Morgan's (1980) and Boddington's (1980) proposals to use the universal soil loss equation to predict the carrying capacity of recreation areas and of mountain trails, respectively, would require enormously complex programmes to make the computation for each combination of slope, slope length, aspect, soil type and microclimate[12].

Clearly, the impacts of recreation on a particular site will vary according to the timing, duration, type, distribution and setting of use (Washburne 1982). In short, without undertaking exhaustive experimental testing of single activity\impact relationships in each set of conditions in each type of environment, valid estimates of ecological carrying capacity are unlikely to be made. This suggests a need to group activities according to resource requirements, then undertake an initially broad assessment for each group of activities. A further level of planning might then address detailed planning for particular activities. This idea will be explored further in section 2.3.4.

4) Heberlain (1977) shows how RCC must be based on a specified level of technology (by describing the increase in capacity on the Grand Canyon brought about by the introduction of "porta-potties" for rafting trips). Related to this is the idea of a certain level of management: technology is so powerful and people so inventive, that there are many interventions which can be made to reduce impacts. The hardening of path surfaces, the diversion of access routes from sensitive sites, the planting of resilient species in heavily used areas, the spatial and seasonal dispersal of use (Turner 1988) are all examples of the manipulative capacity of management[13].

---

11 These ratings are based on interpretation of the literature, discussions with ecologists and National Park managers, and field observations.

12 The Universal Soil Loss Equation (USLE), which is an index of the soil erosion potential of a given parcel of land, uses estimates of these parameters, shown empirically to be determinants of erosion potential, to compute the index.

13 Note that Lime and Stankey's (1971) definition quoted earlier, by including the phrase "developed at a certain level", allows for the possibility of managerial manipulation of carrying capacity, suggesting that RCC is not an absolute, static quantity.

5) Ecology is far from being a predictive science, to the extent that Washburne (1982) doubts the possibility of being able to recognise ecological thresholds until after they have been passed and irreversible damage has occurred. Besides, the definition of *irreversible* change is problematic, especially in the light of recent research on stability and plant community responses to disturbances. Early ecological paradigms were dominated by the concept of succession to an equilibrium climax community, characterized by a persistent species composition and relative abundance (Odum 1969). More recent evidence has given rise to disequilibrium theory - or the "unbalance of nature", as Scholes (1989) calls it. The theory emphasizes biotic responses to environmental heterogeneity, be that variability the result of frequent, natural disturbances, climate change or episodic events (Hansen and Walker 1988; White 1979) which cause subtle shifts in the relative abundance and even composition of species. Thus communities, rather than being static, are characterized by almost continuous fluxes (White and Pickett 1985). In this situation, the identification of a base against which to measure both the direction and magnitude of change becomes vastly more complicated. Although the immediate and short term responses of some communities to disturbance are now well understood (see Pickett and White 1985), few studies have had a long enough life span to establish whether or not the resulting changes were irreversible. In effect, little work has been done on **general** biotic response to environmental variation (Hansen and Walker 1988).

Furthermore, Goldsmith, Munton and Warren (197O) point out that most recreation sites have different spatial boundaries from those of existing ecosystems - this adds to the difficulty of making an integrated functional analysis of the problem. However, the concept of *ecosystem* is more an abstract one that a practical one (Scholes 1989). Eugene Odum, in his landmark text *Fundamentals of Ecology* (1971, 1953; also Odum 1969), also alluded to the difficulty of identifying ecosystem boundaries. Since environments are generally characterized by gradients rather than sharp boundaries and, especially in plant communities, functional dependency between assemblages of species has rarely been demonstrated , there is little point in trying to precisely define boundaries. (This question is discussed further in Appendix A in relation to land classification methods).

Moss (1985, 1983) has a fundamental objection to most approaches to carrying capacity because they evaluate static, artificial qualities of landscape, such as soils, vegetation and slope, and ignore the critical variable, namely ecological *process*. However, Moss (1985) acknowledges the difficulties inherent in trying to classify and map dynamic entities such as processes; he has as yet failed to develop a method suitable for this task. There have been a few attempts to use rates of change in physical processes, particularly soil erosion, as indicators of RCC (Garland 1988; Kuss and Morgan 1986,1980; Morgan and Kuss 1986; Leonard and Plumley 1978).

6) Any use has impacts, and since a satisfactory assessment of when impacts cause irreversible change is unlikely, the question becomes what degree of modification or change is tolerable, acceptable and appropriate (Lime and Stankey 1979; Heberlain 1977; Frissell and Stankey 1972). A perceptual distinction may be drawn between *impact* and *damage* (Turner 1988). Turner describes impact as a rational planning concept which can be measured in an objective manner without recourse to significant value judgements. Damage, on the other hand, is undesirable impact leading to ecological degradation or impairment of the recreational experience; it acknowledges the important role of values and norms in making evaluative decisions (Turner 1988:8; Shelby and Harris 1985). Manning (1986), Lucas (1985) and Washburne and Cole (1983) all found significant differences between the definitions of damage by managers and users: litter, for instance, was rated far more negatively by users than by managers.

7) Deciding on the dividing line between acceptable and unacceptable change, no matter what the level of technical input in seeking a solution, requires a value judgement (Heberlain 1977). Lime and Stankey (1979; 1971) spell out the major methodological and philosophical problems as follows:

> (a) whose definition is to be used, managers' or users'? Managers, because of their training and background, tend to overemphasize biological capacity, limiting numbers (of users) on the basis of demonstrable but trivial biological impact (Heberlain 1977)[14]. Also, their estimates of what are desirable norms for recreationists have a poor track record (Lucas 1970, cited by Frissell and Stankey 1972).
>
> (b) if users', which users' values are considered to be most valid, for instance, resort or wilderness lovers'?
>
> (c) human attitudes are elastic and change with time - does this make the definition of acceptable conditions valid at only one time?

Conclusion

On ecological grounds then, we may conclude that recreational carrying capacity is not an objectively derived reality. While carrying capacity determination can indicate the kinds of ecological constraints likely to be encountered (Sowman 1984), it is given meaning only by clearly defined thresholds of acceptability (Frissell *et al* 1980; Lime and Stankey 1979; Yapp and Barrow 1979; Lime 1977; Pfister and Frenkel 1975; Wagar 1974); it must be seen as a management concept which is judgemental and goal oriented.

14 What he means, presumably, is impacts which have little effect on the functioning of the system.

2.3.2 Social carrying capacity

Social carrying capacity, also sometimes called *perceptual* capacity (Godschalk and Parker 1975; Brotherton 1973), or *psychological* capacity (Bury 1976), relates to the **visitors' perceptions of their recreation experience and the level of satisfaction they derive from it** (Pigram 1983). The assumption is that increases in use beyond a certain point will impair the experiences associated with that opportunity (Glavovic 1988). The notion of recreation **quality** is thus bound up in the concept.

Partly because of the difficulties with ecological capacity, partly due to the increasing public demand for quality recreation experiences, emphasis has been increasingly placed on social carrying capacity as the key to the resolution of recreation planning problems (Heberlain 1977). It is closely tied up with the behavioural approach to the study of recreation which posits the crucial role of motivations and desired experiences in successful recreation planning. The success of recreation planning decisions is as dependent, as Sutcliffe (1981:3) observes, on recreator requirements and preferences as on the environment and facilities provided. The determination of public preferences and attitudes are therefore invariably an important part of RCC determinations. But again, there are problems: **1)** Measurements of attitudes and preferences are complex[15]. They are complicated further by the fact that multiple satisfactions are sought from recreation activities (Stankey and McCool 1984; Stankey 1974, 1973).

A secondary problem is that most researchers in this field seem to use the term *attitudes* very loosely: they rarely define it and it appears to be largely a synonym for public opinion. And indeed, this is the sense in which it is used in this dissertation. The term is of interest to the recreational planner in the sense in which it is used by market researchers. In their understanding, attitudes are significant as the forerunners of behaviour and the term is interchangeable with *opinions*. Attitudes and opinions therefore represent "a person's ideas, convictions, or liking with respect to a specific object or idea" (Churchill 1983).

Methods of measuring social attitudes or levels of satisfaction require the use of scaling techniques which are often mathematically invalid (Greist 1976), because measures of satisfaction are derived by the addition of ordinal or nominal values. The latest quantitative methods used in psychological research indicate, however, that the ordinal scales used in subjective rating exercises may allow mathematically valid manipulations of the results, provided the problem is structured properly (Stauth 1989). The problem was presumed to be that intervals between numerical values subjectively derived could **not** be assumed to be of equal magnitude (a necessary condition of the ratio scale). It has now been shown that subjective ratings based on ordinal scales may, following certain statistical procedures, be

15 The field of behavioural research in outdoor recreation has been criticized for a general lack of theoretical rigour (Owens 1984).

validly converted to an interval scale (Stauth 1989:51, citing Green and Tull 1978). Furthermore, evidence has accumulated that people are able to apply judgements which conform very well to ratio scales, thereby opening the way for quantitatively sound approaches to measuring judgements (Stauth 1989:52, citing Stevens 1975)[16].

2) Social responses are as complex as are ecological ones: travel distance, expectations of the site, weather, party size, the distribution of people, the types of recreational opportunity available at the site, numbers and types of encounters, type and degree of management intervention/regulation (Patterson and Hammitt 1990; Graefe, Vaske and Kuss 1984; Dustin and McAvoy 1982; Lucas 1982; Gilbert, Petersen and Lime 1972) all influence perception of the experience (Lime and Stankey 1979; Heberlain 1977; Frissell and Stankey 1972). The fact that different groups and individuals react in different ways makes generalisations about carrying capacities difficult (Mitchell 1979). Social surveys of recreationists reveal such a wide array of differing perceptions that Heberlain (1977:69) remarks "there is even less agreement about the nature of a recreational experience than there is about a preferred ecosystem". Social responses are so elastic and individuals so adaptable that Pfister and Frenkel (1975) conclude that social standards for thresholds of visitor satisfaction are a less reliable basis for generalisations than are ecological ones. In a study of public attitudes commissioned by the US Bureau for Outdoor Recreation, the researchers could draw no general conclusions and confessed that the exercise had confused rather than instructed them!

O'Riordan (1969) raises the question of whether, in the circumstances, users are really able to identify what they want and, if so, whether they should get it. There are opposing opinions regarding the effects of being guided by behavioural capacity demands: Mitchell (1979) reflects Barkham's (1972) concern that this would tend to favour a small group of elitists whose expectations are more resource consumptive (they are referring to wilderness lovers presumably, whose requirements are more demanding in terms of space per person) than the majority of recreationists. Other authors see demand led decisions as resulting in a general loss of recreational quality by a one-directional shift to the more developed recreation opportunities (McCool 1986; Van Oosterzee 1984; Dustin and McAvoy 1982; Clark and Stankey 1979; Brown, Driver and McConnell 1978).

3) There is frequently considerable disparity between managers' and visitors' perceptions (Lime and Stankey 1979; Hendee, Stankey and Lucas 1978). Managers cannot rely on their own perceptions of what users want, while users are frequently unaware of the constraints faced by management.

4) Observations have been made that people's attitudes change very rapidly with environmental change, so that if the experience changes they either adapt their perceptions to it or they seek satisfaction elsewhere (Dustin and McAvoy 1982; Schreyer 1979, cited by Glavovic 1988; Brotherton 1973; Barkham 1972). In

---

16 There is a lengthly discussion of this issue in Chapter 3 (3.2.3.3)

other words, the quality of the supply affects the nature of demand (Pfister and Frenkel 1975). This means that the visitor population one is dealing with will change, so that even longitudinal surveys will not accurately reflect the attitudes of the original population (Lime and Stankey 1979; Heberlain 1977).

More interestingly, a recent investigation into hikers' encounter norms convincingly demonstrated a high level of incongruity between what they **stated** would be acceptable levels of encounters, and their attitudes to **actual** numbers of encounters (Patterson and Hammitt 1990). The authors found that 83% of respondents had encountered more other parties than they specified as acceptable, but 61% admitted that this had not detracted from their wilderness experience. The 34% who reported dissatisfaction with the violation of their encounter norms (a congruent reaction) all had more stringent requirements for solitude (in terms of number of encounters acceptable to them). Patterson and Hammitt concluded that the majority of recreationists do not have a salient definition of the acceptable number of (visual-social) encounters, and cannot be asked to quantitatively specify this parameter.

This perceptual fluidity is further reflected in the confusion regarding the relationship between satisfaction (or recreation quality) and use levels discussed below.

5) There is disagreement on appropriate and valid measures of satisfaction or visitor attitudes to recreational experiences which express the quality of the experience. Nevertheless, aesthetic questions and perception of crowding are widely regarded as components of social carrying capacity (Graefe, Vaske and Kuss 1984; Pigram 1983; Heberlain 1977; Wagar 1964).

Fisher and Krutilla (1972) proposed the use of interviews to establish a relationship between willingness to pay and use levels (this approach has been largely abandoned now). Some authors, like Stankey and McCool (1984) and Heberlain (1977) regard attitudes to crowding to be indicators of satisfaction. Others, particularly Greist (1976), report a low correlation between satisfaction and perception of crowding. Greist rejects measures of satisfaction based on ordinal measures of attitudes to different levels of use, because then theoretically, high use levels should deliver the greatest aggregate satisfaction (as is implied in the Canada Lands Inventory and South African NORP classifications). This conclusion clearly does not reflect the wishes of those who seek solitude. The irony is that exactly opposite conclusions may be reached regarding the relationship between use level and satisfaction. Clawson and Knetsch (1966) postulated an inverse correlation between use levels and recreation quality. In other words, quality may be associated with any level of use, depending on the user's perceptions and expectations. This understanding has contributed to the development of the idea of maintaining a spectrum of recreation opportunities capable of satisfying a variety of preferences, a subject which will be discussed in the following chapter.

In any case, most authors note the non-linear relationship between satisfaction and crowding, visitor responses being dependent on type, frequency and location of encounters with other people (Stankey and McCool 1984; Frissell and Stankey 1972). Finally, Stankey (1973) long ago warned against the reliance on simplistic indices as absolute measures of satisfaction, because of the multi-dimensional nature of attitude domains. Greist (1976), because of the complexities of measuring satisfaction, holds that carrying capacities should not be based on measures of satisfaction; he proposes a lottery system in which users seeking very low levels of use (which imply a high degree of restriction on use) apply for a permit on which the chances of winning are inversely proportional to the severity of use limits.

6) Despite the variability of social responses, there is wide agreement on certain qualities associated with types of outdoor recreation. Collins and Hodge (1984) report that, using cluster analysis of visitor activity patterns, there were consistent linkages between activities. This is especially so at the least developed or "resource based" end of the recreation continuum, namely wilderness. The requirements for a wilderness experience include a relatively large area of undeveloped, pristine natural landscape, low user density, absence of mechanized recreational pursuits (no cars, powerboats, etc.) and solitude (McKenry 1977; Stankey and Baden 1977)[17]. At the other extreme, lovers of beach resorts are likely to want the social contact of crowds, the use of "hi-tech" toys and the comfort and convenience of a modern infrastructure. Clearly, not only is the choice of activities important to users, but the **setting** in which they are conducted is equally vital to the quality of the recreational experience.

What this means is that, depending on the needs and desires of users, combinations of activities (and this includes non-recreational activities in the same area or in adjacent areas) may or may not be compatible. Again, there are fairly clear general guidelines to the acceptable combinations. This is illustrated in Figure 2.2, a matrix prepared in a South African application by Hugo (1980:141). A similar matrix specifically for wilderness areas is presented by McKenry (1977), while a more comprehensive appraisal of compatibilities in lochside recreation in Scotland is given by Tivy (1980:72). Tivy's matrices are reproduced as Appendix B1 to illustrate the complexity of the matter.

A general distinction may be drawn between what are called, respectively, *resource* oriented and *facilities* oriented outdoor recreation types (see Hugo (1980) and Tivy (1980)), terms which speak for themselves. Resource oriented outdoor activities require natural landscapes and low levels of infrastructural development, if any at all, eg., wilderness hiking, camping and canoeing. Powerboating, by contrast, requires launching ramps and carparks at least, caravanning requires "hook-ups" and amenities such as ablution blocks. Facilities oriented activities thus inevitably involve intervention in and some transformation of the natural landscape.

---

17 The requirements for wilderness areas are discussed further in connection with establishing criteria for the recreation resource allocation procedure proposed in Chapter 4, section 4.2.6;

```
Wildlife conservation
4 Aquatic life conservation
4 4 Plant ecological conservation
4 4 4 Environmental conservation (degradation) noise          CONSERVATION
4 4 4 4 Atmospheric quality
4 4 4 4 4 Water quality
4 4 3 4 4 4 Cultural / Heritage site conservation

2 3 2 3 4 4 4|Walking
3 1 3 3 4 2 4|4 Swimming
2 2 2 3 4 4 4|3 1 Fishing
1 1 2 2 4 1 3|4 1 1 Waterskiing / powerboating
3 3 2 4 4 4 4|3 3 3 2 Canoeing / rowing
3 3 3 4 4 4 4|3 2 3 2 3 Sailing
2 4 3 4 4 4 3|3 3 4 4 3 4 Rock climbing / mountain hiking
2 4 2 4 4 3 2|4 4 4 1 3 2 3 Tented camping
1 3 1 3 4 3 3|1 4 4 4 4 4 1 1 Caravan camping               RECREATION
1 3 1 2 4 3 4|1 4 4 3 3 4 1 1 3 Picnicking
1 1 3 4 4 4 1|1 2 2 1 2 1 2 2 1 1 Hunting (game & gamebirds)
3 3 2 3 4 4 3|2 3 3 3 3 3 3 3 2 3 3 Horse riding
2 3 3 4 4 4 4|1 3 3 3 3 3 1 1 3 4 1 2 Cycling
2 3 1 3 2 4 4|1 4 3 3 2 3 1 1 2 4 1 1 1 Driving (scenic)
4 4 4 4 4 4 2|4 1 4 1 2 2 4 3 1 2 1 3 2 1 Game viewing / birding
2 3 2 3 4 4 2|3 3 3 3 3 3 2 3 3 4 1 3 3 2 2 Hangliding

1 4 1 3 4 1 1|1 4 4 3 4 4 1 1 1 1 1 1 3 3 1 1|Crop production (annual)
1 4 1 3 4 1 3|3 4 4 4 4 4 3 3 3 4 1 4 4 4 2 4|1 Grazing          AGRICULTURE,
2 4 1 4 4 4 2|4 4 4 4 4 4 4 2 3 3 4 4 4 4 3 1|1 1 Forestry            MINING
1 4 1 3 4 3 3|2 4 4 4 4 4 1 1 3 2 1 2 4 4 1 1|1 1 1 Orchards
1 4 1 1 1 1 1|1 4 4 4 4 4 1 1 1 1 1 1 1 1 1 1|1 1 1 1 Mining (open cast)
```

(i) Excluding motorised viewing

1. Conflicting
2. Compatible on a limited scale
3. Compatible but control necessary
4. Strongly compatible, or not in contact

Figure 2.2: Matrix of the relative compatibility of activities in and adjacent to an outdoor recreation area. (After Hugo 1980).

This leads to the conclusion that, in order to satisfy user preferences, *packages* of recreational activities in combination with certain environmental attributes should be supplied. These combinations create recreation *opportunities*, which become the functional units of recreation planning. This theme is picked up in section 2.3.4, in which the relationship between the different components of recreation carrying capacity is considered.

Conclusion

It is clear that visitor attitudes alone may not be a sufficient basis for management or even setting management objectives (Lime and Stankey 1979; Heberlain 1977; Wagar 1974). Nevertheless, knowledge of their beliefs is valuable to ensure a range of opportunities is available which is capable of satisfying their needs (Lime and Stankey 1979; Lime 1977). Barkham in 1972 concluded that social carrying capacity along with physical carrying capacity (See below), was the most important component to be calculated; since then many authors have confirmed his conviction.

However, there is a danger that this emphasis, carried too far, might result in the satisfaction of recreationists' needs to the detriment of ecological values. Accordingly, in this study, ecological factors are seen as the final arbitrators of any RCC limits which might be implemented.

2.3.3 Physical carrying capacity

This concerns the **maximum number of use units - people, boats, cars, bicycles - a specified area can physically accommodate** (Pigram 1983). It is the most frequently used parameter and, supposedly, the most simple to derive. Yapp and Barrow (1979) suggest that manipulation of physical capacity is the key to the control of conflicts and that the **zoning** of activities must set the framework for resource and capacity evaluation. Heberlain (1977) notes its usefulness for limiting use when managers are reluctant to rely on the more nebulous social and\or ecological motivations for limiting numbers. Such application of the concept goes hand in hand with the notion of limiting numbers by restricting the development of recreational facilities in natural areas; we might call this a *facilities* capacity (Heberlain 1977).

Physical carrying capacity is usually determined by the application of widely used space standards which have been developed for specific activities. They have developed through trial-and-error application, managerial intuition and experience (Lime and Stankey 1979). Lime and Stankey (1979) caution that they are not synonymous with true carrying capacity, but they acknowledge that they are frequently the best guidelines available. Heberlain (1977) observes that space standards do not reflect only physical factors: they are affected by technological levels, social needs (*vis a vis* crowding) and safety factors. Lime and Stankey state that such standards also include a "satisfactory experience" factor, but they query the obscurity surrounding the derivation of this factor.

Jaakson (1971, 1970; also Jaakson, Buszynski and Botting 1976) by contrast, has more confidence in these space standards, having done considerable research into them. Most of Jaakson's applications concern the capacity of lakes for boating, but his papers are vague about how the standards are derived. Sowman's (1984) assessment of RCC at Cape Infanta places considerable emphasis on space standards for boating. Her study is valuable in that it demonstrates that the capacities of all components of the recreation complex must match in order to prevent conflict and dissatisfaction, for instance, in a coastal resort township the amount of accommodation provided should not exceed the available beach space and capacity of local boat launching facilities. Certain Mediterranean coastal resorts have been designed round this principle (Baud-Bovy and Lawson 1977).

It is important to bear in mind that so-called physical space standards may solve spatial conflicts between users and result in a neat zoning plan, but they **have very little relation to ecological limits and cannot, on their own, guarantee the maintenance of ecological quality.**

2.3.4 Interaction of the different components of recreational carrying capacity

The relationship of these different components - ecological, social and physical - in a coastal setting is nicely illustrated in Figure 2.3, adapted from Pearce and Kirk (1986). It shows that an assessment of coastal carrying capacity might place the emphasis on different components of RCC in different parts of the recreation environment, depending on environmental vulnerability[18].

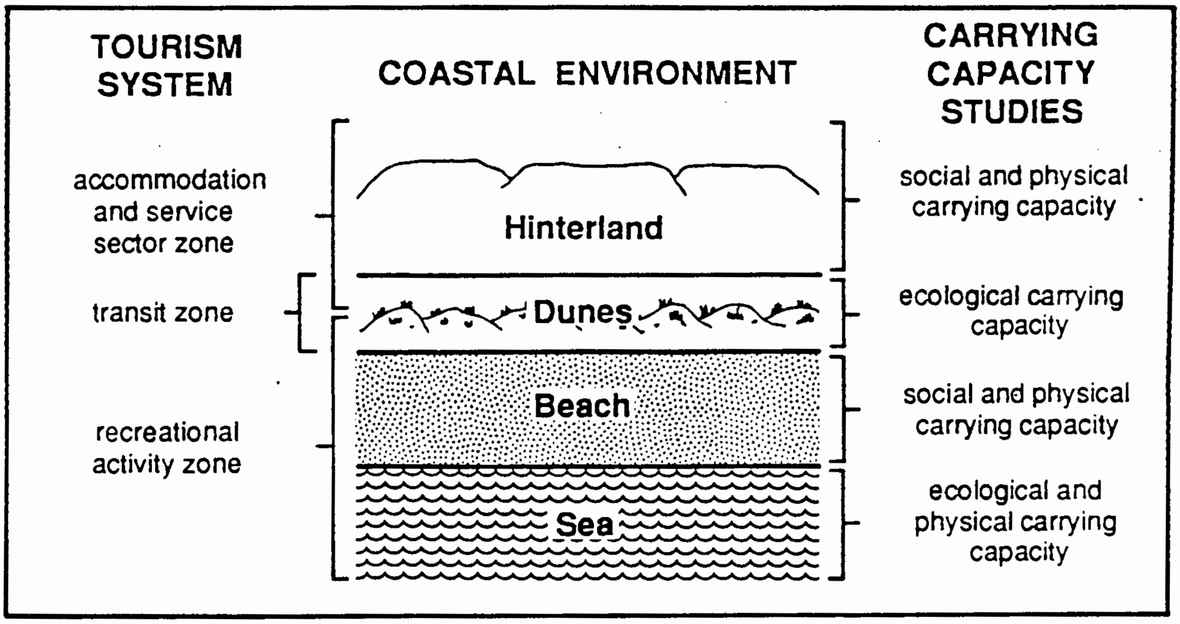


Figure 2.3: The relationship between different components of recreational carrying capacity and the coastal environment. (Modified from Pearce and Kirk, 1986)

Their analysis is corroborated by Bury's (1976) and Heberlain's (1977) earlier observations that these different capacities might be reached at different times in

18 See the detailed discussion on environmental *vulnerability*, *fragility*, or *sensitivity* in Chapter 4, sub-section 4.2.6.1.

different environments. Heberlain contends that physical carrying capacity represents the upper limit of an area's capacity, so that the optimal carrying capacity in an area where, for instance, conservation is paramount, may not be the maximum capacity. Clearly, different combinations of the components of recreation carrying capacity are appropriate in different circumstances. Some authors suggest that assessments of the different capacities be made separately, with the lowest value then being used as the standard (Garland 1988; Wagar 1974). They point out that in wilderness, for instance, social capacity may well be reached before ecological capacity (Heberlain 1977).

Pitt and Zube (1989) are content to leave it to the manager or planner's discretion to decide which combination of concepts to employ in allocating use, since different perspectives and different mixes of uses will produce different definitions of RCC.

In any event, the dynamic nature of ecological capacity, the manipulative capability of management and the social (perceptual) dimensions of recreational landscapes, make the determination of carrying capacity, in respect of single activities, nonsensical, as suggested earlier in section 2.3.2. In effect, the components of RCC, namely ecological, social and physical, in conjunction with management actions, interact to produce the recreational *opportunities* alluded to in 2.3.2. These recreation "packages" can be specified in terms of a set of social, ecological and managerial conditions. It is these conditions which will define and describe the recreation carrying capacity of an area.

In many instances recreation opportunities can be operationalized only by zoning recreational and other uses (Yapp and Barrow 1979). Zoning establishes a territorial structure by delimiting specific lands for specific purposes and uses (Walther 1986). It is the spatial equivalent of resource allocation. While zoning usually takes the form of spatial separation of incompatible activities (so that each recreation opportunity package will occupy a discrete part of the planned landscape), temporal zoning - seasonal, diurnal - may also be employed.

Despite the general acknowledgement of the interactions between different components of RCC, nowhere have I come across any attempts to systematically address the link between, for instance, physical and ecological capacity (if there is one), nor to make explicit trade-offs between them in setting capacity limits. The simplest approach may be to relate them to the objectives of zoning. Where high density recreation areas are provided, a high degree of environmental transformation is tolerated and the satisfaction of users is the chief concern of management. This would be the case at an urban beach. Here space standards (physical carrying capacity) might be relied upon to ensure a minimum level of comfort in a relatively crowded situation. The ecological impacts of high numbers are dealt with by management intervention to ameliorate those impacts. At the opposite end of the scale, the preservation of pristine biotic communities is a major objective of wilderness zones, which then offer dispersed, low technology recreation opportunities. Here ecological carrying capacity is the final arbitrator of management decisions, although, as mentioned earlier, the social capacity of wilderness areas may be reached before their ecological capacity (Heberlain 1977). One would also assume that areas designated for high density use would be less vulnerable to damaging impacts than those set aside for wilderness opportunities, but the reciprocal does not necessarily hold true. Where the environment is robust or social demands high, physical carrying capacity may be most important, while in sensitive environments, ecological capacity should take precedence.

There is, in any event, a wide range of possibilities for management to improve the quality of the experience and to increase carrying capacity. These possibilities are summarized in Table 2.1, in which the type of control is classified as regulatory or manipulative (Gilbert *et al* 1972). Gilbert *et al* (1972) and Lucas (1982) state that manipulative or indirect controls are generally more acceptable to users than the direct limitations on use implied by regulatory controls. As Lucas (1982:148) has said, recreation and visitor regulations are inherently contradictory, because recreation is a voluntary, rewarding activity based on free choice, which regulations must seek to restrict. Regulations are likely to be necessary, nevertheless, where safety concerns are important, or where conflicting types of uses must be separated.

Table 2.1: Types of management control in outdoor recreation (Gilbert, Petersen and Lime 1972).

TYPE OF CONTROL	METHOD	SPECIFIC CONTROL POLICIES
Regulatory	Increased policy enforcement	Impose fines; Increase surveillance
	Zoning regulations	Spatial zoning of uses; Temporal zoning of uses; Limit camping in some campsites to one night
	Restrictions on use intensity	Open or close access points; Require reservations; Assign campsites and travel routes to each camper; Limit usage via access points; Limit size of parties; Limit people per campsite; Limit total park population
Manipulative	Physical alterations	Open or close access roads Improve (or not) access; Improve (or not) campsites
	Information dispersal	Advertise particular attributes to attract certain user types; Educate users on care of park ecologiy; Advertise underutilized areas
	Eligibility requirements	Charge constant entrance fee; Charge marginal cost fee; Require demonstration of ecological knowledge

But will they protect conservation or ecological values? Lucas insists that excessive regulation is counterproductive. Hendee, Stankey and Lucas (1978) suggested that the first principle of management should be *minimum regulation*, that by indirect approaches which inculcate attitudinal changes, visitors could be persuaded to change their behaviour in favour of conservation values. Dustin and McAvoy (1982) are not convinced that manipulative, indirect management approaches, in which education, interpretation and information are supposed to bring about behavioural changes by affecting attitudinal changes, are effective in preventing ecological degradation of fragile wilderness areas. Instead, they take the position that direct regulatory control, in which restrictions on usage and penalties for contravening regulations, by affecting behaviour, will result in attitudinal changes!

2.4 CONCLUSIONS

Recreation carrying capacity as a theoretical concept seems straight forward on first reading, but it is fraught with problems where its prediction and estimation are concerned (Bury 1976; Gittins 1974; Barkham 1972). The idea of some intrinsically determined point at which the recreational population of a natural area should stabilise pervaded the thinking of early proponents of RCC, but the operationalisation of this notion proved elusive. Research and management efforts were oriented to answering the question "How much use is too much?" (Prosser 1986; Stankey *et al* 1985). Attempts to quantify the level of use which a particular environment can tolerate without unacceptable or irreversible deterioration have consistently failed; as Dustin and McAvoy (1982:344) have put it, RCC failed to deliver the numbers.

It has been reported that a **threshold** of irreversible change can be neither identified nor predicted and that the notion of acceptability, in any case, introduces the necessity for subjective value judgement.

Most researchers in the field now agree that:

(i) RCC is not an absolute number based purely on objective, technical information (Stankey *et al* 1985; Heberlain 1977; Wagar 1974; Lime 1972), and subjective decisions play a central part in the implementation of the carrying capacity concept (Mitchell 1979).

(ii) RCC is not an intrinsic characteristic of a particular site, because of the potential for modification of the site (Bury 1976; Godschalk and Parker 1975).

(iii) RCC is multi-dimensional, embracing several distinct types of capacity. Its major dimensions are ecological and social (Pigram

1983; Lime and Stankey 1979; Frissell and Stankey 1972; Wagar 1964;). In recent years attention has increasingly been paid to the social component (Heberlain 1977) as the role of conservation agencies in providing leisure opportunities has grown in importance. What has been generally recognized is the important role of user attitudes and preferences in natural area planning, though they are not, on their own, a sufficient basis for recreation area planning. Physical space standards can play a useful role in reducing conflicts between different uses and users. These standards are, however, subjectively derived and bear little relation to ecological factors.

(iv) The relationship between types and levels of use and environmental impact is complex and non-linear (Lime and Stankey 1979; Wall and Wright 1977), so that simple indices are poor indicators of change. While most damage seems to occur within a relatively short period after initiation of use (Carlson and Godfrey 1989; McCool *et al* 1988), then continues at a slower constant rate (Mitchell 1979), no threshold can be detected which marks the onset of irreversible ecological change (Carlson and Godfrey 1989; Wagar 1964). There is not, in any case, one single threshold, because the environment responds differently to each activity, and its responses vary over small distances in each different set of biophysical conditions (Goldsmith 1983).

(v) Research into the ecological and social dimensions of RCC has failed to establish predictable links between different levels of use and their impacts on the recreation setting (Prosser 1986:5).

(v) The variety of recreational activities, the social dimensions of recreation requirements, the absence of clear thresholds and lack of predictable relationships suggests that a range of recreational *opportunities* must be provided which will satisfy a variety of needs. This means that the first unit of analysis in planning is **packages** of activities which have compatible spatial, social and managerial requirements, these packages going to form recreation *settings* or *opportunity classes*.

I agree with those authors who express unease at the very use of the term: no matter how aware the reader is of the problems associated with this subject, the term *carrying capacity* continues to convey images of an objective, inherently optimal use level. I contend that the use of the term *design capacity*, as suggested by Godin and Leonard (1977) and Godschalk and Parker (1975), is more realistic and conceptually accurate, for reasons elaborated below. I would also echo Wagar's (1974) conclusion that the search for an impersonal carrying capacity formula is totally unrealistic: all existing approaches derive an index of or approximation to, a carrying capacity.

There are too many intervening variables in the use/impact relationship for the development of a single numeric carrying capacity to be valid (Prosser 1986). There appears to be no way of putting a quantitative value to the concept which will stand up to critical examination. In addition, the complexities of the issue make the particular problems to be investigated and their solutions very site-specific, leading some researchers to conclude that the establishment of "any rule-of-thumb set of universal capacity values, applicable to a wide variety of sites, environments and circumstances" (Burton 1974, quoted by Mitchell 1979:193) is unlikely. Two of the earliest pioneers of carrying capacity research, Lucas and Stankey, cautioned in 1974 that the concept might be quite ill-suited for recreation management. Goldsmith (1983:202) bluntly stated that "capacity is an illusory concept expect in a bathtub"!

It has been suggested that resource managers were asking the wrong question, when they should have been asking "How much change is acceptable?" (Stankey *et al* 1985; Stankey and McCool 1984). There is now wide agreement that the primary function of RCC should not be the manipulation of use levels *per se* and that the search for a numeric carrying capacity has detracted from more critical tasks of management: clearly defining what is acceptable, writing standards to describe those conditions, then monitoring the resource base carefully to see that the standards are maintained (Stankey *et al* 1985; Stankey and McCool 1984; Gramman 1982; Washburne 1982; Shelby 1981; Yapp and Barrow 1979; Heberlain 1977; Lime 1977). Instead of setting use limits, standards for ecological and social (experiential) resource conditions should be set which are designed to achieve objectives for the management of impacts (Turner 1988; Yapp and Barrow 1979). What emerges is a management by objectives (MOB) concept (Stankey *et al* 1985) which is only loosely grounded in ecological theory and practice and which is not an intrinsic property of the biophysical environment.

The value of the recreation carrying capacity concept is that it provides a *framework* in which to identify ecological, social and physical constraints on recreation development, to identify conflict situations and to set standards within which these constraints and conflicts can be managed and overcome (Stankey *et al* 1985; Sowman 1984).

The contribution of quantitative methods in establishing these standards is limited by the non-linear response of ecosystems to physical impacts and the difficulties in demonstrating causal linkages between the complex of factors which affect ecological responses. But even if one were able to do so, the process of setting carrying capacity guidelines in terms of resource standards is an inherently subjective procedure. In Mitchell's (1979:199) words:

> As most writers testify, the final decision about carrying capacity is always an arbitrary one. Someone, somewhere, sometime, must decide what constitutes an undesirable change in vegetation and soils, or an unacceptable level of crowding or congestion.

Lime (1972) maintains that the uncertainty of such decisions can be reduced by considering the inter-relationships of management objectives, recreation user attitudes and the impacts of recreation on the environment under scrutiny. In assessing the acceptability of recreational impacts, the consideration of impact *magnitude* (objective assessment) and impact *importance* (value judgement) are necessary (Clark and Stankey 1979). Every decision on use limitations is essentially therefore an administrative one which includes a technical (what can be) and a value (what should be) component (Wagar 1974). In the final analysis, nothing can substitute for management experience and sound judgement (Godschalk and Parker 1975; Lime 1972) but in setting standards judgement can be guided by information about visitor needs and preferences, site capabilities, existing patterns of use, management objectives, alternative opportunities and a sound conceptual framework (Wagar 1974).

Clearly, we are no longer talking about methods to estimate or predict carrying capacities. The concept has developed into an *approach* or *framework* for the planning and management of natural areas which are used for recreation. Recreational carrying capacity thus becomes a design concept or planning framework, in which the emphasis is placed on setting objectives for environmental quality, expressed ideally in terms of quantitative standards of resource condition. The procedure or process used to establish these objectives, set appropriate standards as criteria for meeting the objectives, and delineate a spatial framework for implementation of the plan, thus becomes a framework for making decisions regarding the allocation of recreational opportunities in a natural landscape.

Several authors have identified some characteristics of the procedures involved in implementing such a framework, namely, that **decisions** must be taken which are essentially **subjective,** and that **uncertainty** may characterize those decisions (Turner 1988; Mitchell 1979; Wagar 1974). Then, if the framework consists of a series of decisions about different aspects of the allocation of recreation resources, it might more accurately be labelled a **decision-making framework** for recreation planning and management.

Recall that an objective of the dissertation was to develop an approach to recreation planning and management which would be ecologically rigorous, socially meaningful and comprehensive (page 4). In advancing the rationale for the procedure which I propose in Chapter 4 to fulfill these requirements, it will be instructive to consider in more detail the characteristics of decision-making systems, and of general environmental planning and management decision frameworks. Consideration of the broader field will show that problems similar to those encountered in trying to operationalise RCC as a tool in recreation planning are widespread in environmental and other decision-making. But approaches have been developed to deal with some of these difficulties which may be manipulated to further the aims of recreation planning specifically. To this subject we now turn in Chapter Three.

CHAPTER THREE

TOWARDS A DECISION MAKING FRAMEWORK FOR PLANNING RECREATION IN NATURAL LANDSCAPES

3.1 INTRODUCTION

The Readers Digest Great Illustrated Dictionary defines a framework as, *a structure for supporting, defining or enclosing something*; *a basic arrangement, or system.* McCool *et al* (1988:3) describe a framework as "a comprehensive, systematic and explicit process of problem-solving"; a process which "establishes the rules by which decisions are made". This sets it apart from a *method or methodology*, which Stauth (1989) has defined, respectively, as: "a general type of procedure chosen to direct a scientific enquiry", and "(1) the process by which scientific enquiry is conducted, and theory is related to empirical research; (2) the logic of applying the scientific perspective to the study of events". Of course such a process comprises a set of procedures which may include specific scientific methods (eg. surveys of biota) or other techniques (eg., land classification techniques, public opinion surveys). One might also argue that, using *scientific* in its most general sense, the process thus laid down constitutes a methodology for decision-making![1]

Proposals for a decision-making framework appropriate to planning recreation in a conserved natural landscape are described and discussed in detail in Chapter Four, but the rationale for the proposals needs further elaboration. These decision-making problems are generally encountered in environmental planning and management - they are not specific to recreation planning and RCC - so that the literature from this more general field has been drawn upon in developing the framework adopted in Chapter 4. At the outset, some insight can be gained by considering general models of decision-making and the specific problems of environmental decision-making. The general theory is described and discussed only insofar as it can illuminate problems in and contribute to the resolution of difficulties in environmental decision-making. While it will appear at times that the discussion is digressing some distance away from the RCC problems identified in Chapter 2, this broader perspective is necessary for properly establishing the context of the proposals made in Chapter 4.

No attempt has been made at conducting an exhaustive review of the vast field of decision theory, but a cursory glance at its scope will put this discussion in its proper context. Bell, Raiffa and Tversky (1988a:ix) describe three spheres of interest in decision theory:

1 the *normative*, which seeks to explain how people **should** make decisions if they wish to obey certain fundamental laws of behaviour; this branch has its disciplinary origins in statistics, mathematics and economics;

---

1 At the same time, attempts to ensure the correct use of terms often obfuscate, rather than clarify. Environmental scientists are prone to attempting precise definitions of these generic terms, such as method, methodology, process and procedure. My own view is that procedures (for accomplishing some environmental task) employ certain methods in order to complete part/s of their task; and methods must necessarily involve specified procedures in the course of obtaining results. The difference, rather than being substantive, is usually a matter of scale or perspective.

2 the *descriptive* researcher is interested in how people actually make decisions, and to what extent this is consistent with rational theory; contributing disciplines are psychology and the behavioral sciences;

3 the *prescriptive* school is formed by those involved in trying to solve real world problems, whose interest lies in trying to devise ways of improving the quality of decisions in practice: between theory and its axioms, and cognitive limitations, what can one do? The relevant disciplines here are operations research and management science, both of which are, academically, closely linked to the normative disciplines.

My interest, and the orientation of this dissertation, lie unequivocally in the prescriptive school with those who seek feasible solutions to practical problems, but this entails drawing on normative principles and marrying them with behavioral and descriptive observations regarding operational limitations.

It is quite clear that much of the motivation for formal treatments of decision-making arose from the importance of economics, from a desire to understand economic choice behaviour. Economics traditionally had to do with the production, exchange and consumption of goods and services. More recently this definition has been broadened to be "the study of the (rational) allocation of scarce resources among unlimited and competing uses" (Rees 1968, quoted by Simon 1988), i.e., the fundamental tenets of economics are linked to the necessity to make choices between resources with different, often competing, uses, and which are available in varying degrees of scarcity or abundance. Such a definition makes its links to the kind of resource allocation problem - of different types of recreational and conservation resources - with which we are concerned, very obvious. It is for this reason that Stauth (1989) has argued for the application of economic tools of analysis to environmental problems. Because of its dominance in Western, technological society[2], economic rationality has been applied to areas of decision-making far beyond the boundaries of classical economics (Simon 1988). The application of principles of decision-making developed in the economic sphere are thus entirely appropriate to environmental decision-making.

What is meant by *environmental* decision-making is, any decision about the allocation of resources which, explicitly or implicitly, considers the likely environmental impacts of the proposals. While a multitude of other factors may also influence such decisions, the purpose of including environmental issues is to facilitate decisions which will protect environmental quality (Fuggle 1983b). Much of the literature on environmental decision-making has been written in connection with difficulties encountered in implementing requirements for formal

---

2 The dominant paradigm in modern society has been described as materialistic, based on an assumption of the primacy of economic values (Caldwell 1987).

environmental impact assessments[3]. The primary purpose of environmental impact assessments is to assist those making policy, planning and development decisions concerning the allocation of resources (Fuggle 1983b; Stauth 1983). Such procedures are essentially a tool to help decision makers make **rational** decisions regarding the environment. And as Turner (1988) has observed, the assumption that environmental management is the consequence of a rational decision-making process is necessary for a belief in the efficacy of planning to control environmental impacts. The aim of planning the allocation of recreational uses in a national park is to do precisely that: to protect conservation values by limiting the impacts of recreational use.

We turn now to consider what operations are involved in decision-making, what the problems are when applied to resource allocation decisions, what methodological responses have been made, particularly in the planning and environmental management spheres, and how this material has contributed to the development of the recreation planning framework presented as the subject of Chapter 4.

3.2 THE NATURE OF DECISION-MAKING

A decision is essentially a choice (a selective action (White 1969)) amongst a set of feasible alternatives in the light of some objective (Saaty 1986; Fatseas and Vagg 1982; Keeney 1982; Martino 1972)[4]. This choice behaviour requires judgements to be made on the relative value of the alternatives. In environmental decision-making the choice between alternative allocations of scarce resources involves judgements on the relative social value of the anticipated outcomes (Stauth 1989).

In undertaking the decision "operation", the following steps are performed (Stauth 1989; De Jongh 1988; Saaty 1986; Curry 1982; Fatseas and Vagg 1982; Keeney 1982; Hansen 1972; White 1969):

1. the objectives of the exercise (the problem to be solved) are defined;
2. feasible alternative solutions are identified;
3. their possible outcomes are forecasted;

3 The National Environmental Policy Act (NEPA) of 1970 in the USA made it a statutory requirement to furnish details of the environmental impacts of all federal proposals, via the mechanism of an Environmental Impact Assessment (EIA), and documented in an Environmental Impact Statement (EIS) (Fuggle 1983).

In South Africa EIA is now but one component in *integrated environmental management (IEM),* which is a process that starts with project proposal and generation, continues on to detailed planning and environmental evaluation, and ends in implementation and monitoring of the approved plan. It may itself be regarded as a decision-making framework!

4 although, as White (1969) has pointed out, a choice does not necessarily imply that a *decision* has been taken. Only when the problem has been converted into a **final** choice, is the decision complete.

4. information pertinent to evaluating the outcomes of the alternatives is gathered;

5. the alternatives are weighed relative to each other, according to some criteria or decision rules which may or may not be stated;

6. the alternative which best satisfies the objectives is selected.

Decision analysis (="decision theory") adds two further features as being fundamental to all decision problems: uncertainty about the outcomes of alternatives is common, and the possible consequences are not all equally valued, that is, decision-makers have preferences (De Jongh 1988; Saaty 1986; Keeney 1982; Hansen 1972; White 1969). The primary decision therefore generates secondary decisions, about the decision-making model to be used, the selection of feasible alternatives, what information to gather, what evaluation method to use, and so on (White 1969).

Clearly, complex decisions, eg., resource allocation decisions, will require a large number of inputs and a *sequence* of related decisions (Chapman 1981; Hansen 1972; White 1969). Commonly individuals undertake these complex procedures informally on the basis of casual, intuitive judgements which even the decision-maker herself/himself may not be able to analyse or describe fully. The more complex a problem is, the less useful is intuitive appraisal, and the more efficacious it becomes to approach these operations deliberately and systematically (Saaty 1986; Keeney 1982). Decision analysis is precisely about formalising such procedures. Stauth (1989:18) has nicely conceptualised the operations involved as *decision procedures* (to guide decision-making), *evaluation procedures* (to inform the decision-making process), and *measurement procedures* (to inform the evaluation process). We shall return to these shortly.

Whatever the particular methodology for decision-making, a necessary assumption is that decisions are *rational* (much decision research being directed to improving the rationality of decision-making procedures). The dictionary definition of rational is "agreeable to reason; not absurd, preposterous, extravagant, foolish, fanciful or the like; intelligent, sensible". In the realm of decision-making this translates into a decision which is consistent with the values, alternatives and information being weighed by the individual or group (Simon 1955)[5]. In other words, the course of reasoning which leads from one step to another must (seem to) be logical; it must make sense. Rational analysis, that is, systematic, comprehensive and explicit analysis, can further strengthen the decision-making operation (Stauth 1989:20). Hiding behind the insistence on rationality is a belief that rationality will confer *objectivity* on decision-making procedures. While some components of the decision operation - the forecasting of outcomes and gathering of information, for

5 Caldwell (1987) gives a sensible definition of rationality as "a form of logical reasoning consistent with an *objective perception* of reality". By objective perception he means a view of reality shared independently by many observers, and rational analysis does not admit to information acquired by subjective revelation.

instance - could, arguably, be objectively conducted, there are more reasons why decision-making is inherently subjective. Quite apart from anything else, the exercise of *judgement* is considered a profoundly subjective activity (Saaty 1986; Matthews 1975). Nevertheless, as Martino (1972:341) has suggested, the purpose of rational analysis is to eliminate the need for handling on an intuitive basis those pieces of information which can be handled rationally and explicitly.

In environmental decision-making, models of this rational procedure have traditionally assumed the relationship between management objectives based on the best available scientific information and the choice of the plan which will, according to specified criteria, meet those objectives (Turner 1988; McCool 1986). Hollick (1981b:81) describes the *rational comprehensive* planning approach similarly, but includes as intervening steps the listing of **all** feasible alternatives and their consequences, and the evaluation thereof to determine the best course of action. It is rational because it follows a systematic and logical procedure; comprehensive because all alternatives and all consequences must be considered[6]. The assumption is that if decision-makers are supplied with objective information on the consequences of actions and plans, they will be led to make a correct decision regarding the choice of plan which will maximize benefits to the affected society (Beanlands and Duinker 1983). Environmental decision-making has thus always accorded science an important place in its procedures (Caldwell 1987).

Because of this preoccupation with science and information, early concern was focused on the validity and accuracy of impact predictions and the role of scientifically generated information in such decision-making processes. But the realisation rapidly grew that apparently good science did not necessarily produce good decisions (Turner 1988; Beanlands and Duinker 1983). Early environmental professionals had clearly misunderstood the nature of decision-making.

3.2.1 Decision procedures

Turner (1988), in analysing the components of a decision-making framework for resource planning, points part of the way to why this should be so: he distinguishes two fundamental components in environmental planning and decision-making, these being a technocratic, rational and a political, bureaucratic component. The technocratic, rational part concerns procedures used to generate and evaluate alternative plans for the use of a specified area: these are procedures to generate objectives, control data collection and analysis and specify the criteria by which alternative solutions are to be evaluated; i.e., the methods by which qualitative and quantitative information are manipulated to generate plans. This is embedded in the political and bureaucratic procedures whereby plans are reviewed (by affected

---

6 In the planning context this is called synoptic planning, in which there is an emphasis on information which is quantifiable (McCool and Ashor 1985). The authors point out that the information requirements for such a comprehensive approach are quite unrealistic!

publics and/or decision-making authorities) and approved. It would be comfortable to draw the objective/subjective divide along the same line, but it is not so simple. As we shall see, the so-called technocratic, rational component which was assumed to be objective and scientific, also has many unavoidably subjective elements.

Turner's two components in combination are the equivalent of Stauth's (1989) **decision** procedures. Decision procedures, embracing as they do the entire process of making a choice, could be called the institutional arrangements which guide the decision process. Seen in this way, the administrative procedures which in many countries lay down the manner in which environmental evaluations are to be conducted, properly constitute the decision procedures as conceptualised by Stauth (1989), eg., Integrated Environmental Management in South Africa (Council for the Environment 1989), Integrated Resource Management in Canada (Walther 1987), and NEPA regulations in the USA.

Like Turner's (1988) paper this dissertation is more concerned with the technocratic, rational component of decision procedures in recreation planning. Nevertheless, the bureaucratic component is of interest to the extent that it might affect the practical application of any proposals made for improving rational procedures. It will be shown that bureaucratic (public authority) values in combination with limitations inherent in the rational component, create a need for a very explicit decision-making framework for recreation resource allocation. This is to enable public scrutiny of the process and so improve bureaucratic accountability. In addition, such a framework should be workable in the real world, that is, it must be feasible within the operating constraints of public authorities responsible for outdoor recreation planning and management.

It will be instructive, in order to clarify a bureaucratic frame of reference for the proposals made in Chapter 4, to further examine operational constraints on rational decision-making in environmental planning and management. Two excellent papers on the subject are therefore discussed below. Thereafter, the discussion will consider in greater detail the technocratic, rational component, which comprises Stauth's (1989) **evaluation** and **measurement** procedures. The role of values, rationality and information in,, and other influences on these operations will contribute to the foundations of a philosophical basis for a decision-making framework for recreation resource allocation.

3.2.1.1 Operating Constraints

In a revealing paper Curry (1982) described the results of a survey of decision-making processes in public agencies responsible for the provision of recreation in the English countryside. He compared actual operating procedures with a model of the rational decision-making procedure identical in essence to that described above in 3.2. His findings were disturbing. The dominant influences on decision-making in all the agencies were **constraints** on the process, by far the most important of these being financial constraints, followed by the influence of political figures on the final choice of alternative. Of very low priority were the formulation of objectives, the use of input information and the use of formal techniques for evaluating and selecting alternative plans. Curry (1982:24) concluded that pragmatic expedients took precedence over any systematic approach to evaluating the nature of resource allocation problems. This was ironic, he suggested, since the main area of academic interest in the field was precisely in developing and improving formal approaches for optimizing resource allocation decisions. Theoretical logistics therefore lose their force, he submitted, when they ignore the empirical milieu in which decisions are made.

Similar ideas have been expressed in a recent paper by Walther (1987). Integrated Resource Management (IRM) is a planning and management concept, adopted by the western provinces of Canada, which aims to provide an effective remedy for establishing social order in natural resource use. This is to be done by putting in place a hierarchy of policy directives, plans and co-ordinating committees, the objectives of which are to improve communication and to exercise cooperative decision-making among experts and sectorial interest groups. Again, professional interest has centered on methodological and procedural aspects of IRM, but Walther (1987:439) shows that the outcome of the IRM process is more a function of the historic situation into which a project is placed, than its professional design. As good as it may sound, the implementation of this ambitious system has been largely ineffectual in solving resource allocation problems, because it has been introduced into a system with deeply entrenched traditions of sectorial power balances and historic commitments (eg., land use rights). IRM runs counter to the trends of specialization, differentiation and profit maximization which predominate in modern society; without the power to change goal heirarchies, problem perceptions and the political rules of society, it is likely to remain ineffective. Walther therefore cautions environmental professionals against too optimistic a belief in the problem solving capabilities of IRM.

These authors confirm my own observations both about the practical limitations experienced by public agencies responsible for environmental planning and management, and about the dangers of placing one's faith in elaborate, academic procedures and methodologies which fail to consider their empirical context. These ideas are considered further in section 3.4 and in Chapter 4 as premises underlying the approach proposed in this dissertation for recreation planning in natural landscapes.

3.2.2 Evaluation procedures

Evaluation procedures are the crux of decision-making processes: their object is to result in an improved decision for a reasonable amount of effort (Stauth 1989). Evaluation consists in weighing the alternatives, according to explicit or implicit criteria (decision rules), to select which alternative best satisfies the objectives. This requires the possible outcomes of each alternative to be forecasted and their relative value determined (Stauth 1989; Keeney 1982).

Forecasting in environmental decision-making means determining the probable **magnitude** of impacts, while assessing the **significance** of impacts assigns value to them. The processes involved in accomplishing these two tasks are very different. While forecasting properly requires the application of quantitative and objective techniques of estimation and measurement, the assessment of social value is inherently subjective and qualitative. Since the problems of forecasting are related to the role of science in decision-making, this topic is discussed in terms of measurement procedures (which inform evaluation procedures) in section 3.2.3 below. The remainder of this sub-section will consider the difficulties of assigning values in evaluation procedures.

3.2.2.1 The role of objectives

One of the first problems encountered is when the decision problem (the objective) and the underlying assumptions of the procedure are not clearly and precisely stated which is usually the case, according to Saaty (1986). The precise statement of goals is necessary for establishing explicit, workable criteria. When this is not done the logic of the decision is unlikely to be discernible, and inconsistencies creep in. Roome (1984), in reviewing methodologies for evaluating nature conservation resources, found that inconsistencies in the evaluation procedures and unsubstantiated bases for evaluation were common. He attributed these deficiencies to three things: ambiguity of objectives; a failure to make basic assumptions explicit; and a lack of appreciation of the nature of evaluation procedures as comprising objective and subjective elements, hence the confusion of these elements in those procedures. Distortions in environmental evaluations have been caused by the failure of those undertaking seemingly objective analyses to acknowledge the subjective and value-laden aspects of their procedures and conclusions (Lemons 1987).

In general, the underlying goal of most resource allocation problems is to improve social well-being, but the social welfare goal may be perceived and defined differently by different social groups (Stauth 1989; Caldwell 1987). Thus, where alternatives are mutually exclusive - wilderness versus dune mining, for instance - evaluations may be controversial, because different affected groups bring different modes of rationality to the evaluation process (Stauth 1989; Hollick 1981a): environmental lobbies are likely to clash with proponents of development who tend to narrowly define social welfare in terms of economic production (McKenry 1977)[7].

7 By contrast, conservationists' definition of social welfare might be the preservation of species, even at the expense of local human populations!

In addition, many resource allocation problems explicitly have multiple objectives, eg., economic development **and** conservation. Since it is considered impossible to maximize **all** objectives (Keeney 1982), such problems require complex value tradeoffs (Stauth 1989; Saaty 1986; Keeney 1982). Sophisticated techniques would be needed in the above example to evaluate the degree to which each alternative would meet the dual objectives of economic growth and minimum environmental impact. In planning a national park, the situation is similar: the dual objectives are conservation of the fauna, flora and landscape of the park, and providing recreation opportunities for the public. Clearly, the objectives of recreation planning in such a case would have to be very precisely formulated in order to guide the evaluation process.

What this amounts to is that the allocation of resources is difficult, because there is no universal agreement on the objectives of the exercise, or on what criteria for decisions should be applied (Stauth 1989; Caldwell 1987).

3.2.2.2 Values and rationality

Environmental decision-making, at best, involves the **use** of scientific knowledge and the use of knowledge is a socio-political phenomenon (Beanlands and Duinker 1983). As such, environmental decision-making is grounded in the perceptions and values of society (Beanlands and Duinker 1983:37) and decisions resulting from it may be based as much on subjective judgements involving values, feelings, beliefs and prejudices, as on the results of scientific studies (Matthews 1975). Values have been described or defined variously as: "fundamental principles..., the *a prioris* of [a particular society's] cultural pattern" (Skolomowski 1975:8); "ideal units of meaning" (Kraft 1981:6); prescriptive or proscriptive beliefs, wherein some means or end of action is judged to be desirable (Rokeach 1973, cited by Glavovic 1988); they are standards which influence behaviour and are directly linked to motivation (Glavovic 1988; Caldwell 1987). Thus, if motivations are contradictory, the intractability of some controversies may be due to conflicts over values and beliefs rather than over facts (Beanlands and Duinker 1983), especially where facts are uncertain (Stauth 1989).

Environmental decision-makers are inevitably guided by a set of assumptions and values that influence the outcome of decisions (Caldwell 1987:302), these assumptions and values being embedded in the socio-political context of decision-making, in the prevailing "world view" that determines perceptions about the outcomes of forecasts. But while environmental decision-makers believe they are guided by the canons of their profession, the public affected by these decisions may have different views. Caldwell (1987:302) goes so far as to say that anyone whose professional responsibilities include environmental decision-making, functions in a situation of value conflict. "It is conflict among *values* that causes trouble for decisionmaking"! says Carpenter (1987:327). Resource allocation decisions inevitably involve a number of groups with competing values and objectives whose judgement of the significance of impacts is likely to vary. One of the consequences of this is that decision-makers are being called apon to defend the logic and rationality of their decisions by an increasingly articulate and critical audience (Caldwell 1987).

In a recreation context, managers and users may not have the same interests and concerns; and this may be compounded by their misperceptions of each others' attitudes (Lucas 1985; Washburne and Cole 1983). In addition, McCool *et al* (1988) show how different (hidden) reasons for management responses to the necessity to make a decision, may be. They suggest that the results of decisions may be very different depending on the underlying motivation of the particular decision-maker, to the extent that environmental degradation may be caused by such hidden agendas and conflicts (in other words, personal values may take precedence over the values which management is supposed to represent).

Rationality is closely linked to the problem of values in decisions. Values determine the decision "rules" which constitute rationality. Or, it is only in understanding the values underlying a decision, that any sense can be made of it, so each set of values provides the basis for a singular rationality. Hollick (1981a) elegantly showed how decisions which are perfectly rational within one framework of values, may be inimical to the interests of those operating within another frame of reference. The frame of reference in which a decision is made determines the goals of the decision, the methods used to reach it, what units for measuring value will be employed and the appropriate degree of quantification. He distinguishes between ecological, economic, social, legal and political rationalities; quantitative methods are inappropriate to the last three. Since most environmental evaluations have a high degree of scientific input, but the final decisions are made by politicians, it is not surprising that scientists (ecological rationality) may be baffled by the decisions of politicians, who act according to political and economic criteria.

Ecological, economic and usually political rationality enter into all resource allocation decisions. The problem is inseparable from the very nature of resource allocation. As Matthews (1975) has said, there is a conflict of interests inherent in man's necessity to manipulate the environment to meet his needs (food, shelter, etc.) and in so doing, to pay the cost of such actions in the currency of environmental degradation.

Even in allocating recreation opportunities in a national park, in an era when conservation agencies are increasingly having to pay their own way, the financial cost (economic) of each option might be weighed against its conservation value (ecological) and its capacity to satisfy public demand for recreation (political). Since there are differences between economic, ecological and political rationality which have important implications for the outcome of resource allocation decisions, these forms of rationality need further elaboration.

Economic versus political rationality: to optimize or to satisfice?

Economic rationality is predicated on a hypothetical unit of analysis, the so-called "rational man", whose material interests and goals drive his behaviour. The rational man operates always in such a way as to **maximize** the benefits of decisions. Maximizing means finding the "best" solution to a problem, by comparing the numerical values of a range of alternatives and selecting the optimal course of action (Stauth 1989). Maximizing assumes that sufficient information can be obtained at a reasonable cost to allow optimal choices. Traditional economic evaluations thus employed sophisticated calculations to precisely quantify the values of alternative resource allocations. The classic test of value is what individuals will pay for an outcome (Caldwell 1987). Economic valuations are bounded by short time horizons, usually much less that the lifespan of an individual, because the rational man is not supposed to see any benefit to himself of deferring for too long gratification of his material desires.

Political rationality, on the other hand, is based on the idea that the decision environment is in constant flux, the problems are very complex and sufficient information is rarely available to allow optimal solutions. The decision-maker is, in fact, faced with many external and internal constraints on rationality: in environmental resource allocation problems, objectives are often ill-defined if not conflicting, the uncertainties associated with outcomes are usually considerable, there are cognitive limitations on rationality and institutional constraints on the consideration of alternatives. These problems make it difficult to act according to the dictates of economic rationality (Stauth 1989). The task is then to arrive at a decision which is satisfactory under the circumstances and is likely to remain stable (Stauth 1989). The implications of this change in goals is that the methods of analysis are not as rigorously quantitative (qualitative approaches are acceptable), fewer decision rules are applied and the search for alternatives is shorter (Stauth 1989, citing Janis and Mann 1977).

Simon, in famous papers in the 1950's, characterised this kind of practical rationality. He postulated that the human brain is limited in its ability to process and manipulate information and to make computations based on that information. He therefore suggested people have a limited capacity for rationality. This has come to be known as *bounded* rationality (Stauth 1989; Bell, Raiffa and Tversky 1988b), in which it is perfectly acceptable to satisfice rather than optimize. Political rationality is relevant to most resource allocation decisions, in Stauth's view, because it recognizes the limitations associated with the functioning of the "social animal", and that optimization is unlikely ever to be achieved. Nevertheless, Stauth (1989:23) argues that optimizing behaviour is a higher form of rationality suited to evaluating **controversial** resource allocation proposals, where political rationality is likely to break down because of great antagonism, mistrust or lack of understanding. Simon (1988:60) casts some doubt on the superiority of economic analysis. He points out that economic rationality - **maximizing** behaviour

- is a very special case of rationality, and that rationality in the dictionary sense is implicit in all the social sciences. He therefore warns that the so-called "rational man" of economics who is a maximizer, who will settle for nothing but the best, is possibly a creature more of normative theory than of the real world. Simon holds that rational analysis of the ordinary kind is quite sufficient to explain a wide range of choice behaviours, and that recourse to the specialised rationality of economic theory adds little to our predictive understanding of how people make decisions.

Ecological rationality

Caldwell (1987:304-305)) gives the salient characteristic of ecological rationality as being synergistic and holistic, rather than reductionist: it looks at the functioning of the entire system, the ecosystem and species which inhabit it being the units of analysis. Time horizons are typically long, being determined by ecological processes which operate over decades and centuries. The perspective is therefore historical, extending from the evolutionary past into the future far beyond the lifetime of a single individual. The survival of the system is superior to the interests of the individual or particular groups; their interests are contingent upon conformity to natural principles (ecological dynamics). Accordingly the major test of value is the sustainability of the action and its contribution to environmental quality. The mechanics of decision-making are heavily dependent on scientific input which elucidates environmental interactions.

However, many of the environmental goods to be exchanged are not concrete, priceable resources (mineral, water, etc.), but concern rather such qualitative, intangible entities as wilderness opportunity or scenic beauty (Stauth 1983); in other words, environmental quality. Such commodities are not usually amenable to truly quantitative measurement[8] (Shopley and Fuggle 1984). Economic values, by contrast, are precisely expressed in terms of monetary units. Then, in comparing economic outcomes versus environmental consequences, goods measured in incommensurate units must be traded-off, hence the trend to developing methods for expressing environmental values in the common currency of money, eg., shadow pricing, contingency pricing, cost/benefit analysis (Stauth 1989). And there is the added complication that even the monetary value attached to these different commodities would in all probability be very different among different groups of society.

Clearly, the search for the recreational carrying capacity of a national park is underwritten by ecological rationality, because the concern is to ensure the sustainability of recreational use. A purely economic analysis would result in a different solution, because the major concern would be to maximize the benefits to users. And political rationality is relevant to planning recreational use insofar as the goal of satisficing is appropriate: the complexity of use-environment interactions,

8 Despite this, researchers persist in their efforts to find an objective measure of environmental quality, by assigning numerical values to subjective judgements (discussed further in 3.3).

an understanding of which is necessary for establishing carrying capacities, and the expense of the experimental investigations required to improve that understanding, suggest that an optimal solution is unlikely to be found.

3.2.2.3 Psychological bias

It is at the evaluation stage that the evaluator's or decision-maker's attitudes to uncertainty and to risk (a special case of uncertainty), and the decision-makers' personal preferences and biases play an important role in influencing the weightings given to each alternative (Saaty 1986; Keeney 1982).

Rational decision-making may well be bedeviled by the structure of the human brain. Decision theory has been largely concerned with analysing and improving **normative** (ideal), rational choice behaviour, but a number of doubts about the potential of real people for rational decision-making, have been raised (Simon 1955, 1956; Bell, Raiffa and Tversky 1988b). Saaty (1986), Miller (1985; 1984), Keeney (1982) and White (1969) all allude to the inability of the human mind to comprehend and make discernibly rational judgements about very complex problems which might require the simultaneous consideration of multiple inputs or objectives. This problem is exacerbated by the multi-disciplinary nature of most resource allocation problems in which, because of their complexity, there are no overall experts. Consequently, not only do contributions from a range of people have to be co-ordinated and integrated, but the decision-maker must consider aspects about which he/she knows little (Keeney 1982). A well known response to such complexity is to simplify it to manageable proportions, but simplification invariably leads to subtle distortions or omissions which may be carried through into the interpretation of environmental data. The necessity to feel in control of one's milieu and to compensate for the information overload syndrome, may therefore significantly bias an environmental scientist's judgement (Miller 1983). Miller (1983) also showed how preconceptions and prior attitudes about general issues bias scientists' interpretation and selection of data. He stated flatly, after testing student resource managers' appraisals of a pest control problem, that "scientific objectivity was not apparent" in their proposals!

Saaty (1986) discusses modern ideas about cognitive processes and the role of previous experiences in shaping and limiting our perception of and response to the informational stimuli from the environment. Modern studies show that decisions in the brain are made by the intuitive, creative, right half of the neocortex, while the job of the so-called rational left half is merely to interpret this message to the world (Saaty 1986:9). What is more, observations on the persistence of *ir*rational preferences in decision-makers have been made (Bell, Raiffa and Tversky 1988b). Tversky and Kahneman (1988) discuss several crucial ways in which decision-makers commonly violate the most basic tenets of rational choice theory, including consistency in their preferences. These deviations, they insist, are too widespread to be ignored, too systematic to be attributable to random error and too fundamental to be accommodated by relaxing the axioms of the normative (theoretical) model (Tversky and Kahneman 1988:167). In the end, they support a position very similar to that posited by Simon's *bounded* rationality (see 3.2.1). In short, despite all attempts to ensure the rationality of decisions, deep psychological decision-making processes might remain irrational or limited in their rationality, thereby introducing biases into decision-making procedures which are not amenable to analysis and "improvement" (White 1969). Nonetheless, the professional needs to be aware of and identify, if possible, these pitfalls of reason.

Group judgements: no easy solution

Even the use of groups of informed specialists to reduce bias, which is standard practice in environmental evaluation and planning (Lee 1982), is not ideal, for the output of groups is a function not only of intellectual activity, but interpersonal dynamics as well, despite all attempts to reduce the latter. Miller (1984), in an excellent paper, explores why groups have difficulty achieving effective collaboration.

While the incompatibility of certain personality types is a factor which one might expect (and there are techniques to minimize the interactions of personalities, eg., Delphi panels), the crucial role played by differences in *intellectual* style is less obvious. Miller reports findings by Barmark and Wallen (1979) that collaboration in a large, interdisciplinary, forest ecology research programme was persistently undermined by deep, unbridgeable rifts between theoretical ecologists (systems modelers) and empiricists. Their mutual failure to bridge differences in conceptual and methodological approaches resulted in major changes in even the management of the programme, and in an inability to integrate the findings of the project. It is obvious that specialists will often lend greater significance to their subject than to others (Fuggle 1983b).

Such biases and prejudices become even more pronounced when the group goes beyond the natural sciences to include social scientists as well. Here differences between "hard" and "soft" scientists become obstacles to progress. The conflict is between those who prize objectivity and empirical rigour above all else, and those who make greater allowances for intellectual flexibility, even to admitting speculation as a valid intellectual exercise. The pecking order from physical, through natural scientists to social scientists described by Miller (1984), is something many of us will have experienced. In short, irrational elements play a major role in group processes (Miller 1984).

3.2.3Measurement procedures

What information, how it is measured, how it is used, and how cost effective it is in improving the decision output, are questions which must be addressed by decision-makers. But let us begin by considering observations made by a number of authors on how information is used by real decision-makers.

3.2.3.1 Information content of decisions

Clearly, every operation in a decision procedure requires information, but information is used to different degrees by decision-makers, and the types of information available vary from scientific data and statistical probabilities to subjective opinion and intuitive judgement. Beanlands and Duinker's (1983) discussion of Hammond's (1978) analysis of modes of enquiry involved in decision-making (Figure 3.1) may serve to put information and science in perspective in their decision-making context.

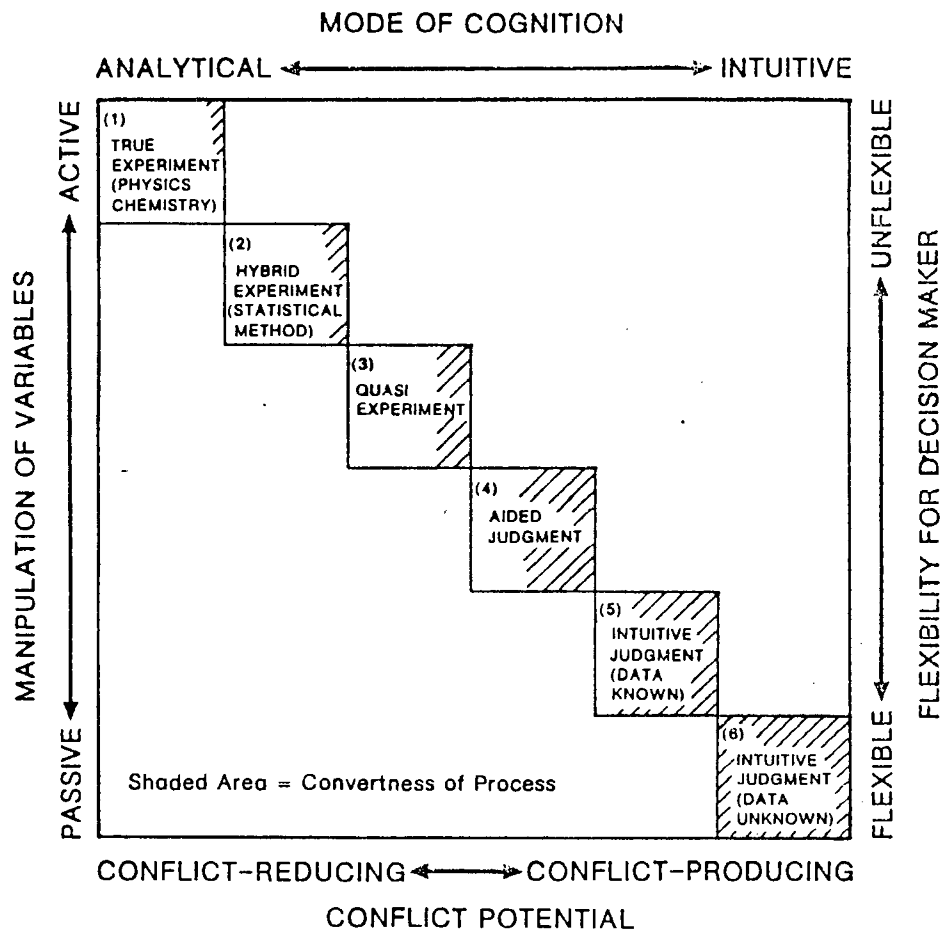


Figure 3.1: Modes of Enquiry. Adapted from Hammond (1978) by Beanlands and Duinker (1983))

The figure indicates how small a role information as such may actually play in decision-making. What emerges is that the analytical rigour of the information base is inversely proportional to its efficacy in solving complex social-environmental problems; the problem-solving power of "objective" data typically decreases as complexity increases (Keeney 1982). The classic experimental approach to scientific enquiry is regarded as the "highest" mode of information generation (upper left in Figure 3.1), but although results are not usually the basis for conflict, neither are they of use in solving complex social-environmental problems. It can also be noted from Hammond's analysis that most environmental decisions have been based on intuitive judgement either with or without data: this is what has been attributed to most of us and called "quasi-rational thought" by Beanlands and Duinker (1983). This still, to a large extent, remains the case. Rather than exact science characterizing environmental management, decisions in this field are based on qualitative data and the accumulated experience of experts (Murphy 1988:1). Proponents of expert systems have pointed out that experts use available data, experience and intuition in an **implicit** reasoning process to make management decisions (Starfield and Bleloch 1983)[9]. Characteristically, decision-makers use intuitive judgement with or without data, no manipulaiton of variables and no statistical controls. Furthermore, their frequently inconsistent logical rules are not made explicit (Beanlands and Duinker 1983). Curry's (1982) survey of decision-making procedures in English rural recreation agencies confirms these observations: neither information nor formal planning methods and techniques featured prominently in decision-making procedures.

Furthermore, Hammond saw a certain inevitability in the tendency among scientists, in many cases, to disagree on the advice to give decision-makers. The reason, he suggested, was that most environmental problems are so complex and involve such a high degree of unpredictable risk that they cannot be fully grasped[10]. Miller (1984) concurs, in pointing out that disagreements on interpretation of data are common amongst scientists. In many large environmental projects, he argues, integration and interpretation of data may occur around political issues, i.e., data are selected and interpreted to support a political position on the particular issue. (Miller quotes figures from a review of EIS's in which 2 or 3 out of 200 reports made findings antithetical to the interests of the proposal they were evaluating. In South Africa I have personally reviewed two EIS's which would, in my judgement, support Miller's contention). Perhaps it should come as no surprise then, that there may be a tendency for decision-makers in general to mistrust expert opinion (Carpenter 1980).

I see no point in denying that the use of information is inevitably biased to some degree, be it in making a decision, or in presenting information relevant to a

---

9 However, experience and intuition must still be combined in discernibly logical processes of thought to be considered rational, for, as Caldwell (1987:303) has pointed out, rationality is distinguished from other forms of "knowing" by the rejection of subjective revelation as a reliable source of information.

10 Perhaps this is why scientists cannot even agree on the methods to use: in most fields of endeavour there are almost as many methods as there are authors! eg. see plethora of methods of land evaluation commented on in Appendix A.

decision. Again, one of the few counters, is to make the values underlying the analysis clear and unambiguous.

3.2.3.2 Science - an imperfect tool

Decision-making by definition involves making projections about future outcomes of present actions (Duinker and Baskerville 1986; Saaty 1986; Keeney 1982), and in environmental decision-making the scientific method, is assumed to be the ideal way of approaching this task. Classically, scientific method comprises constructing hypotheses about the functioning of the natural world, which the scientist then sets out to disprove by experimental investigation. Pielou (1981:17), however, makes an instructive distinction between *investigation* and *modeling* in the practice of science. Investigation is described by him as searching directly, by any appropriate means, for answers to single, clearcut questions without preconceived ideas as to what the answers will be. Modeling is closer to the classic definition, in that a plausible representation of the functioning of a natural system is constructed, in the form of mathematical equations. This is then tested to see if the actual behaviour of the system conforms to it. On cursory inspection, it would appear that modeling holds more promise for predicting the ecological impacts of resource allocation decisions, but the practice of impact assessment in fact falls far short of the promise of either approach to scientific analysis. The reasons for this are to be found both in the nature of ecological systems, and in pragmatic constraints on scientific analysis.

The complexity of environmental interactions alone, coupled to the as yet poor understanding of their dynamics, means that accurate predictions of impacts can very rarely be made, if at all. Uncertainty and complexity in natural systems are scientifically described in terms of stochastic probabilities which limits predictive capability (Carpenter 1987). The use of probabilities is in any event an aspect neglected in most environmental impact assessments, according to Bisset (1988), although stochastic probabilities are widely used in applications of decision analysis, because of the condition of uncertainty which characterizes decision environments (Saaty 1986; Keeney 1982). And what in fact happens in many environmental evaluations can hardly be called scientific studies: beyond initial resource surveys, conducted perhaps with scientific rigour (objective, predictable, replicable (Russell 1931)), specialists invoke educated guessing or informed judgement - the kind of knowledgeable wisdom gained from experience and intuition - to predict the probable consequences of proposed actions (Beanlands and Duinker 1983). Frequently, there is simply not the time available to go through the lengthly process of baseline studies and experimental investigation of predicted change. Very rarely are real scientific methods utilized to forecast impacts (Bisset 1988; Eberhardt 1976). Numerical methods may well be used, as when experts rate, on a numeric scale, the anticipated severity of impacts associated with each alternative in respect of their area of expertise (see Sondheim 1978; Dee, Baker, Drobny, Duke, Whitman and Fahringer 1973). However, many of these methods are mathematically unsound because the numbers used, based as they are on subjective judgements, cannot be assumed to be on the interval or ratio scales (Bisset 1978). So-called scientific decisions on even the magnitude of impacts are thus neither entirely quantitative nor objective. In addition, because of the lack of information about many ecosystems it is not impossible that quite incorrect data may be used (Fuggle 1983b).

While many environmental professionals have called for greater use of modeling to predict environmental response to change (Bisset 1988; Wathern 1988; Beanlands and Duinker 1983; Munn 1979), there is good reason to be wary of computerized mathematical models of ecosystems (Miller 1984). Pielou (1981) classified models according to their uses, the types relevant to environmental decision-making being descriptive, mechanistic models, which attempt to **explain** the behaviour and interactions of populations in an existing ecosystem, and forecasting models, which often take the form of time series analyses used to predict future events without attempting to explain them. The large number of interacting variables involved in understanding ecological systems makes modeling these systems particularly difficult. Starfield and Bleloch (1983) have commented that attempts to use computational methods to solve resource management problems usually involve unreasonable levels of detail, and doubt that such levels can be reached. Also, the level of precision in measuring and estimating natural populations is inherently low (Pielou 1981), being a function of natural variation and poor experimental (especially statistical) design (Carpenter 1987). The tendency has therefore been to model simple, closed experimental systems, from which extrapolations to the real world have been made. The characteristics and dynamics of spatially large, unbounded systems may be fundamentally different from the small, closed laboratory system, so that extrapolations from one to the other may be invalid (Pielou 1981). The mismatching of assumptions may thus result in a degree of error so large that the results are rendered unreliable for many applications. Such large, complex systems may be examples of "transcience" problems, which are insoluble by currently available experimental and modeling procedures (Miller 1984). Such problems are common in environmental problem-solving, according to Miller.

Not only may assumptions be inappropriate, but some terms in the modeling equations may not represent truly quantitative data. In some models a series of *factors* is used to represent interactions which are not quantitatively measured in the field, but are estimated by the relevant expert. This has certainly been the case with the Universal Soil Loss Equation (Garland 1988; Hudson 1987), which has been proposed as a basis for calculating the physical carrying capacity of recreation areas (Morgan 1986; Morgan and Kuss 1986; Boddington 1980). The USLE utilizes a series of factors which cannot all be objectively measured in the field, numeric "data" being generated on the basis of the soil scientist's experience and judgement, that is, the data are qualitative. The best result yet obtained in South Africa in using the USLE (adapted for local conditions) to predict soil losses, was a twofold overestimation of losses as measured in the field (Hudson 1987).

Furthermore, according to Pielou (1981:17), modeling has become an end in itself: "Models are being constructed, refined, tinkered with, and displayed with little or no effort to link them with the real world". Although Pielou was writing a decade ago, similar remarks were made by Miller in 1984, and Scholes (1989) has recently echoed his comments in saying that many ecological models are the butt of jokes for having no data to test them!

In the sphere of environmental impact assessment, most models are based ultimately on informed judgement, not quantitative data[11]. The usefulness of formal modelling diminishes in proportion to the subjective input to the problem (Raiffa 1968, cited by Stauth 1989). This means that there is a judgmental gap between the output of any model and the real world because of the intangible, subjective feelings and hunches not included in the model (Stauth 1989:249). The subjective nature of primary data is well illustrated in Shopley's component interaction matrix (Shopley and Fuggle 1984): the validity of the secondary impacts mathematically generated from a matrix of primary ecological dependencies, is entirely dependent on the validity of the primary dependencies established by a group of experts. An attempt to utilize Shopley's matrix as an aid in an EIA was abandoned because of problems in identifying these initial dependencies (Sowman, Shopley and Fuggle, in press). Another example of quasi-scientific data used frequently in resource evaluations are vegetation and soil maps: these are rarely based on quantitative analysis. Rather, the distribution of vegetation types and soils is based on the *a priori* recognition of types in the field by experienced natural scientists. Soil types are usually then described qualitatively without recourse to laboratory testing, unless specialized applications are required. Although the recognition of vegetation types may be refined by the application of computerizered cluster analysis or ordination techniques, these still do not establish quantitative relationships between the components of the system.

So far nothing has been said about the complexities of investigating and modeling the socio-economic environment. Suffice it to say here that the preoccupation with science and the naivety regarding socio-economic systems, have resulted in an emphasis on the biophysical aspects of environmental problems and a failure to incorporate socio-economic factors into systems models.

I submit that there has been a general misrepresentation of the nature and possibilities of science and, more specifically, scientific method in environmental evaluation, planning and management. There is ample reason for challenging the notion of science as it is practiced in environmental management, as objective truth,

---

11 Perhaps this is no cause for complaint. Miller suggests that the preoccupation with the quantitative demands of models may result in the neglect of important qualitative data. Expert systems enthusiasts would no doubt agree.

and the scientist as impartial observer[12] (Miller 1985; Skolimowski 1975), yet scientists continue to cling to these notions. Science with its hypothetical orientation, produces theories to explain the natural world, and theories are mental constructs. What is and what is not a fact is frequently dependent on theory, (facts are "theory-laden"), and what is or is not a *significant* fact is determined by values (Callicott 1987:280). Furthermore, what scientists say are significant facts are rarely opened up to the general analysis of uncertainty and risk which accompanies decisions in the economic and political spheres: this is a task which is considered the preserve of scientific peers, but its exclusion from more general review may undermine the legitimacy of scientific expertise (Lemons 1987).

More importantly, regarding scientific method, one is constantly hearing about the necessity to **integrate** multidisciplinary information in seeking solutions to resource planning and management problems, but few methods and techniques exist for guiding this process, or for pursuing truly integrated research (Scholes 1989; Miller 1984). Miller (1984) suggests that the fundamental problem may again be related to intellectual styles. The distinction here is between the (classically) analytic style - which emphasizes reductionism, compartmentalism, mechanism - and the synthetic approach - which stresses integration, teleology and synthesis. He demonstrates how differently the two groups would conceptualise a solution to a pollution problem.

Science and facts can therefore never have more than a very limited role to play in the complex judgemental procedures which comprise environmental decision-making. Science remains useful, nevertheless, in forcing the analyst to deliberately pursue an approach which is as systematic and replicable as possible, and which demonstrates its rational basis.

3.2.3.3 Measuring values: the problem of scales

Thus far the discussion has dealt only with the measurement and estimation of ecological parameters. Measuring the value that society places on alternative outcomes is a different matter again, because there is no universally accepted scale of measurement for subjective judgements. Scientific measurements are defined in terms of mathematic equations and measured in numbers on the ratio scale, in which the magnitude of the interval between integers is assumed to be equal and there is a true zero (Smith and Theberge 1987; Tull and Hawkins 1976; Russell 1931). Social values, with the exception of economic values, have no such common currency. Economic goods are measured on an interval scale of monetary units in which an arbitrary zero point is assigned. The costs and benefits of alternatives can thus be compared in common units, but resource management problems invariably include classes of costs and benefits which have not been valued in traditional economics (Sinden and Worrell 1979). These are the so-called *nonmonetarisable*

12 One hardly needs recourse to Heisenberg's Uncertainty Principle to prove the point!

goods, such as the value of the loss of a pristine canyon, aesthetic appeal, or the value of natural resources to future generations. The major categories of non-monetarisable goods are *common property resources* and *externalities*. They cannot be priced because they cannot be **owned** by an individual and exchanged in the market place. Stauth (1989) has given an excellent discussion of this complex topic, including a review of the large number of techniques available for assigning prices to unpriced goods. Many of these sophisticated techniques involve considerable costs and specialist knowledge to implement, and major problems in price estimations remain. In any event, Stuath concludes that there remain some environmental goods for which quasi-monetary values assigned within the bounds of classic economic rationality (i.e., in which the major criterion of rational decision-making is "efficiency") are insufficient as measures of value. He therefore proposes an evaluation technique which uses as its foundation the principles of cost/benefit analysis, but draws on theories of socio-psycho measurement for assigning values to alternative outcomes.

There are four problems in applying numerical scales to social values. Firstly, there is no true zero, since there is no objectively derived point which can be assumed to have no value (Stauth's approach to circumventing this problem is described in 3.4); such a scale is, at best, an interval scale, to which a zero point must be arbitrarily assigned (eg., altitude, temperature). All mathematical operations can be performed on an interval scale, thus, for instance, if one wished to obtain the total score of value of an alternative, based on several weighted criteria, multiplication and addition of individual scores would be valid.

But there is disagreement on whether subjective judgements can be measured on an interval scale. There is no reason to assume that "intervals" of subjective judgement are of equal magnitude, nor that two people have the same reference scale, that is, that the numbers will have the same magnitude of meaning for both of them, nor that the subjective intervals of value will remain constant in the individual over time. Tversky and Kahneman (1988) illustrate this point well: they point out that the difference in value to an individual of \$200 *versus* \$300, is not the same as that between \$1200 and \$1300. Such subjective scales are correctly ordinal scales (Bisset 1978), which simply express a rank order of values without any assumptions about the value of the intervals between numbers. Mathematical manipulations such as multiplication and addition cannot be performed (Tull and Hawkins 1976)[13]. Most numerical ratings employed in environmental evaluation techniques, either as measures of the social significance or of the magnitude of impacts, are ordinal values.

The third problem concerns the comparison of values measured in different scale units, that is, the problem of comparing unlike or *incommensurable* goods ("apples" versus "pears"), a process which is standard, if implicit, in environmental decision-making: the economic benefits of jobs provided by dune mining must be weighed against the value to future generations of a pristine wilderness; the loss to migratory waterfowl of an important feeding wetland which would be eliminated by dam construction, against the benefits of cheap hydroelectric power to nearby communities[14].

Now consider, for example, a method for recreation resource allocation in which allocation is to be based on an aggregate score of the suitability of land units for recreation. This score is to be calculated by adding a number of criteria scores, including the conservation value of land units (calculated by a formula which includes values for rarity, species richness, etc.), the area of the land unit, its ecological vulnerability, and its suitability for several particular activities (presence of resources important for those activities). This operation can be performed only if all the criteria are *numerical*, that is, expressed on an interval or ratio scale, and if they are *comparable*, that is, if their scores are standardized and normalized (Hwang and Yoon 1981, cited by Smith and Theberge 1987). The assumption of comparability is necessary because in performing mathematical operations on the scores, the assumption holds that similar changes in levels of criteria are equivalent. This concern with comparability is frequently neglected in such evaluations (Smith and Theberge 1987:454). But mathematical niceties are not the only drawback of aggregated scores and incommensurable values. Leatherberry (1979), after reviewing methods of river amenity evaluation, cautioned restraint in the use of aggregated scores of value. He found aggregated scores both obscured conflicts (also Bisset (1978)) and incompatibilities and presented a very static picture - the dynamic nature of the resource being evaluated was lost. He also found the replicability of the scoring methods to be questionable.

The fourth problem is encapsulated by Arrow's Impossibility Theorem, which states that it is logically impossible to obtain a consistent social preference by aggregating a set of individual preferences when there are more than two alternatives (Hollick 1981a).

13 Smith and Theberge (1987) make an interesting observation about ordinal scales: that some authors regard them as a qualitative scale (Voogd 1983, cited by Smith and Theberge), while others call them quantitative (Ghiselli *et al* 1981, *op.cit*)

14 While theoretically this is unacceptable, (you cannot add or subtract apples and pears) Garrett Hardin (1978) has pointed out that we perform such comparisons virtually every day of our lives. All that is required to do so is a criterion of judgement and a system of weighting.

All these problems notwithstanding, numerical indices of social value continue to be used and statistically manipulated in the social sciences, and group evaluations are invoked to provide composite social values. As Stauth (1983) put it: "numbers serve as a powerful means of rigorously describing, testing and analysing relationships in ways not possible through the use of qualitative concepts and descriptions", though he cautions professionals not to forget that qualities are the essential content of any assessment.

I submit that one either puts one's faith in numbers or one does not: the debate has changed little in the last twenty years; and there seems to be no entirely rational reason why some authors promote the quantification of all parameters, while others are uncomfortable with the reductionism of numbers in representing complex preferences and attitudes. Numbers are a convenient and widely appreciated way of expressing values, and insistence on their use is likely to continue. As Whitaker (1984) has suggested, even if mathematical manipulations of simple numerical rating scores are not theoretically correct, they may still be adequate for most resource evaluation problems, unless the issues are so complex that more sophisticated techniques are really necessary.

I, however, lean to the qualitative descriptors' camp for problems where a great deal of precision is unnecessary, if only because the information base for evaluation is sketchy, and where the lay public has a very direct stake in understanding the outcome. Bisset (1988), for instance, has questioned the efficacy in resource allocation decision-making of multiple attribute utility theory, a type of decision analysis which employs complex procedures for quantifying preference (utility) functions. The reason is that the method is so complex that its effective use requires highly numerate participants who are familiar with utility theory. Though qualitative descriptors may be long-winded, they better encapsulate the subtleties of interactions, the common uncertainties of prediction, and vagueness in the information base. Moreover, the values underpinning the evaluation are immediately accessible to ordinary people without having to be interpreted by "experts".

3.3 APPROACHES TO IMPROVED DECISION-MAKING

The complexity of decision-making has been demonstrated, but how is this complexity to be handled? Clearly, decision procedures are amenable to improvement in a number of areas, and these improvements can be accomplished with varying degrees of formality (Keeney 1982): formulation of the decision problem; improvements in forecasting the outcomes of alternatives in order to reduce uncertainty; improved information gathering procedures; improved evaluation methods; exposure of the values and assumptions underlying the decision (De Jongh 1988; White 1969). The following section examines some methodologies applied to general decision-making operations as well as to resource allocations. They provide the tools on which the decision-making framework for recreation opportunity allocation advocated in Chapter 4, is built.

Beanlands and Duinker (1983:38), referring to impact assessment, quote a workshop participant's remark that there have been two general approaches: the first being the quick-and-dirty in which a group of experts generates best-opinion guesstimates, and an information-based, model-oriented, scientifically established approach. There have been very few of the latter type of studies undertaken, say the authors. Despite the implied cynicism, that analysis is corroborated by the literature, which displays two streams of thought regarding the appropriate response to the difficulties inherent in resource allocation decisions. This division is to a large extent artificial, since the majority of decision-making frameworks combine elements of both classes.

(1) There are those who suggest that, in view of the existing "quantomania" of society, there is no question that procedures for environmental decision-making must attempt to be scientific (Duinker and Baskerville 1986; Beanlands and Duinker 1983; Sinden and Worrell 1979; Whipple 1974; Dee *et al* 1973): systems modeling or linear programming, and cost/benefit analysis, contingency valuation or shadow pricing techniques, which put a monetary value on all parameters, would fall under this banner. Hansen (1972) has called these *information processing models* (of decision-making), in which the emphasis is placed on information acquisition and processing.

(2) The second group place greater emphasis on developing procedures for systematically drawing out and analysing informed judgement, subjective evaluation and intuition. The expert systems approach (Murphy 1988; Starfield and Bleloch 1983), Analytical Hierarchy Process (Saaty 1986) and decision analysis (Bell, Raiffa and Tversky 1988a, 1988b; Keeney 1982; Bisset 1980; Sinden and Worrell 1979; White 1969) are classic examples, though their applications are not confined to natural resource allocation problems. These are *problem-solving models* in which the stress is on evaluating alternatives and elucidating the reasoning processes by which evaluations are made.

Comprehensive procedures combine scientific methods and procedures for forecasting outcomes or investigating man-environment relationships, with techniqes for establishing quantitative relationships between those forecasts and the social values assigned to them. The latter task comprises the weighting and rating of values on numeric scales. The numeric scales utilized to express the suitability of landscapes for recreation (1 = Highly Suitable; 2 = Moderately Suitable, etc) are examples of this (eg., A'Bear and Little 1976; Beaumont, Carter and Gregg 1975; Lacate 1969). Ferrario (1978) evaluated South Africa's tourist potential by means of rating scales. Dee *et al* (1972) and Sondheim (1978) developed environmental quality indices by quantifying the relationship between environmental parameters and the social value attached to different levels of each parameter. The examples are legion.

The discussion in section 3.2 showed that so-called scientific approaches to decision-making cannot escape the necessity for subjective judgements, nor uncertainty in their information base, a deficiency to which such approaches pay insufficient attention. In addition, operating constraints in public agencies, including those observed in working with the South African National Parks Board in planning the recreational use of a new national park (Chapter 1), suggest that it would be inappropriate to choose an approach to recreation resource allocation which is too sophisticated for use by management staff, and which is time consuming and expensive. Under such circumstances it is apparent that subjective inputs into the decision-making process may be considerable, so that it would be more appropriate to select an approach from those which seek to systematize and make explicit subjective judgement and informed intuition. It was stated in section 3.2 that this thesis seeks to improve the rational, technocratic aspects (Turner 1988) of decision procedures. It will do so by addressing both information gathering aspects of, and subjective decision operations **within** the rational, technocratic component. The succeeding discussion will therefore concentrate on those problem solving models of decision-making which will directly contribute to the development of the decision-making framework proposed in Chapter 4.

3.3.1 Qualitative Approaches

3.3.1.1 Rules of combination

The problem-solving group of approaches can be classified according to who the decision-maker is, and how value judgements are described/expressed/measured. The "unit" decision-maker may be an individual (expert systems, Analytical Hierarchy Process (AHP), and decision analysis), or a group - the Nominal Group Technique and Delphi panel are examples of the latter type, although there is no reason why the principles of decision analysis should not be applied to group decisions (Keeney 1982). More importantly perhaps is the approach to expressing value judgements. Few methodologies rely on purely qualitative, verbal descriptions, because they cannot, obviously, be mathematically manipulated to produce composite indices of judgement[15]. Recall the necessity in resource allocation decisions to trade-off incommensurable goods: how does one decide which is the best alternative if a total "score" for the overall value of each alternative is unobtainable; if one must decide on the basis of a large number of disaggregated, verbal statements? - One relies on subjective judgements, which is the problem everyone has been trying to circumvent!

15 Bisset (1988:60) in recently commenting on the persistence of index methods (checklists, matrices, overlays) in EIA, suggests that these methods fulfil a need of decision-makers, who like to be faced with an easy decision. Index methods provide a means of encapsulating complex combinations of impacts in by amalgamating them in a total index for each alternative.

However, making the criteria and reasons for that judgement explicit, albeit with a verbal statement, will enable the critical observer to scrutinize the logic of the decision. Ian McHarg, the famous landscape planner, was an exponent of verbally expressed rules of combination. He combined these with a quasi-quantitative approach in which a scale of importance ratings was translated visually as shadings of varying intensity on transparent overlay maps (McHarg 1969). In the planning sphere, some authors called for direct public participation in evaluation procedures, as a means of circumventing the "numbers as valid representations of values" problem (Gold 1977; Runyon 1977).

3.3.1.2 Expert systems

Expert systems are computer-based models which capture the knowledge of highly skilled experts (Bramer 1986). They were developed to simulate the way an expert reasons, to work with beliefs and intuitive information where quantitative data are scarce. They provide a computer framework for investigating the rationale behind decision-making, for identifying information gaps and indicating where research and monitoring are required (Starfield and Bleloch 1983). There have been several applications dealing with resource management problems in South Africa (Starfield and Bleloch 1983, 1986; O'Keefe, Danielewitz and Bradshaw 1986). Expert systems function as a kind of computer consultant which interacts with the user via a series of questions, where questions asked are dependent on answers given to previous questions (Starfield and Bleloch 1983). The hierarchical stucture of the system is thus similar to that of Saaty's AHP.

There are two basic types of expert system, frame-based and production systems. The former organize descriptive, static information as slots in a frame. In production (rule-based) systems, knowledge is stored in the form of production or decision rules. These can also be called rules of combination, because they take the form of "If X, then Y". If precondition X is fulfilled, then Y is assumed to hold true, and a truth value can be assigned to it. More complex rules might be, "If X and Z, but T, then adopt W course of action". The rules establish the preconditions for the output, which may be in the form of decisions, advice or actions (Murphy 1988). The system is able to justify its conclusions, explain its reasoning, handle conflicting information and process rapidly changing information (Hayes-Roth, Waterman and Lenat 1983). Most expert systems are production systems, though these can be combined with frame-based systems. Production systems are more suitable for representing problem-solving, because all problem-solving expertise can be formulated in rules (Hayes-Roth *et al* 1983). These rules codify and encapsulate the "rules of thumb" commonly used by experts (Bramer 1986).

This discussion is intended to indicate the tremendous apparent potential of rule-based expert systems to deal with resource allocation problems which, as shown earlier, tend to be constrained by insufficient data, a high order of complexity, a spectrum of values and incomplete theory (Stauth 1989; Eberhardt 1976; Whipple

1974). Expert systems are designed precisely to deal with these difficulties. However, Bramer (1986) has cautioned against too optimistic a faith in these systems, for a number of technical and theoretical reasons. There are difficulties associated with extracting knowledge from experts, whose knowledge tends not to be packaged in neat rules, but is often unconscious and difficult to articulate. Related to this is that "rules of thumb" often represent uncertainty in knowledge and only partial truth, whereas expert systems can deal only with absolute truth or falsity. This results in prescriptions based on approximate and uncertain data, lending a perhaps false confidence to the outcome. Furthermore, there is no sound theoretical basis for how the knowledge is represented in the program: frames and production models are just two possible models, and their use for a particular problem is based on experience, not theory. He shows too how easy it is for inconsistency to creep into a set of rules. In short, building an expert system requires considerable expertise and subtlety. Two experts who have participated in expert system building workshops in South Africa have made similar remarks to me: the exercise was very valuable in helping the participants to structure and clarify their own thinking about the particular management problem, but they felt that the product, the resulting expert system, was then of trivial value in assisting decision-making relating to that problem. Expert systems may therefore be extremely valuable in clarifying conceptualisation of the interactions of parameters which affect the outcome of the decision, even if these relationships are not described quantitatively, but the computer models are of limited value as an operational management tool.

3.3.2 Quantitative problem-solving methods

3.3.2.1 Decision Analysis

Keeney (1982:806) has described decision analysis as a "formalization of common sense for decision problems which are too complex for informal use of common sense". More formally, decision analysis consists of a set of logical axioms and a collection of systematic procedures based on those axioms, for analysing the complexities inherent in decision problems (Keeney 1982; White 1969). The two principal axioms which underly the systematic procedures are that the desirability of alternatives should depend, firstly, on the probabilities of the possible consequences of each alternative, and, secondly, on the preferences of the decision-makers for those consequences (De Jongh 1988; Keeney 1982; Fatseas and Vagg 1982; White 1969). The major contributions of decision analysis have therefore been in the formal treatment of probabilities under uncertainty and preference structures. Its value lies in that its theories and procedures were developed to formally introduce and process subjective judgements in evaluation procedures (Keeney 1982:829). The remainder of this discussion is based on Keeney's (1982) excellent overview of decision analysis.

The four basic steps in decision analysis are:

1. structure the decision problem
2. determine the probabilities of impacts of each alternative;
3. determine preferences of decision-makers;
4. evaluate and compare alternatives.

Structuring the decision problem includes identifying alternatives and specifying the objectives. Objectives are structured hierarchically, so that at the lowest level, attributes of each objective are identified by which to measure the degree to which that objective is achieved, eg., profitability, measured in net annual income in dollars.

In step 2, assessing the impacts of alternatives, the estimation of probabilities is the major task. There are a variety of methods for determining a probability distribution function over the set of attributes (as defined in step 1) for each alternative. Where formal predictive models are not available for determining probabilities, the quantitative assessment of professional judgements of probabilities is done. This is a special feature of decision analysis (Keeney 1982). While admitting that there are many potential sources for error in these complex procedures Keeney reports that recent evidence suggests that, with experience and training, professionals can reliably formulate probabilistic forecasts. On the other hand, the tendency of a number of experts to give different forecasts about the same event remains an area of research in decision analysis (Keeney 1982).

The value trade-offs required to select from amongst the alternatives, and attitudes to risk are functions of the preferences of decision-makers. In order to assimilate these parameters into the analysis an objective function is needed which aggregates individual preferences and risk attitudes. This is the utility function, another hallmark of decision analysis and the subject of a discipline in its own right, utility theory, with various sub-branches such as multi-attribute utility theory. Multi-attribute utility theory has been applied to complex natural resource allocation decision problems (Bisset 1988). The utility function u indicates the desirability of the impact relative to all other impacts. This step is unique to decision analysis in that it creates a model of values to evaluate the alternatives (Keeney 1982). The quantified value judgements elicited by structured means reflect equity concerns, risk attitudes and information about value trade-offs. This process also allows checks for consistency and calculations of the value of obtaining additional information. Clearly, it is a powerful tool for honing the rationality of complex decisions.

However, there are problems in implementing the methodology, not the least of which is a relatively heavy commitment of time and manpower resources. It is a slow process, requiring subtle skills on the part of the decision analyst which are not to be found in textbooks. There are also many sources of bias in and misrepresentation of experts' and decision-makers opinions and information which may become disguised in the numerically expressed utility functions. A number of authors in the EIA arena have urged caution in applying sophisticated numerical treatments of uncertainty and priority setting in environmental decision-making. Hobbs (1985) expressed concern at the tendency of composite utility functions (the end product of the amalgamation of contributing factor scores) to disguise, rather than reveal, tradeoffs and value conflicts; the apparent precision and elegance of such methods may hide inaccuracy and lack of consensus, and may be in contradistinction to their operationality. Bisset (1980) pointed out that the increasing public interest and involvement in environmental decision-making, would require information appropriate both to the decision-maker and layman, and would cause a shift to the use of methods which do not emphasize quantitative manipulations.

I have therefore concluded that the full-blown application of decision analysis to the problem addressed by this dissertation would be too complex and time-consuming for most public conservation agencies without ongoing expert guidance. But the general principles are obviously relevant to decision-making for recreation resource allocation (decision analysis has been used extensively in natural resource allocation problems, particularly in the field of energy policy (Keeney 1982)). Keeney shows the way forward. He makes some sensible observations about the usefulness of decision analysis beyond its theoretical niceties. Firstly, he suggests that **partial** analyses may be appropriate for many decision problems, and that selected elements of decision analysis procedures can be employed to accomplish certain tasks. The approach is most useful in forcing the proper formulation of objectives and articulation of values; its greatest contribution lies in the systematic procedures for addressing the "softer" parts of the problem - its structure and professional value judgements. It is in this limited sense that it will be employed in the recreation planning procedure proposed in Chapter 4.

3.3.2.2 Analytic Hierarchy Process (AHP)

Thomas Saaty's AHP is a derivative of decision analysis in which he spells out in great detail how the procedure is to be implemented. It is based, he holds, on general principles of analytic thought and how the human brain processes information and undertakes complex problem-solving. The hallmark of the process is the hierarchical structure of each stage of the decision process, from goals and objectives formulation, to preference structures (what he calls setting priorities).

Hierarchies are a fundamental tool of the mind, but there are no inviolable rules for constructing them, says Saaty (1986:29). Essentially, complex systems are broken down into their constituent elements, the elements are clustered according to similar characteristics, then the clusters ordered according to level of detail. Each successive level comprises a sub-set of the previous level, just as species are grouped into genera, which cluster to form families, and so on. The characteristics of each level are subsumed or implied in the features of the previous level, but the elements within one level must be of the same order of magnitude. There are more elements in each successive level, but the number is usually between five and nine[16]. The simplest hierarchies are linear, the most complex are networks.

Hierarchies may be constructed round functional relations between constituent parts of a system, or by grouping structural properties in descending order. In decision-making, sequences of decisions can be arranged hierarchically, with the elements of each level of the hierarchy contingent upon the outcome of decisions at the preceding level (Chapman 1981). Such a structure is also called a *decision tree*, a commonly used technique in decision analysis (De Jongh 1988). In this way the alternatives and their consequences can be logically structured. This is a functional hierarchy which steers the system towards a desired goal (Saaty 1986), when the alternative solutions form the bottom level, rising through successive levels of selection criteria, to the overall goal at the top or *focus* of the hierarchy.

Such structures appear to fit my observations about the way in which planners and managers went about allocating recreation opportunities in the Weskus National Park landscape in South Africa (see Chapter 1). A hierarchically structured decision tree is thus featured in the decision-making framework proposed in Chapter 4, although the more complex and formal aspects of the AHP process, for establishing priorities and calculating utility functions, were not utilized.

3.3.2.3 Panel Evaluation Method

Stauth has proposed a multiple-component decision-making framework for evaluating resource allocation proposals. To guide the decision-making process for most proposals a general framework is proposed which is based on political rationality, with its goal of satisficing. This framework is called *integrated environmental management (IEM)*. Within IEM, however, he proposes a formal evaluation procedure for especially controversial proposals. This *panel evaluation method* aims to determine the socially optimum allocation of resources by means of a procedure which attempts to quantify intuitive judgements and values by a novel scaling technique. Features of the approach are the use of the Delphi technique for eliciting group judgements in the elaborate IEM procedure, and the establishment of three universal criteria by which the evaluation of alternative allocations is to proceed, namely, *equity, efficiency* and *sustainability*. While the establishment of these explicit criteria are an important advance in dealing with the problem of hidden values in resource allocations in general, they are too abstract to be of use in many environmental planning problems[17].

---

16 There is an interesting correlation with rating scales such as the Likert scale, about which it has been observed that people are rarely able to discriminate between more than seven points on a qualitative scale.

17 Although, interestingly, Pitt and Zube (1989:1026) observe that the concept of recreational carrying capacity implies an explicit concern for intergenerational equity, in as much as it is supposed to ensure that the future stream of benefits flowing from recreational use will not be diminished by present use.

Stauth's formal evaluation method, like expert systems and decision analysis, is also aimed at drawing out and explicitly analysing informed intuition. This is rather close to Beanland and Duinker's (1983:38) somewhat pessimistic assessment of future possibilities, that "the best we can hope for is to invoke mode 4 (Hammond's Aided Judgement) as the primary basis for decision-making.... with limited use of conventional statistical analysis, computer simulation models and a more rigorous approach to the analysis of expert opinion and judgements". While Stauth's procedure does solve some of the theoretical problems in applying judgements to resource allocation decisions, it is complex and, as he says himself, is unnecessarily complex for most uncontroversial resource allocation decisions.

3.3.3 Planning approaches

In the planning sphere Hollick (1981b:81-82) has summarized theories relating to the appropriate response to the reality of complexity, competing values and incomplete knowledge in the decision environment. These are:

1) *disjointed incrementalism*, in which the range of alternatives is limited to those which differ only marginally from one another, evaluated in terms of a few, well understood goals; many environmental problems stem from the incremental approach to decisions;
2) *routinization*, the reduction of complex problems to precise procedures which can be performed mechanically by anyone without understanding the details of the process, eg., effluent standards;
3) *sequential decision-making*, the total problem is broken up into a series of small, similar problems which can be sequentially undertaken with the use of rigid procedural rules being applied; the implicit strategy of most environmental evaluations;
4) *satisficing*, the acceptance of any solution that satisfies the objectives, though it may not necessarily be the best; this is usually the case because of poor understanding of natural systems;
5) *mixed scanning*[18], in which the most general decisions are made first, followed by increasingly detailed decisions, with cycling back to the upper hierarchy when deadlocks occur.

Perhaps most decisions involve elements of more than one or all of these procedures. They must all weigh different goods with changeable value, in a situation of incomplete information. Turner puts it succinctly: management (of natural areas) is a blend of rational analysis and the politics of the possible in which

18 Curry (1982) is dismissive of these approaches' claim to theoretical status. He points out that, rather than being theoretical contributions to the theory of decision-making, they are merely descriptions of how decisions are actually made in planning agencies.

quantitative and qualitative data vie with bureaucratic and political considerations in the formulation and implementation of public policies (Turner 1988:3).

The need to develop political legitimacy in planning procedures has led to the adoption of processes which are perceived as being deliberately political. One such approach used in the planning of wilderness recreation areas in the USA is called *transactive planning* (Ashor, McCool and Stokes 1985). It places at its center small working groups composed of affected citizens with their intimate knowledge, and planners with their models and systematic methods of data manipulation. The technocratic, rational and bureaucratic, political components of the decision-making process are, in this instance, amalgamated.

3.4 TOWARDS A RATIONAL DECISION-MAKING FRAMEWORK FOR RECREATION RESOURCE ALLOCATION

3.4.1 Summary

Rational decision-making comprises defining the objectives of the exercise (the problem to be solved); identifying feasible alternative solutions; forecasting their possible outcomes; gathering information pertinent to evaluating the outcomes of the alternatives; weighing the alternatives relative to each other, according to some criteria or decision rules which may or may not be stated; and selecting the alternative which best satisfies the objectives. The act of selection requires judgement, which is an inherently subjective process. The selection process consists of decision procedures (to guide decision-making), evaluation procedures (to inform decision procedures) and measurement procedures (to inform evaluation procedures) (Stauth 1989). Complex decisions may require a sequence of related decisions. Two further features are universal in decision problems: uncertainty about the outcomes of alternatives is common, and the possible consequences are not all equally valued, that is, decision-makers have preferences, they have a value system that underlies their decisions.

Problems encountered in decision-making are largely related to the uncertainties associated with predicting outcomes, the subjective nature of judgement, and the ways in which values and preferences affect even so-called objective data collection and judgement. Without understanding the values behind a decision the rationality of decisions cannot be discerned. Rationality is generically defined as being a process of *logical* reasoning that is consistent with the values underlying it, whatever they might be, so that different forms of rationality are possible. However, underwriting this definition, at least in the Western scientific tradition, is a perception of reality shared independently by many observers , and a rejection of information acquired by subjective revelation (Caldwell 1987). With respect to environmental decision-making, therefore, science has always played a prominent part, and rational analysis - systematic, comprehensive and explicit - used to strengthen decision procedures. Nevertheless, according to Simon (1988), the common conception of rationality as behaviour which is not preposterous and foolish, but is sensible and intelligent, is sufficient to explain most decision-making behaviour.

While scientific research is especially important in information acquisition for environmental decision-making, it has been found that scientific data play a small role in most decisions. This is because environmental decision-making invariably involves multiple objectives and the weighing of often conflicting sets of values. This requires not only the prediction of environmental impact magnitude, but also impact significance, the latter implying subjective valuations. Apparently sophisticated numerical techniques may disguise the subjectivity and biases of planning and management models. The objectivity of science itself can be challenged, and scientific procedures can be shown to comprise a series of decisions which are subject to many of the same biases and uncertainties as the more generalized decision procedures.

Decision theorists are concerned with quantifying uncertainties as probabilities, and formalising preference functions, so that the rationality of decisions can be improved. But there are various problems associated with numbers as measures of value, especially subjective, qualitative value. Many approaches have been developed to deal with these problems, amongst which decision analysis, the Analytic Hierarchy Process, expert systems, rules of combination, and Stauth's panel evaluation method have been briefly discussed. Amongst this plethora of possibilities, one can perhaps take courage from Nash, Pearce and Stanley (1975). In reviewing project evaluation techniques, they found no single, logically unique way of conducting evaluations. They suggested that analysts can do anything in an evaluation provided that their judgements are made explicit[19]. What is more they contend that individual choices are a perfectly proper basis for social choice decisions.

Of course, decision-making does not occur in a vacuum. The technocratic, rational component of environmental decision-making is embedded in social perceptions of and political, bureaucratic procedures in society (Turner 1988). The general failure to make subjective considerations - be they hidden values or uncertainties due to incomplete knowledge - explicit in planning and evaluation procedures, has tended to put environmental managers under pressure to explain the basis of and criteria for their land planning decisions: land managers are being called to account for their decisions and management practices. In developed countries at least, public involvement in policy making has become routine (Caldwell 1987). In this situation *informed* judgement and intuition are presently the most cost effective guides available for the planning and management of natural landscapes, provided that their

19 **Rogers and Steinitz (1967) made an almost identical remark with respect to planning approaches.**

assumptions and values are made explicit. As regards RCC, the lack of awareness amongst users of the different factors involved in RCC assessments, and their frequent obliviousness to the significance of environmental change, mean that managers/planners must be prepared to explain the rationale for their plans and actions to the public (Pitt and Zube 1989). Furthermore, the costs of expensive, time-consuming experimental research appear to outweigh the benefits of answers which are likely to be only refinements of informed judgement[20].

In the original approach to determining recreation carrying capacity (RCC) it was assumed that scientific investigation and analysis of use-environment interactions would yield equations with a numeric solution. But the complexity of use-environment interactions defied such solutions, and the recognition of the importance of user *perceptions* in defining RCC led to a reformulation of the concept. Also, with growing populations of outdoor leisure seekers, this approach did not appear to offer any solution to the necessity to provide for ever increasing demand on an effectively finite resource base. The consequent emphasis on the formulation of objectives, setting standards to define *acceptable* change in the resource base, and monitoring to test the efficacy of those measures, put the determination of RCC firmly in the decision-making framework camp.

Recall that in Chapter 1, the undertaking was made to seek an approach to RCC determination which would be ecologically rigorous, socially meaningful and comprehensive. In Chapter 2, it was concluded that this would require the establishment of clear objectives for the definition and maintenance of acceptable levels of environmental impact (due to recreation), and the creation of a range of recreation opportunities to satisfy social needs. The nub of the decision problem in recreation resource allocation is to achieve a compromise between potentially conflicting objectives, between managers concerned with conserving an unimpaired natural environment and recreationists seeking satisfying outdoor experiences.

In the light of the problems explored in this chapter, these objectives can best be satisfied by putting in place a procedure to guide the planning process which

> rather than simply attempt to introduce more objective, verifiable data into the assessment, or further refine data collection techniques, emphasis should be placed on improving the subjective assessment process itself by adopting a procedure which is designed to ensure that the analysis is comprehensive, explicit and systematic (Stauth 1983).

The dissertation is placed firmly in the prescriptive school of decision analysis, in that it seeks a practical solution to a real problem, in which cognitive and operational constraints play a prominent part. The nature of the recreation resource

20 Of course, this is not to deny the need in the longterm for good, fundamental research on use-environment interactions. It is merely a pragmatic statement, that the manager/planner who needs an answer or plan in the reasonably near future, cannot afford to wait long or does not have the money to spend.

allocation problem under investigation is not, however, likely to be particularly controversial, and the outcome of the decision-making process does not have to be extremely precise. The direct interest of the public in the outcome of the process favours a simple, explicit procedure which can be readily comprehended by lay people. An informal evaluation procedure, as opposed to a fully quantitative, elaborately formal procedure (as in Stauth's panel evaluation method), is therefore deemed appropriate to planning the recreational uses of a national park in such a way as to establish objectives for managing the impacts of use within acceptable limits. The general principles of decision-making will be employed to guide conceptualisation of the decision-making framework for recreation planning, and some specific techniques of decision analysis, such as decision trees, will be employed in conducting the procedure. Beyond this, decision-making procedures developed specifically in the field of recreation resource planning must be further explored to examine their possible contribution to the task set here.

3.4.2 General attributes of an appropriate decision-making framework

McCool *et al* (1988:3) give one of the most comprehensive descriptions of an acceptable decision-making framework for wildland planning and management. Such a framework is to have the following attributes (I have changed their order):

> 1. *Rational and systematic*: Its logic must be discernible to managers and the affected public alike. The planning process must have legitimacy and the flow of activity from one step to another must be clearly apparent.
>
> 2. *Goals and objectives important:* The process must be problem-driven rather than information-driven (Turner 1988). The specification of the problem, or what the specific objectives of the exercise are, determine data collection and the details of planning activities. This means that goals and objectives must be useful, that is, specific, output oriented, quantifiable if possible, time bounded and attainable (Schomaker 1984, cited by McCool *et al* 1988).
>
> 3. *Based on substantive knowledge:* Despite the acknowledgement that much of the information input into resource allocation procedures is not truly quantitative or cannot be quantified, this does not mean that relevant quantitative data should not be used, since the uncertainties accompanying these complex decisions can be reduced by consideration of the appropriate data. (The authors note that a considerable knowledge base for wilderness and backcountry situations exists, and this should be incorporated where appropriate.)
>
> 4. *Process rather than output oriented:* The emphasis is on the process of decision-making, rather than on its outcomes. Outcomes

can be changed so long as the process by which they were reached can be systematically followed.

5. *Explicit and defensible:* In the modern context of public accountability, this is, to my mind, the crux of the matter. So long as imperfections in knowledge and methods for incorporating values, exist, the criteria underlying decisions undertaken in the course of planning activities must be made explicit. They should also be quantified where possible. This should minimize implicit and internal decision-making (McCool *et al* 1988). The framework then becomes defensible, because it is open to scrutiny and criticism.

6. *Adaptable:* A frequently mentioned problem in environmental planning is the high degree of natural and social (in terms of values) variability, and the site specificity of ecological interactions. The process must thus be broad and flexible enough to handle a wide variety of environments and situations; it must not be rigidly tied to the specific resource and management conditions operative in a particular area. In other words, it should be applicable in a range of environments subject to a number of administrative arrangements.

7. *Political viability:* Resource allocations being political procedures, affected parties must be incorporated into planning activities. The process and its output must be available for public input and review.

This set of principles is adopted in its entirety to guide the decision-making framework proposed in this dissertation. In exploring the RCC literature, the most fruitful line of research which takes an explicitly decision-making approach to the problem, was found to be the Limits of Acceptable Change (LAC) planning system, and its parent, the Recreation Opportunity Spectrum (ROS). The discussion now turns to examine these concepts. The intention is to explore whether the LAC process can satisfy both the specific demands of planning recreation in natural environments in such a way as not to impair the quaiity of the resource base, and the general requirements for a rational decision-making framework..

3.4.3 The recreation opportunity spectrum and limits of acceptable change system

The fundamental propositions of RCC, the problems in its determination, and reformulated approaches to the concept, were recognized relatively early in RCC research (Stankey and McCool 1984). But it is only within the past decade that these reformulated ideas have been systematically and coherently articulated by those early pioneers of RCC research, George Stankey, Robert Lucas and others, as the Limits of Acceptable Change System (McCool, Cole, Lucas and Stankey 1988; McCool 1986; Prosser 1986; Stankey *et al* 1985; Stankey and McCool 1984).

The LAC system is merely a practical approach, amounting to a methodology, for establishing carrying capacity guidelines, what I have labelled *environmental quality standards*, in natural landscapes.

The LAC approach derives from an earlier concept articulated by Clark and Stankey in 1979: the Recreation Opportunity Spectrum (ROS) approach. As Clark and Stankey themselves acknowledge, there is no deep theoretical meaning to this essentially commonsense approach. Having observed, with others (Wagar 1974; Pfister and Frenkel 1975; Lime and Stankey 1979; Yapp and Barrow 1979), the futility of seeking the elusive numerical limit to use, and recognizing the role of management objectives and user preferences in defining acceptable limits to environmental degradation, they suggested that the role of resource planners and managers should be to ensure that a range (a spectrum) of recreation **opportunities** would be provided. This spectrum would be capable of satisfying the full range of public preferences for recreation, by defining and developing a series of Recreation Opportunity Settings.

One of the Recreation Opportunity Spectrum's primary purposes was to arrest the pattern of succession-and-displacement in recreational facilities which had been identified as a problem in recreation area management (Prosser 1986; Dustin and McAvoy 1982; Clark and Stankey 1979; Clark, Hendee and Campbell 1971). This phenomenon concerns the one-directional gradual change, in response to increasing demand, of many recreational areas from less to highly developed or more crowded, as has been commented upon with respect to national park landscapes (Machlis and Tichnell 1985; Fitzsimmons 1979).

The interesting aspect of this phenomenon, report Dustin and McAvoy (1982), is that despite increased levels of crowding, little or no reduction in the satisfaction of participants has been observed. The explanations given are that dissatisfied participants move to other areas which are less crowded, or that people adapt their attitudes to the changed circumstances. The result of this adaptability is that people become less sensitive to crowding and to the environmental deterioration that accompanies increased use. The overall consequence is the acceptance of generally lower quality recreational opportunities. Furthermore, because there is not an unlimited supply of land set aside for recreational use, the less developed - simple, rustic, or wilderness - recreation options are in increasingly short supply.

Dustin and McAvoy's analysis of the phenomenon suggests that it is the widely accepted planning and management goal of providing satisfying experiences for users which is the problem. While management is guided by surveys of what has satisfied past or current participants, they will continue to be plagued by the problem of supplying high quality recreational opportunities in the wake of seemingly endless demand on a limited resource base.

Their answer, and the Recreation Opportunity Spectrum's answer, is to make **diversity** of recreational opportunities an equal partner of satisfaction in planning and management goals. I do not believe that there is, ultimately, an answer to the problem, but that strategies such as the ROS may at least delay and slow the deterioration of quality opportunities at the undeveloped end of the spectrum.

The importance of the ROS is that it was the first overt attempt at creating a *hierarchy* of recreation decision-making tools. It moves the focus from a single site capability approach to a comprehensive demand-supply approach (Glavovic 1988), a conceptual shift which could only improve the sophistication of possible solutions. The ROS describes a broad spatial context within which individual (local) recreation areas interact and can be located.

Clark and Stankey defined a *recreation opportunity setting* as

> the combination of physical, biological, social and managerial conditions which give value to a place (Clark and Stankey 1979:1).

The concept is shown graphically in Figure 3.2 overleaf. Clark and Stankey identified six factors which defined the opportunity setting classes. These factors were derived from existing perceptions of the ROS, from research on recreationists' preferences, management experience and state-of-the-art judgement.

The factors were **access, non-recreational resource use, on-site management, social interaction, acceptability of visitor impacts and acceptable regimentation (use restrictions).** Figure 3.2 demonstrates how shifts in factor values will affect the opportunity setting in terms of the anticipated recreational experience and degree of associated environmental change or impact. The chart displays a range of values on a scale from Modern, through Semi-modern and Semi-primitive to Primitive. It simply makes good sense.

The ROS was originally developed for regional planning purposes, but has been applied in more limited spatial dimensions to produce local opportunity spectrums (Stankey and McCool 1984; Tobin 1983; Buist and Hoots 1982; Brown, Driver and McConnell 1978). At a local scale it has been elaborated as the LAC planning system. Application of the ROS requires the combination of an inventory of recreation resources (supply) with studies of demand factors to produce, for any one area, an appropriate balance of opportunities. With such an inventory in place, the ROS provides an almost physical decision-making framework, into which data for a particular area can be "plugged", and the area's position in the spectrum generated. The product then has several possible uses. The concept has been adopted by the US Forestry Service and, in Australia, by the New South Wales National Park and Wildlife Service, for co-ordinated planning, and as a tool for park zoning and management (Stankey and McCool 1984; Van Oosterzee 1984). It has been proposed as a framework for national recreation planning in South Africa (Glavovic 1988).

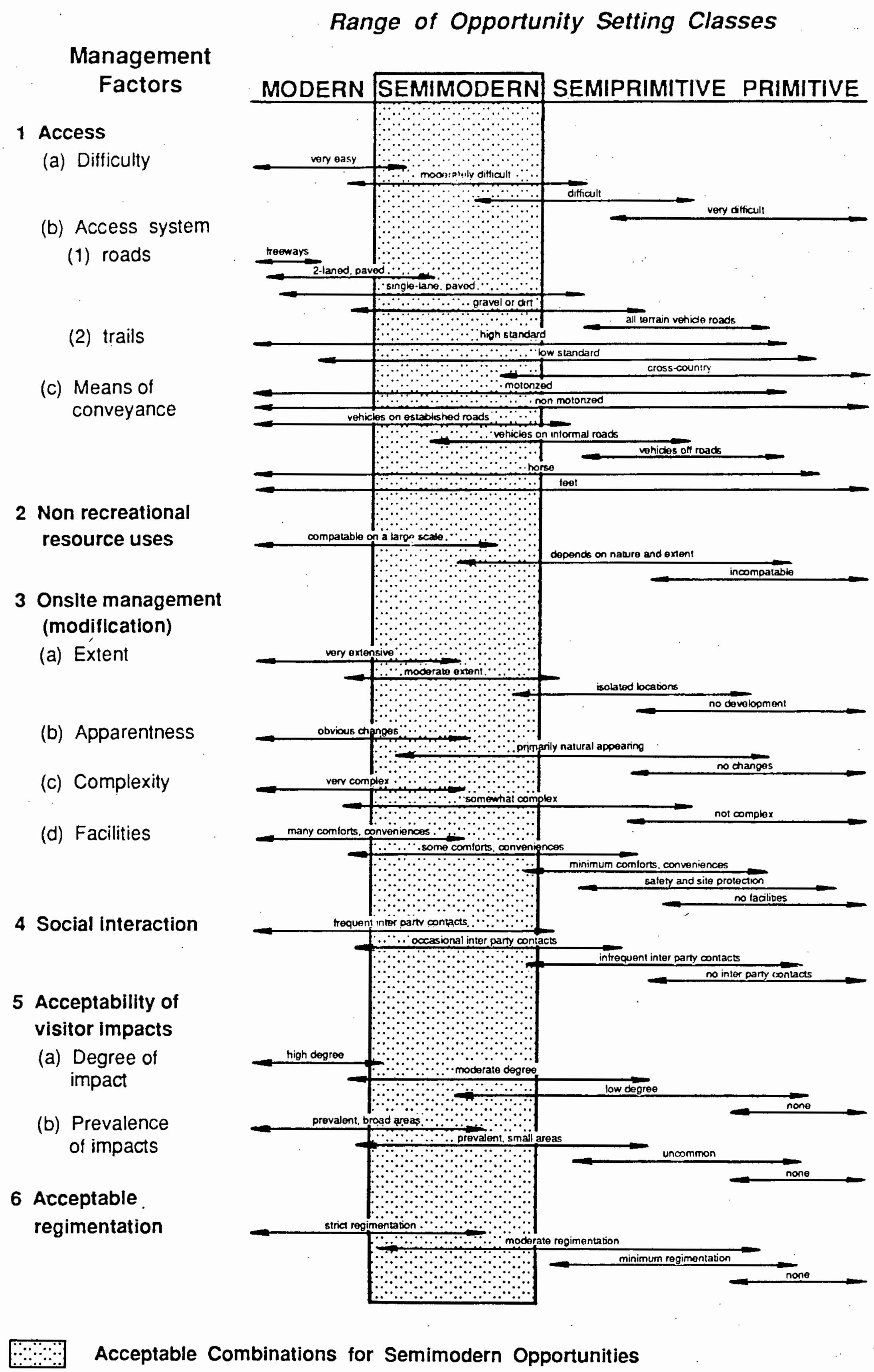


Figure 3.2: The Recreation Opportunity Spectrum (Clark and Stankey 1979)

The value of this framework is that the ROS assumes that by providing people with, and making them aware of, the range of possible settings, they will be able to choose the experiences they desire (Van Oosterzee 1984:97). The effect should be to prevent misuse of existing opportunities, as well as providing quality recreation opportunities. Van Oosterzee further points out that the ROS provides people with information on what a place is like, not about the actual experiences they will derive. This means that applying the ROS is not dependent on understanding the link between opportunity settings and experiences (Clark and Stankey 1979:7), so that researchers are spared the complexities of deep psychology.

Van Oosterzee is wary of the indiscriminate application of the ROS in relatively small areas, chiefly national parks. This is because she sees ROS as a utilitarian concept devoted to maximizing human satisfaction. This can only be done, according to the ROS, by providing the full range of opportunity settings. She fears that in this context National Parks become mere vehicles for the satisfaction of human wants and the potential for a concomitant loss of conservation values is very large. However, it has been pointed out that management does not need to provide all possible recreational opportunities in all possible locations for the maximum number of visitors (McCool 1986:1, citing Schreyer 1976). The opportunities provided in parks are in any case limited by statutory directives to provide only certain types of recreational opportunities, opportunities which emphasize unmodified environments and which will not impair natural processes (McCool 1986).

Glavovic (1988) also observed that, contrary to the architects' claims, straight application of the ROS would probably lead to a loss of opportunities at the undeveloped (wilderness) end of the scale, because of its demand-led nature (far more people appear to prefer options at the highly developed end of the scale and wilderness is necessarily space consuming). His solution was to give precedence to the maintenance of diversity of opportunities over visitor satisfaction where the consequences of decisions affecting the supply of opportunities were irreversible.

Glavovic's reservations would appear to be well founded. Stankey, Brown and Clark (1983:227) - two of them being the architects of the original concept - cautioned against subtle shifts in recreation settings which could go undetected. These might be caused by management actions, or lack of them, change in users or, especially, in adjacent land uses. Their proposed remedy for such insidious shifts was continuous monitoring and evaluation of an opportunity setting, in order to determine whether management objectives were being met. It is impossible to predict every consequence of an action or plan, or all the effects of adjacent actions. In addition, integrated planning is an extremely complex procedure. It is therefore, I submit, unrealistic to expect any particular framework to meet all the goals set for it at all times. Nevertheless, the importance of clear formulation of objectives is reiterated: is it to be maximizing satisfaction or maintaining diversity of opportunity?

The primary yardstick against which decisions which might result in a shift in the local opportunity spectrum, must be measured, is management objectives. If these are specified in detail, there is no reason why the range of settings should not be manipulated for such limited applications. Management objectives might require, for instance, use of only a part of the spectrum to define appropriate opportunities in a national park, provided the park is put in its regional context. This is indeed what Stankey *et al* (1985) have done in a worked example of their Limits of Acceptable Change (LAC) system.

In developing the LAC system (or approach), what Stankey and co-workers have done is lay out a step-by-step procedure for establishing carrying capacity guidelines, expressed as standards for the limits of acceptable change in specified environmental indicators. The result is a zoning scheme which defines the appropriate range of opportunity settings and which, most importantly, explicitly defines environmental, social (experiential) and managerial standards for each opportunity class. Monitoring must then ensure that these standards are maintained.

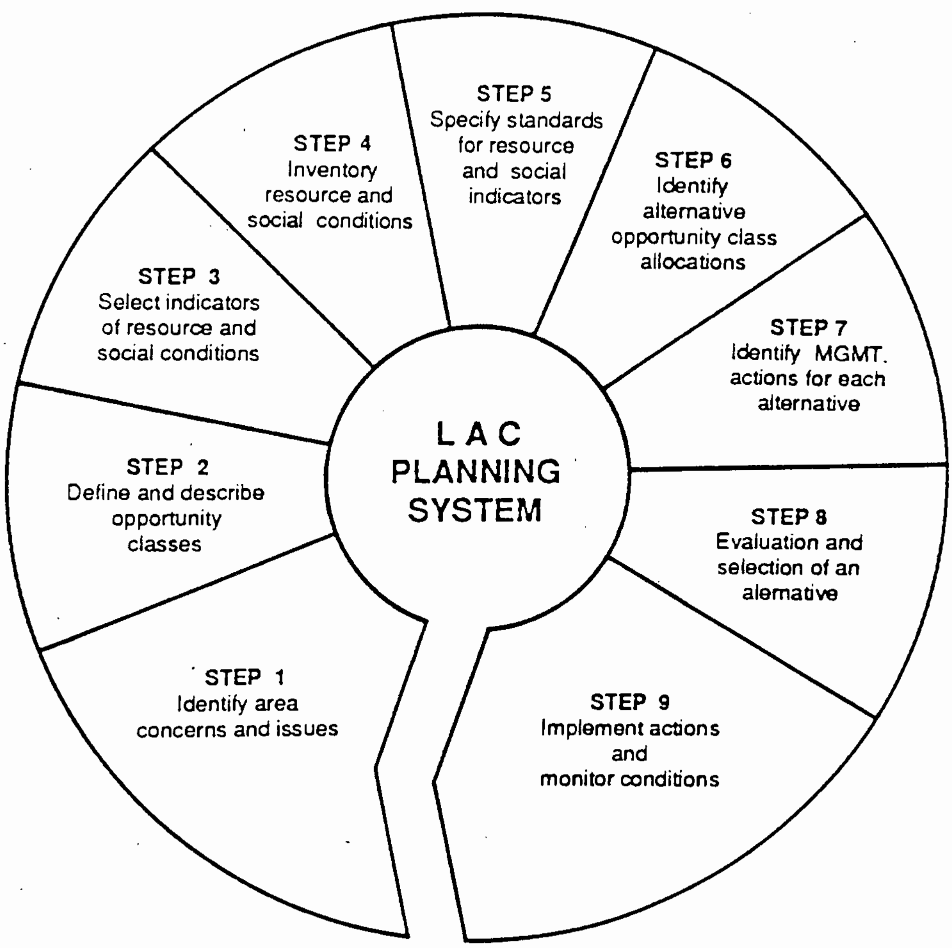


Figure 3.3: The Limits of Acceptable Change process for recreation planning (Stankey et al 1985)

When they are exceeded, the signal is given that the carrying capacity of the area has been exceeded and management action to rectify matters is necessary. This enables planners to circumvent the problems of setting numerical use limits: instead of attempting to predict how much use is too much, planners and managers are deciding how much use is acceptable and appropriate (Stankey *et al* 1985). The focus is now on limiting impacts to what is acceptable and appropriate for a given recreational opportunity and a given area of land, by considering the area's resource values, recreation potential and other management issues (Prosser 1986). Turner (1988) calls this impact management, because the major object of attention is the damage which might result from activities, rather than the activities themselves.

The method consists of a nine-step process shown in Figure 3.3 and summarized in Appendix B2. It is intended, according to Stankey *et al* (1985:3), as a dynamic, continuing process in which recreational capacity is **designed** within a framework set by management objectives. These in turn are determined by regional considerations, user opinions, existing patterns of use, resource conditions and conservation imperatives.

Step 1, which concerns the identification of area issues and concerns, invites a succinct overview of all the different factors and special values which may affect resource management decisions in the study area. This step ensures the relevance of the data presented, allowing the researcher to circumvent the presentation of a large, unwieldy data set. It is thus the specification of the problem which drives the planning process, thereby focusing the analysis (Turner 1988).

These issues and concerns should provide the background for establishing management objectives for the area, thus laying the groundwork for the succeeding analysis. It is worth noting that, as presented in Figure 3.3, the procedure appears to proceed linearly. In fact, there are feedback loops at every stage with, for instance, Step 4 (the inventory stage) probably providing material for Step 1.

Steps 3 and 5, which identify indicators of resource and social conditions to distinguish opportunity classes and define standards for these indicators, respectively, go some way to resolving the problems of quantifying recreation impacts. They accomplish this by proposing simple measures of key variables, physical and social, which are to serve as indicators of desired conditions in each opportunity class, for instance, in a campground, the area of devegetated ground around each site; trail width; number of parties encountered daily. Planners are then spared the necessity of having to measure an apparently endless number of contributing variables in the inventory stage, as well as ensuring that the data collected will reflect the relevant issues (Step 1) and will be related to opportunity class definitions (Step 2). Such measures also provide the framework for future monitoring programs. However, Stankey *et al* (1985) are under no illusions as to the objectivity and quantitative base of these measures: in their commonsense approach to choosing and establishing these standards, they acknowledge Clark's (1982) remarks that the process is judgmental and state-of-the-art.

Nevertheless, Step 5, in which standards for each indicator, based on information gathered in Step 4, are defined, is a potentially viable attempt to improve the objective inputs to the process. Here explicit, specified, c standards are set: these become *the limits of acceptable change*. Theoretically this exercise is relatively simple, but again lack of predictive understanding of environmental and social responses to recreational impacts limits the validity of these standards, assuming they can be quantified at all. Stankey *et al* (1985) use existing conditions, campground condition for instance, as a guide in setting these standards. The real problems arise in attempting to establish standards in areas which have not been subjected to recreational pressure: existing conditions are no help here. Then the only guideline is experience elsewhere in similar environments and extrapolation to the study area. However, as Sowman (1987) has pointed out, it would be a rare occasion indeed to find two sets of conditions similar enough to allow for such extrapolation.

In their worked example of the LAC process Stankey *et al* (1985) describe in considerable detail the techniques used to derive these standards, such as determining site spacing standards for wilderness campgrounds. However, when it comes to the allocation of opportunity classes in the landscape (Step 6), the delineation of zone boundaries is not fully explained. All they have to say on this subject is that existing management areas were kept, defined mainly by topographic features and use patterns (Stankey et al 1985:30). This falls far short of the detailed land evaluation procedures which precede most natural resource planning applications. This is regarded as a shortcoming in this method where conservation areas are concerned: where nature conservation is paramount a sound ecological basis for zoning land uses is imperative. Stankey, in a personal communication, pointed out that the LAC process was not designed to solve all the problems in recreation planning. Nevertheless, a major aspect of this study has been to establish a thorough ecological basis for the allocation of recreation opportunities which could serve as a model for all applications of the LAC process.

The final steps of the LAC process, namely the allocation of alternative opportunity classes (Step 6), the identification of management actions for each alternative (Step 7) and the evaluation and selection of a preferred alternative (Step 9) are further useful refinements in the determination of RCC, for they introduce flexibility into the procedure and require systematic consideration of the costs and benefits of applying alternative management options. While this should contribute to identifying the **optimal** option, in practice cost-benefit analyses are complex and problematic and may be beyond the capabilities of many conservation agencies. In addition, if management objectives and the criteria for zone allocation are carefully specified, there can be little room for the designation of alternative allocations.

3.5 CONCLUSIONS

How to improve environmental decision-making, given the complexities of environmental interactions, competing objectives, the uncertainties of prediction, the biases of analysts/ decision-makers, measurement difficulties and the inherent subjectivity of judgmental processes, is a complex subject. There is consequently an enormous range of approaches available to the analyst interested in reducing these difficulties. The range goes from very formal procedures and techniques for the quantification of all values, through a continuum of increasingly informal, qualitative approaches. Considering the widespread evidence of bias on the part of even the most apparently objective scientific analysts, the conclusion is easily reached that the choice of a decision-making approach is also likely to be influenced by preferences and prejudices. In addition, numerous constraints caused by factors external to the decision problem, may further affect the choice of approach.

The only counter to this pervasive bias is to open the decision-making process to scrutiny by making it systematic, comprehensive and explicit. By clearly structuring the problem, specifying objectives, formulating decision rules and describing the sequence of decisions taken to reach a conclusion, interested parties can explore and question the logic of the process. The techniques or methods used to solve particular information gathering or analysis problems within the overall process need not be prescribed, provided that they are made explicit.

A decision-making framework appropriate to outdoor recreation planning, with the objective of maintaining environmental quality, has therefore been selected which attempts to do precisely that. The re-formulation of the carrying capacity concept as the Limits of Acceptable Change planning system places the definition of objectives, the specification of standards for their attainment, the evaluation of alternatives and the structuring of data acquisition, at the core of the decision-making process.

It is clear that the hierarchical framework established by the Recreation Opportunity Spectrum and Limits of Acceptable Change planning system in combination, provide a powerful decision-making tool for planning recreation and maintaining environmental quality. Since the emphasis in this dissertation is on how to accommodate both recreation and conservation in protected natural landscapes, the focus here is on the LAC as an approach to local area planning and management. The LAC was designed as a decision-making framework for local area planning and management: it guides the formulation of objectives, generates alternative recreation opportunities, defines attributes by which to measure environmental quality objectives for those alternatives, focuses data gathering and evaluates alternative allocations.

However, it still fails to make explicit a sufficiently rigorous ecological analysis for the planning of protected landscapes. More importantly, it does **not** lay bare the values and preferences for, and criteria by which, planners and managers allocate recreation opportunity classes in the landscape. The development of the LAC concept is therefore taken further in Chapter 4 with my proposals for a decision-making framework for recreation resource allocation.

PART 2

CHAPTER FOUR

A PROPOSED PROCEDURE FOR RECREATION PLANNING IN CONSERVED NATURAL ENVIRONMENTS

4.1 INTRODUCTION

4.1.1 Development of the methodology

In the early phases of attempting to assess the recreational carrying capacity (RCC) of the Weskus National Park, Cape, South Africa, many problems were encountered in taking an "old" approach to the task, following Sowman's (1987, 1984) procedure. Despite the existence of extensive data on the ecology of the lagoon and its surroundings, these were only of general use in formulating solutions to the carrying capacity problem. The data were inadequate for **calculating** the ecological carrying capacity of different biotic communities in the landscape, because, with the exception of some marine organisms in the lagoon, the effects of disturbance on these communities had not been the subject of scientific investigations[1]. And the methods used by scientists asked to make such assessments subjectively, could at best be labelled as Hammond's Mode 5, "Intuitive judgement (data known)" (Beanlands and Duinker 1983) (Figure 3.1).

Besides, as discussed in Chapter 2, such is the nature of the problem that detailed information on environment-use interactions (impacts) is unlikely to provide the requisite solutions, though such information might improve the foundation of decisions. Recall that recreational carrying capacity comprises both ecological and social components. Social values require a different set of criteria for evaluating the suitability of the landscape for recreation. Hence information on ecological responses to recreational use is only one element in the information base necessary for recreation resource allocation decisions. In addition, it is necessary to identify and allocate appropriate recreational *settings*, or *opportunities*, in the landscape rather than individual activities.

The framework for recreation resource allocation developed in response to these difficulties, is the product of four factors:

> (1) theoretical problems related to recreational carrying capacity and its determination, identified in the literature and in an actual attempt to determine the RCC of a national park on the Cape West coast;
>
> (2) discovery of papers on the Limits of Acceptable Change (LAC) planning system;
>
> (3) deficiencies identified in the LAC system in the course of attempting to implement it, namely,
>
> **i.** a failure to distinguish between broad scale and detailed environmental indicators/standards, that is, between indicators

---

1 **In addition, in the terrestrial landscape, each vegetation association or different land type would have to be tested**

appropriate to recreation **opportunity** settings and those tailored to (single) recreation **activity** planning.

ii. the absence of a rigorous ecological classification of the landscape as a basis for recreation opportunity allocation, and

iii. the failure of procedures within the LAC process to ensure the exposure of the subjective criteria by which recreation opportunity classes/settings are allocated in the landscape, hence compromising the public accountability of the procedure;

(4) direct observations on how planning, both by public agencies and by professional planners, is actually undertaken within the constraints generally experienced. This resulted in a set of working assumptions which underlie the proposed procedure:

i. The approach must be readily usable by managers, it must be straightforward and readily comprehensible by those who have to implement it.

ii. The approach must be credible but readily understandable to the public; it must be capable of responding to their comments.

iii. Reliance is placed on the use of existing data, because of the restricted temporal and financial frame within which public conservation agencies usually operate (although where conditions are different, there is no reason why a program of field data collection should not be utilized).

iv. The approach must be flexible enough to respond to the results of monitoring programs.

Furthermore, pioneering work by Clark, Stankey and others on the Recreation Opportunity Spectrum (ROS) showed the applicability of a hierarchical structure to recreation planning. They have demonstrated the need to start with a *broad scale, regional* perspective to set the general parameters for small area planning (Glavovic 1988) has called for the use of the ROS for regional recreation planning in South Africa). The next step in the hierarchy is to allocate the appropriate range of recreation opportunities in the area landscape: this is what I shall call *area level* planning, and is best represented by the Limits of Acceptable Change planning process. The LAC has, I contend, failed to distinguish the necessity for one further level of planning, namely the *single activity/site* level of planning. This is detailed planning in which the distribution of individual activities or small clusters of activities are organized and distributed in the recreation opportunity zones identified at area level planning. This is because, in areas not previously used for recreation, locations for specific facilities and the routing of linking structures, such as roads and hiking trails, must be selected, and the facilities/structures designed. Since the resource requirements for each activity or type of facility are so different, since they vary from site to site, and since they are different from the general requirements for opportunity classes, these two types of planning - opportunity class and activity -

should be undertaken separately. In addition, if we are to follow through with the idea of setting environmental quality standards as carrying capacity guidelines, then the standard *indicators* (see Chapter 3 discussion of Limits of Acceptable Change planning system) for opportunities and individual activities might be different.

Recreation planning can thus be seen as a tiered hierarchy of plans, with each level dependent on the previous one for its framework. It conforms to the hierarchical nature of many decision processes.

Because in national parks the preservation of ecological communities and the unimpaired maintenance of ecological processes are the most important objective of management, area level planning is a crucial step. At this stage packages of activities, the recreation *opportunities*, are assigned to and distributed in the park landscape. Since these opportunity classes determine what types and intensities of overall use will be allowed in each class, they are critical to how unimpaired the natural communities associated with them will remain. Resort development results in the physical removal of vegetation, and the activities associated with it are likely to cause great disturbance to fauna, but wilderness is designed to cause minimal surface damage, and so on. The procedures by which opportunity classes are identified and allocated in the landscape are therefore the crux of park planning. Mistakes made here will be amplified at detailed level planning. It is therefore the allocation of recreation *opportunities* in national park - or other conserved area - landscapes that the procedure proposed below, addresses. Regional factors are brought into the analysis where possible, but they are not the subject of a separate analytical procedure in this dissertation. Because of the costs of detailed level planning it could not be undertaken here, but an example for a particular site in the national park case study is given as Appendix D. This example demonstrates too that indicators of carrying capacity/environmental quality for specific activities may emphasize different aspects of the recreation carrying capacity concept, that is, ecological, physical and social.

The sequence of steps comprising the procedure described below is derived from the Limits of Acceptable Change planning system (McCool *et al* 1988; Stankey *et al* 1985; Stankey McCool and Stokes, undated; Stankey and McCool 1984;). The LAC system provides a viable philosophical framework for and the skeleton of a practical approach to establishing carrying capacity **guidelines**. The LAC system is an ambitious one and on closer inspection is still subject to the problem of hidden values and vague criteria as far as the allocation of recreation opportunities are concerned. The major thrust of this research has therefore been directed to:

1 developing a practical procedure to ensure the systematic and explicit treatment of the subjective decision processes which characterize recreation opportunity allocation decisions;

2 elaborating the definition of objectives necessary to guide the planning process, especially in the case of areas set aside for conservation;

3 improving the information content of the decision process by including a rigorous ecological classification of the landscape as a basis for recreation opportunity allocation;

4 developing an explicit set of criteria or decision rules for recreation opportunity allocation decisions, so that the decision process is wholly open to scrutiny by interested members of the public or otherwise, and thereby satisfying the need for accountability which characterizes modern planning approaches.

The procedure is also tailored to fit the constraints under which many conservation agencies operate. It provides a potentially rapid, relatively inexpensive means of planning recreational use which is nonetheless explicit and open to scrutiny by interested parties. The decision-making procedure shares features with mixed scanning and transactive planning in the wide range of inputs it seeks.

4.1.2 Synopsis of the proposed procedure

A flow diagram of the procedure followed for zoning the recreational use of a conserved natural landscape is presented in Figure 4.1. While a flow diagram suggests a linear sequence of planning activities, it should be noted that several steps might be underway simultaneously, with the tasks interacting to refine the analysis as it proceeds. (*Steps* referred to in parentheses in the discussion below are the "Steps" shown in the diagram.) The following description presents the steps and features of the decision-making framework in summary only. It will be followed by a detailed discussion of the rationale for and methodology of each step.

In Chapter Three the conclusion was drawn that the first step in recreation planning must be the spatial zoning of recreational land uses, to establish a spectrum or series of recreational opportunities. Such a spectrum of opportunity settings is then capable of satisfying a diversity of recreation needs. Each opportunity setting or class is defined in terms of a set of standards which determine the degree of environmental impact (both biophysical and social) and management activity or intervention appropriate and acceptable to that class. These standards define the "carrying capacity" of the area.

Phrased in this way, planning a reserve area, be it National Park or wilderness, becomes an exercise in setting the limits of acceptable change or establishing environmental quality standards to be maintained in each zone. The final product of this exercise, a *recreation zoning scheme*, defines what is being conserved, what range of recreational opportunities will be provided in what type of environment (biophysical and social) and therefore what standards of environmental quality will distinguish each designated area.

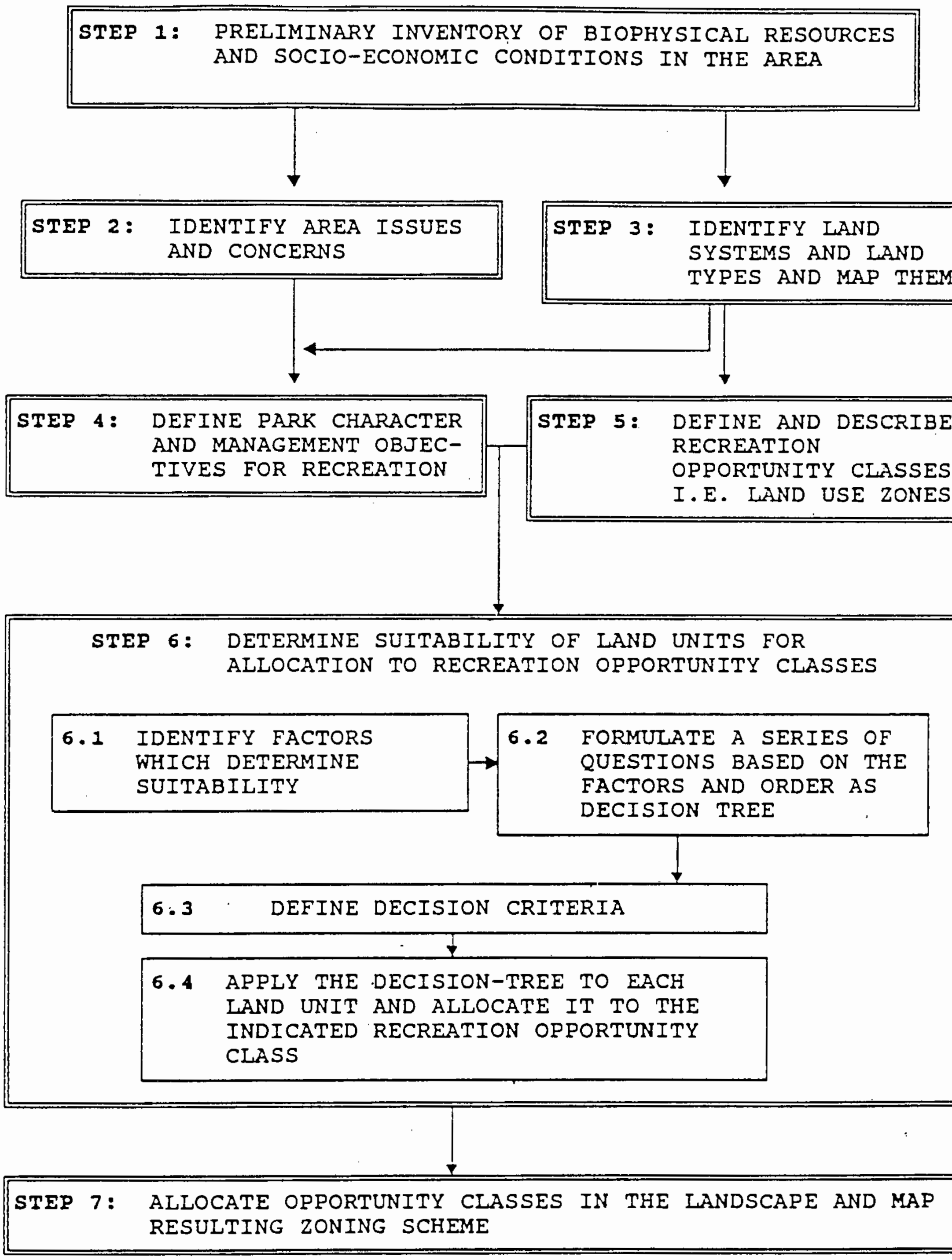


Figure 4.1: A decision-making framework for Recreation Opportunity Allocation in conserved natural landscapes.

In accordance with the concept of non-degradation, the environmental quality standards (EQS) define the baseline below which conditions should not be allowed to deteriorate (Stankey *et al* 1985). Within each zone, however, more detailed investigations would have to be undertaken to quantify environmental quality standards for particular activities, especially where recreation has not been part of the history of that landscape. In developing these standards for different areas, emphasis may have to be placed on different aspects of recreational carrying capacity, i.e., physical, ecological or social carrying capacity. This would be an additional planning phase not discussed in this dissertation, except for the example given in Appendix D.

The choice of the range of opportunity classes (Step 5) deemed appropriate to a particular locality is a planning decision which can never be wholly objective, but which can be improved by undertaking a hierarchical planning process, whereby regional issues are considered as the first "sieve" in deciding what opportunities should be provided at a particular locale. This broad perspective meshes in with the next, most important "sieve", which is a thorough consideration of all local issues and concerns (Step 2), the nature of the resource base (Steps 1 and 3), its conservation value (Step 2) its likely sensitivity to impacts (Step 6), and traditional patterns of use (Steps 1 and 2). This gives rise to an explicit statement of what is being conserved and what type of park environment is to be created (Step 4), in order to provide a yardstick against which management objectives and actions can be evaluated for their efficacy in protecting park values. For applications in conservation areas, an integral part of the proposed procedure is, therefore, a Definition of Park Character.

Having once defined the ideal zone characteristics, these must then be fitted into the landscape in question. Where the conservation of ecological communities is a primary objective of management, a sound basis for the identification of ecological units, which are to serve as the basis for management and the allocation of opportunity classes, is necessary. This requirement is addressed here by the application of land classification techniques to the relevant biophysical environment (Step 3). Land classification divides the landscape into a number of units which are internally homogeneous with respect to their biophysical attributes. The land systems approach (Christian and Stewart 1968; Mabbutt 1968; Brink and Partridge 1967; Christian 1958) has been applied here.

The evaluation of the suitability of the land units for inclusion in a particular recreation opportunity class (Step 6) is the crux of the procedure. This step is accomplished by identifying the most important criteria for allocation decisions, defining these criteria in the form of questions-and-answers which function as a sequence of decision rules. The decision rules are ordered as a decision-tree to guide the evaluation process. Classification to ROC's is performed by answering the series of questions about each land unit, the outcome or this process determining its assignment to a particular ROC. These criteria reflect the base conditions of biophysical resources and social (perceptual) requirements necessary for zones of differing use intensities and the experiential qualities implied thereby.

It will be observed that this procedure, in contrast to the LAC process, does not consider alternative ROC allocations. Stankey and co-workers are chiefly concerned with the management of *wilderness* areas, so that the scope of their process is much narrower. Zone differences in a wilderness may be more subtle, and less **resource** dependent, i.e., they are related rather to perceptual factors. Where the range of allocations goes from intensive use areas, eg. resorts, to wilderness, resource conditions and prior usage are more deterministic. The nature and condition of the landscape determine to a large extent the allocation of appropriate zones at this broad level, because certain resource conditions would be incompatible with some recreation opportunity settings, or the cost of developing and maintaining them for such purposes would be prohibitive. The emphasis here is placed on the definition of criteria for zone allocation: only by changing the criteria are alternative allocations possible.

A limitation of the dissertation is that no attempt has been made to develop **quantitative** indicators of environmental quality standards (as in Step 5 of the LAC process). Why I consider detailed indicators associated with individual activities inappropriate at the intermediate level of planning, which comprises recreation *opportunity* allocation, was explained earlier in 4.1.1. In addition, the case study concerned a natural landscape much of which had **not** previously been used for recreation, so that the relationship between use and environmental impacts was not known, and in which the preferences of potential users had to be indirectly assessed. Consequently, this would have required time consuming experimental work which was beyond the project budget limits. Instead, it is suggested that the refinement and quantification of these standards could be undertaken after the basic planning stage, in the development of more detailed layout plans for each area, so that a "nested hierarchy" of plans is developed which at each successive level gives more detailed expression to the management objectives for the area. **Such a detailed plan is demonstrated by a report done for the National Parks Board on the management of recreational use at one site in the study area. This report is included as Appendix D.**

4.2 DETAILED DESCRIPTION OF THE PROCEDURE

No strict methodological procedures are specified for data gathering, or planning and analysis techniques. The framework retains methodological flexibility to allow each application to be tailored to its financial, manpower and temporal resources. Weaknesses built into the process by any such limitations are at least visible because of the explicit nature of the process.

The proposed procedure will be illustrated by its application in contributing to a master plan for recreation in the Weskus National Park on the Cape West coast of South Africa. Because of the difficulty of describing the general procedure without using as an example the case study methods, it has been difficult to avoid some repetitiveness in the remainder of the dissertation. In order to minimize this, the remainder of this chapter will comprise the general discussion, and the reader will be directed, at the end of each sub-section, to the section in Chapter 5 where the corresponding part of the case study is described. In both chapters the layout will follow the step-by-step procedure drawn in Figure 4.1. To further facilitate easy perusal of Chapter 5, the Case Study Methods will run in parallel, on the boxed left hand (even) pages, with the Case Study Results on the corresponding right hand (odd) pages. Each component of the discussion will be clearly labelled, for example, "CASE STUDY METHODS: STEP 1/2 (etc.)". Additional background material is included as appendices which will be referred to where appropriate.

4.2.1 STEP 1: Inventory of resource and socio-economic conditions

In contrast to the Limits of Acceptable Change process, in which Step 1 comprises the identification of area issues and concerns, the "inventory" has been placed first. In fact, these first two steps combine in an iterative process: without gathering preliminary information about an area it is impossible to analyse area issues and concerns, but once identified, they serve to concentrate further data gathering.

As it is, a fairly detailed and comprehensive data set may be required for the identification of appropriate environmental quality (or LAC) indicators, unless a considerable body of information on similar environments already exists. McCool *et al* (1988), for instance, remind readers to utilize the knowledge built up in connection with wilderness management in North America. Where data on the impacts of use on the area's ecosystems are scarce, an understanding must be gained of the area's biophysical properties - climate, geology, soils and vegetation - as a basis for indicator identification. Ideally, the parameters used should, according to Stankey *et al's* (1985) Limits of Acceptable Change process, reflect the choice of indicators for the LAC standards set for each opportunity class (LAC system Steps 3, 4 and 5). This is frequently not possible, since in many cases detailed experimental work would have to be undertaken to establish quantitative use:impact relationships.

In any case, the inventory need not be exhaustive - it is not a guidebook to the area, after all - but it should be comprehensive[2]. It also serves the function of uncovering what information about the area is actually available, so that major gaps can be identified.

---

2 Although this initial data gathering exercise is comprehensive, it is not an exhaustive listing of resource characteristics formally set out as a sort of "audit", as is implied by the term *inventory*.

4.2.1.1 *Biophysical Data*

General information about the biophysical attributes of the relevant land area are required, with the emphasis placed on "flagging" the most significant facts relevant to conservation and recreational use of the area, for instance, important habitat areas such as breeding and nesting sites, locality of rare and endangered species, steep slopes, and highly sensitive land types.

A review of land classification applications oriented to recreation planning (Appendix A) consistently revealed the use of the following parameters in recreational land evaluation: geology, soils, slope, vegetation, and climate, and, less frequently, hydrology, aspect and fauna. It is suggested that basic information on at least the climate, geology, soils and vegetation of an area be obtained. Land uses in the study area should be mapped and evidence of human impacts present in the area, recorded.

Written sources, including mapped information, interviews with natural scientists familiar with the area, and site visits are data sources. Site visits are a particularly important aspect of the intuitive judgement process; getting the feel of the place is an important element in the planning process (Gasson, pers comm.).

4.2.1.2 *Socio-economic Variables*

<u>Regional factors</u>

Socio-economic resources in the region which have a direct bearing on recreation planning are the second vital data set. As suggested earlier, park planning should form part of a larger, regional planning process. The interactions between a park and its surroundings make it necessary to ensure the compatibility of adjacent land uses with conservation and enjoyment of the park and to regulate the pressure of visitors on the park (Crowe 1979; Hartzog 1979). Quite apart from the problem of the diffusion of impacts (Brockelman and Dearden 1990)[3], such an approach is required to prevent the indiscriminate use of national parks for a range of activities simply because there is no where else to go: "only by planning the whole of our environment can we hope to conserve the special values enshrined in National Parks" (Crowe 1979:167).

A general picture of regional land uses and economic activities which may influence the study area can be built up from existing written sources. It is also desirable to obtain statistics[4] on regional population distribution and to develop an understanding of regional recreational trends. Here reliance might have to be placed on government analyses, should they exist, since regional studies are expensive to

3 The problem has become sufficiently severe that increasing research interest is being shown in protected area boundary management problems, say these authors;

undertake and require considerable manpower and data manipulation resources. There are some sophisticated analytical techniques for regional level studies, most of them now computer based eg., Taylor 1984; Michigan RECYS Study (as described by Rogers and Steinitz 1969); travel behaviour analysis (Mercer 1980; 1970; Cox 1972; Patmore 1970); demographic characteristics (Mercer 1970b, 1980).

Study area characteristics: Recreational pressure

It is necessary to assess current *recreational pressure* in the area in the worst case situation, namely, peak holiday times, and to attempt to estimate probable future recreational pressure. This constitutes, obviously, an assessment of demand, and the problems inherent in assessing this variable (Chapter 2) make this a difficult task. Most studies use current recreation participation rate (CRP) as an indicator of demand. CRP may be ascertained by means of statistics on participation obtained from management authorities, and questionnaire surveys administered in the study area at peak holiday times, in combination with structured field observations which might go as far as repeat aerial surveys, the latter, however, being very costly (Ashton and Chubb 1972).

Future recreational pressure might be assessed by inspecting historic records which reflect the past rate of growth of recreational use in the area, in conjunction with indirect indicators, such as growth in demand for real estate or housing, or increases in applications for accommodation during holiday periods.

Study area characteristics: User attitudes and preferences

In planning the allocation of recreational opportunities, the attitudes[5] and preferences of the likely users are as important as the judgement of managers and the assessment of recreational impacts (Pigram 1983; Heberlain 1977; Lime 1977). In the LAC planning system the attitudes of users is a vital input into identifying local issues and concerns, and in establishing the combination of recreation opportunity classes (ROC's) which is to be provided in the landscape under examination (Stankey *et al* 1985). The better known one's public is, the more effective is planning likely to be (Sutcliffe 1981).

While user attitudes to and preferences for **existing** recreational opportunities and resource conditions are important (they indicate to what extent users derive satisfaction from present facilities and conditions), planners need also to gauge what other opportunities presently unprovided for, users might like in the future.

---

4 Used here simply to denote numerical information

5 While much is made of the term *attitude/s* in the sociological and psychological literature, it is of interest to the recreational planner in the sense in which it is used by market researchers. In their understanding, attitudes are significant as the forerunners of behaviour and the term is interchangeable with *opinions*. Attitudes and opinions therefore represent "a person's ideas, convictions, or liking with respect to a specific object or idea" (Churchill 1983).

There are a number of approaches available to the investigator researching the perceptions and preferences of affected parties. Public hearings, game simulations, workshops, advisory committees and review of and comment on environmental impact assessments are some of the most common (Cortner, Gardner, Taylor, Carpenter, Zwolinski, Daniel & Stenberg 1984; Wandersman 1979). The analysis of popular literature, such as articles on local matters or letters to newspapers can provide valuable insights. Interviews with special interest groups and knowledgeable local people may yield a wealth of specific information. For example, interviews with representatives of sporting bodies may clarify the physical requirements for conducting their particular sport in a satisfactory way.

But to obtain statistically manipulable data pertaining to large numbers of the general public, survey techniques must be applied. Public opinion (questionnaire) surveys have been less widely used in resource planning because they are relatively expensive and require a greater degree of expertise to design (Cortner *et al* 1984). Nevertheless, questionnaire surveys have been extensively used in recreation studies to obtain a representative sample of visitor attitudes and preferences and to assess recreation demand (eg., Glavovic 1988; Preston and Fuggle 1988; Bristow 1987; Sowman and Fuggle 1987; Lucas 1985, 1964; Collins and Hodge 1984; Roome 1983; Washburne and Cole 1983; Drake 1982; Shelby 1981; Boddington 1980; Kaplan 1980; Dorfman 1979; McLaughlin and Singleton 1979; Stankey and Clark 1976; Peterson 1974; Stankey 1973; Clark, Hendee and Campbell 1971; Frissell and Duncan 1965). Recreation studies also use questionnaires to obtain data on visitor demographic and socio-economic characteristics, leisure behaviour, participation rates in different activities and favoured locations for different activities. They may be a valuable supplement to direct observations of recreational activity. Furthermore, they may be a substitute for data on past conditions at the site.

Public opinion surveys may be conducted by interview or by self-administered questionnaire. The particular survey techniques used to explore visitor/user attitudes are a function of the relative costs and benefits of the exercise. The in-depth interview technique may well give a more complete picture of the respondent's perceptions, but cannot be taken as representative of large groups of people. Self-administered questionnaire surveys have the advantage of generating large data sets at a far lower unit cost than the equivalent done by interviewing and they are also less time-consuming.

These data are then used to build up a profile of users and their perceptions and preferences, so that the social component of the LAC standards and ROC's can be developed.

4.2.2 STEP 2: Identify area issues and concerns.

Information from the inventory is analysed and synthesized to produce a **succinct** description of essential features of the area and the important issues and concerns arising therefrom. These issues and concerns identify the unique values, special opportunities and particular problems requiring attention in the area. Unwieldy inventory information does not, therefore, need to be presented in the main body of the planning report. Instead, they are summarised in a Statement of Area Issues and Concerns. The inventory merely provides the background to this interpretive statement.

This statement must identify those public issues and concerns that relate to:

(1) special features and characteristics of the area's natural resources, that is, sites of special conservation value or of outstanding historical, archaeological, scientific or aesthetic value;

(2) the relationship of the area to other recreation areas in the region in terms of the availability of recreation opportunities (Stankey *et al* 1985:4);

(3) the nature of existing and potential recreation opportunities in the area, potential in terms of management's perceptions **and** public preferences;

(4) the compatibility of land uses in lands surrounding the park, otherwise the identification of sites, because of prior or existing abuse, both in and around the park, which are likely to require special management attention;

(5) social and institutional factors which are likely to affect management, either positively or negatively;

Issues raised by managers, planners, scientists and the public are identified and reviewed. The Statement should also indicate deficiencies in the information base and identify those gaps which can feasibly be closed.

The idea of presenting preliminary findings in this way is an excellent addition to the field of recreation carrying capacity assessments. So often, as Stankey *et al* (1985) and McCool *et al* (1988) warn, unwieldy inventory data sets must be presented, an awkward task when dealing with large volumes of data in a number of different forms (eg., mapped data, reports, lists of species). This material need now be included only in an appendix or supplementary report. Nonetheless, it must be available for scrutiny, as part of the strategy to keep procedures explicit and decisions accountable.

4.2.3 STEP 3: Identify land systems and land types and map them

Where the protection of ecological functions and the preservation of species is important, there is a necessity for a sound ecological basis to zoning recreational opportunities. A *land classification* approach has been taken to this problem, and is considered an important facet of the methodology. The premises underlying the use of land classification in the process of establishing carrying capacity guidelines are that, firstly, capacity and suitability for different land uses are by-products of the intrinsic properties of land; and, secondly, human activities may so modify the attributes of the natural landscape that affected areas may be considered as distinct entities - certainly their "natural"[6] biotic characteristics may be dramatically different - and such areas need to be identified.

In order to assess the suitability of the landscape for and its capacity to withstand recreational land uses, the systematic identification and classification of elements of the recreation resource base, i.e., the natural landscape, are necessary (Pigram 1983:42). Land classification[7] provides a uniform basis for decision-making about land uses and simplifies the task of delineating areas with different land use potential (Mitchell 1973). The *evaluation* of the land for recreation planning is not part of the classification methodology, however; this is conducted in Step 6 (Figure 4.1).

It is important to note Gilmour's (1951) observation that the particular classification system is dependent on the specific purpose, that is, there is no one ideal and absolute scheme of classification. This becomes all too apparent in the field of land or resources classification (and evaluation), in which a vast number of approaches has been developed (Rogers and Steinitz 1969). As a broad guideline, since the conservation of natural ecosystems is a major objective of this planning process, a land classification approach must be selected which is appropriate to *ecological* analysis.

While the technical reasons for selecting the *land systems approach* as the appropriate methodology, specifically for this recreation planning process, are explored in detail in Appendix A, the rationale will be summarised here.

There are two fundamentally distinct approaches to the classification and analysis of land: the *integrated* and the *parametric* groups of methods. The *integrated* group includes the *integrated resource survey* (Bastedo and Theberge 1983), *landscape*[8] (Mabbutt 1968) or *land systems approach* (Brink, Partridge and Williams 1982; Brink and Partridge 1967; Brink, Mabbutt, Webster and Beckett 1966; Christian 1958), *regionalisation* (Bailey *et al* 1978), *gestalt* methods (Hopkins 1977; Mitchell 1973; Rogers and Steinitz 1969), *biophysical land classification* (Hamill 1984; Rowe and Sheard 1981; Rowe 1980; Lacate 1969) and *multifactor*

6 Concerning the difficulties associated with defining *naturalness* for ecological management purposes, recall the discussion in Chapter 2 (2.3.1)

7 Since "classification" is the division into classes on the basis of similar properties, *land classification* is "the identification and recording of character and establishing its occurrence by categorising land character into units of determinate extent" (Mabbutt 1968:11). Land *evaluation* is the process of estimating the potential of (evaluating) land for one use or several alternative uses (Mitchell 1973:5). Land classification is thus the precursor to land evaluation, but the two processes are frequently blurred in methodologies.

8 Mabbutt uses the term *landscape*, not in an aesthetic sense, but in a strictly physical sense, meaning the composite of characteristics that give an area its particular bio-geophysical character.

ecological classification (Spies and Barnes 1985; Barnes, Pregitzer, Spies and Spooner 1982). In contrast to this group are *parametric procedures* (Hammond and Walker 1984; Hugo 1984, 1981; Ferguson 1981; Gordon 1978; Hopkins 1977; A'Bear and Little 1976; Mitchell 1973; Zetter 1974; Speight 1968; McHarg 1969; Mabbutt 1968)[9]. Both classes of method aim to distinguish units of land which display internally consistent or homogeneous characteristics.

4.2.3.1 Parametric approaches

Parametric methods overlay the distribution of individual attributes of land, as independent variables, to develop a composite picture of the landscape. Each attribute of interest is mapped, individual attribute maps are then overlaid and areas homogeneous with respect to each attribute may be outlined by using approximately coincident boundaries that require only minor adjustment (the visual method); or by combining information from different overlays which appears to be complementary (Hammond and Walker 1984; Ferguson 1981; Mitchell 1973). In this way a composite mosaic of land units is built up. Computers have vastly improved the ability of analysts to define terrain classes in terms of complex combinations of attribute values applied simultaneously (Brink *et al* 1982:211). In such methods it is necessary to fix limiting values for class intervals which are likely to be related more to some land use criterion (eg., slope classes for urban suitability), than to the natural dynamics of landscapes. Landscape features should, strictly speaking, play no part in the delineation of class boundaries in parametric approaches, but in practice they often do (Brink *et al* 1982)[10].

A critical step in the parametric resource survey is thus the choice of attributes and range of data to be inventoried. The general requirement is for attributes which are relevant to the land use being considered, and which are recognizable and measurable in the field (Mitchell 1973:34). Parametric approaches require systematic field sampling, often using a grid system, to generate their data base. This yields an array of numerical values related to a grid of sample points, and mapping proceeds by drawing isopleths connecting points at the class cut-off values. But the choice of attributes to map can be problematic, since any environment presents an apparently endless array of characteristics to choose from, and the configuration of the resulting land units are at least partially dependent on the attributes mapped (Mitchell 1973). Rogers and Steinitz (1969), in only 16 papers they reviewed, found a total of 450 distinct variables which were used in the analyses. Nevertheless, some authors (eg., Wallace-McHarg (undated), the United States Army Corps of Engineers (1968), Hills (1960) and Christian (1958)) claim to

---

9 A third group of methods which does not fit neatly into this scheme, is concerned with the analysis of land's aesthetic or spiritual appeal. To confuse matters, this group is called *landscape evaluation*, which aims to classify the aesthetic value of landscapes (eg. Pickles 1978; Appleton 1975; Turner 1975; Linton 1968; Zube 1967)

10 Landscape methods, by contrast, identify land units on the basis of visible spatial differences in landscape features.

utilize "comprehensive" data banks in order to circumvent the problem of choice, but bias and selection are unavoidable. McHarg, although compiling apparently exhaustive inventories in all his studies, rarely, in fact, uses precisely the same mix of attributes. Comprehensive data banks are obviously expensive, involve enormous logistical problems in data handling, and manual methods are, in any event, limited to a maximum of six or seven levels of overlays (Gordon 1978). Computer manipulations have the advantage of allowing combinations of large numbers of variables in mathematically defined relationships, thereby potentially improving the precision and predictive power of analyses (Brink *et al* 1982; Gordon 1978; Coppock and Duffield 1975; Rogers and Steinitz 1969). Numerical analysis has allowed the development of some at least partially predictive models of landform (Gordon 1978).

The alternative, of course, is classifications based on a small number of *critical* variables, variables which through experience and analysis are known to play a major role in morphology and ecological relationships. Such classifications have been presented by South Africans, Beaumont, Carter and Gregg (1975), A'Bear and Little (1976), Boddington (1980) and Hugo (1984), and Coppock and Duffield (1975) of Scotland. Mitchell (1973) advocates classification on the basis of the "fundamental and permanent features of the landscape", these being soils, geology, climate and slope; other authors would certainly include vegetation as one of the fundamental features of landscape (eg., Dawson and Doornkamp 1973; Mabbutt 1968; Brink and Partridge 1967).

Parametric methods are considered to be more objective because they are able to make use of quantitative data (Hopkins 1977; Mitchell 1973; Mabbutt 1968). This gives them greater potential for providing very precise information (Brink *et al* 1982). Also, as understanding of natural systems and measurement of their characteristics improves, so can parameters be modified or added to increase the accuracy and efficacy of evaluative models (Mitchell 1973). There is no doubt about the potential power and versatility of parametric methods, given the flexibility and sophisticated modelling techniques afforded by computers. But parametric methods are disadvantaged for general land use planning purposes by the large number of field observations which may be necessary to establish a sufficiently comprehensive data base to ensure accuracy in interpolating boundaries; in combination with the need for increasingly sophisticated data handling facilities, this may constitute uneconomic effort (Brink *et al* 1982:213). In addition, combining attribute values is complicated by differential accuracy and precision in data for different attributes, and by the different spatial dimensions in which the data are recorded. Some data, for instance, are derived from point sources, some from transects, and some are diffuse (Mabbutt 1968). Importantly, the approach requires that attributes be considered as independent variables, so that cause/effect relationships can be accommodated only with difficulty (Hopkins 1977). The descriptive mapping of discrete attributes thus does not reflect their functional relationships in terms of biophysical processes (Bastedo and Theberge 1983; Moss

1983; Mitchell 1973; Mabbutt 1968). And it is *ecologically interacting* units of land with which we are concerned.

4.2.3.2 Integrated methods

The integrated/landscape/gestalt class of methods analyse the land in its entirety, as an integrated whole, without first separating it into its component attributes of climate, soils, geology, vegetation. The method proceeds by the *a priori* identification of land units on the basis of discontinuities in visible surface features, namely landform and vegetation, which are distinguishable on remote sensing products such as aerial photographs. Landform is classified as a series of hierarchically arranged units, which at each level define areas of homogeneity at different scales. Units at each level may be differentiated by different components of the landscape, or by visual characteristics which are artifacts of the remote sensing technology (eg., photo tone) rather than being intrinsic properties of the land. This inconsistency across levels in differentiating criteria has drawn comment from theorists, who protest that such a system does not obey the laws of hierarchical systems. However, is this relevant? If different physical and biotic processes operate at different levels to affect the morphology of land, then it would be spurious to apply uniform criteria at these different levels. Hence macroclimate and geology will continue to distinguish land systems, while soil structure and local moisture gradients define land units or land facets (these terms are clarified in the next paragraphs).

There has been a long history of integrated land classification, one of the best known examples being *land systems mapping* or *classification*, which has been widely used for reconnaissance mapping in Australia (Aitchison and Grant 1967) and by engineers in Britain and South Africa (Brink and Partridge 1967; Brink, Mabbutt, Webster and Beckett 1966; Christian 1958). While land *systems* are physiographic entities at the scale of geographic regions which are dominated by one major geologic or geomorphic feature (Brink *et al* 1982), land (mapping) *units* or *facets* are small areas characterized by a simple surface form, a specific soil profile and a uniform vegetation type (Brink *et al* 1982; Mabbutt 1968). Land units are the smallest physiographic entities which can be distinguished on aerial photos (Mabbutt 1968; Brink and Partridge 1967), although problems of resolution and interpretation may be considerable (Mabbutt 1968). Soils cannot always be distinguished and changes in the appearance of vegetation may be subtle, defying all but the most experienced analysts. Field checking is therefore done to verify interpretations, but there is no denying the subjective aspects of the process, which relies to some extent on the evaluator's experience and understanding of geomorphological dynamics. The approach's widespread use is attributable to its applicability at a range of mapping scales and the rapid, cost effective means it provides of identifying order and pattern in the landscape, and of separating parcels of land with different biophysical characteristics.

Although integrated methods have been criticized for the supposedly implicit basis of land unit identification, Rowe (1980:20) counters by arguing that it is the observed and inferred spatial coincidences, patternings and relationships of landscape attributes - soils, vegetation, climate - that the land evaluator must elucidate[11]. Landform is assumed to be the integrated expression of its underlying geology, soils, vegetation and climate (Dawson and Doornkamp 1973; Mabbutt 1968; Brink and Partridge 1967). It is for this reason that integrated classification methods are considered "ecological" classifications: "components of the landscape occur in patterns and complexes that affect physical and biological processes such as erosion and plant succession. Process...emerges only at the integrated system level which shows not only composition, but structure and interactions" (Bailey *et al* 1978:652). Since land systems mapping always deals with geographically associated objects, each land unit is a concrete, unique piece of terrain (Bailey *et al* 1978:653), and they represent **natural** units based on origin, process and form (Brink *et al* 1982; Mitchell 1973; Mabbutt 1968). Land systems mapping thus generates units which are natural areas of interplay of land-forming agents (Mabbutt 1968), the same units which comprise the interacting elements of an ecosystem (Mitchell 1973:27). Rowe and Sheard (1981) hold that landform therefore provides the best means of identifying functionally similar and dissimilar ecosystems.

The definition of boundaries is always problematic in land classification. A certain degree of arbitrariness cannot be avoided because changes in biophysical properties tend to be manifest as environmental gradients (Mabbutt 1968; Mitchell 1973; Cook and Doornkamp 1974). However, certain cues are available: slope breaks, drainage lines and marked differences in the shade of colour and texture of airphoto images. Land types are described in terms of the following attributes: geology, soils (to soil form) and vegetation (communities) and general air photo appearance (texture predominantly, colour being too variable to be reliable).

Since vegetation is the ultimate integrated expression of changes in the landscape, and land uses may profoundly affect it, to the extent of transforming or removing the natural vegetation, land uses are mapped as an initial step. The approach taken in this study to those areas where recent or past agricultural cultivation had completely or significantly altered the composition and appearance of the vegetation, is to identify them as a distinct land type without assigning such areas to any particular land system. The reason for this is twofold: firstly, in such areas the normal clues to boundaries between land systems and land types have disappeared; secondly, the degree of disturbance is a factor in the evaluation of suitability for inclusion in a Recreation Opportunity Class (ROC) zone. Land on which settlements or homesteads are built or which have been severely impacted by intensive recreational use must be similarly treated.

---

11 In any event, the evaluator may make these distinguishing features quite explicit in describing the attributes of the land units.

The end product of this step is a map of individually identified land types or units, described in terms of their geology, soils and vegetation. These units form the basic management units of the park, the suitability of each of which for designation to ROC's is assessed in Step 6.

4.2.4 STEP 4: Define management objectives for recreation and park character

Recent studies in this field have stressed the importance of setting management objectives at an early stage of the planning process. However, my observations suggest that very few planning teams are specific enough in framing statements of objectives to operationalise them as yardsticks for evaluating the plan's efficiency in meeting those objectives. Accordingly, the management agency's stated and published objectives for the area may need to be refined and modified.

An important element which is equally neglected in framing objectives for nature reserve/national park management, is to define exactly what is to be conserved, in combination with what type of recreational possibilities (in general terms) will be offered. I have called this the park *character*.

Defining the park's character must include not only a description of the natural assets of the conserved area, but how these are intermingled with cultural and historical resources. It should define the practical implications of any priority awarded, for instance, to conservation over recreation. The overall nature of the recreational settings which management deems appropriate to the natural and cultural characteristics of the area, will also be set out here. This then leads naturally into the detailed descriptions of appropriate zones (opportunity classes) which comprises Step 5.

There is no objective guide to defining park character. It is an entirely subjective conclusion based on historic literature, knowledge of the area and on public surveys and interviews with interested parties. The descriptions are qualitative only.

4.2.5 STEP 5: Define and describe Recreation Opportunity Classes

Recreation Opportunity Classes (ROC's) are descriptions of hypothetical packages of biophysical, social and managerial conditions which in combination define a recreation setting (Stankey *et al* 1985). ROC's define in qualitative terms subdivisions or zones in which different types of recreational experiences and activities will be undertaken. They are not at this stage on-the-ground allocations (Stankey *et al* 1985:6). As Stankey and co-workers have said often enough, and Goodall and Whittow (1975), both the ROC and activity requirements are determined by observation, experience, interviews with potential participants, and the literature; there is no theoretical guide.

The idea of ROC's was first elaborated in the Recreation Opportunity Spectrum (ROS), the ROS is likely to be a good guide to undertaking this step. Recall that the twin goals of the ROS are to ensure a diversity of recreational opportunities and to provide satisfying experiences to all users, but was not designed to be mechanistically applied, so the range of settings might be manipulated for any situation. The point has already been made that inside declared national parks, the range of recreation opportunities is severely curtailed by legislation which enshrines the unimpaired preservation of natural ecosystems as its primary objective (McCool 1986). Also, the consideration of regional recreation opportunities which should emerge in Step 2, will also contribute to establishing the appropriate range of opportunities to be provided in the park.

There is no universally correct zoning scheme. Quite different zoning schemes might have to be devised for different landscapes with different recreational characteristics. Land areas and water bodies, for instance, are difficult to include in the same zoning scheme because their characteristics and the requirements of the activities undertaken in them respectively, are so different.

Other factors which play a role in determining the range of opportunities to be provided in the area are:

(1) features of the biophysical resource base;

(2) what exists in the area, in terms of recreational facilities and evidence of human impacts, and the extent to which management authorities consider existing conditions acceptable;

(3) the regional context and the extent to which it would be desirable and feasible to provide opportunities not found elsewhere in the region and appropriate to the area's status and character;

(4) past and present land uses, settlement patterns and the extent and distribution of infrastructure.

The appropriate zoning scheme also considers the following factors:

(a) it is considered generally desirable to provide as wide a range of recreation opportunities as is appropriate to the character of the area. Specifying the appropriate range of opportunities defines the types of access permitted, the density of users and anticipated levels of interaction, the types of activity permitted, facilities provided and the quality of the natural surroundings.

(b) Zones must be meaningful, that is they must occupy real space in terms of use requirements so that their management is enforceable. Thus a major resort facility in the middle of a wilderness zone, for example, would be untenable, or an intermediate density beach defined as being seaward of the high water mark from a wilderness zone, would be meaningless. Zones must be compatible: Walther (1986) drew attention to the problem of buffer areas, pointing out that it makes no sense to put a development node right next to a wilderness area, as in the above example.

In developing the classes a description of the desired resource, social and managerial conditions are organised in tabular form, along with the zone's (i.e. ROC's) name, an explanation of its purpose (objectives), its major natural features and the appropriate types of users. Desired resource conditions, called Environmental Quality Standards, are described in qualitative terms. These take the place of Stankey *et al's* (1985) LAC indicator standards, not only because there is no presently satisfactory way to determine such standards for landscapes which have not been previously used for recreation, but also because at this level of planning such specific indicators may not be appropriate. The specification of these standards should thus await detailed investigation of the problem.

Ideally the name given to the ROC should convey information about the resource conditions and recreation opportunity provided by that class, but in practice this is difficult because comprehensive descriptions would become too longwinded to make effective labels. The resulting labels then convey the overall recreational setting; resource and management conditions are included in the more detailed descriptions [resource conditions also enter into the criteria for assigning recreation classes, as will become apparent later (Step 6)]. The table of ROC's is called a *zoning scheme.*

4.2.6 STEP 6: Determine suitability of land units for allocation to recreation opportunity classes

We now have a Table which describes the desired characteristics of a series of ROC's (or land use zones), and a map of land units. The two must now be combined to produce a recreational (land use) zoning plan, that is, the land units must be allocated to particular ROC's. It has been noted that the criteria whereby conservation managers and planners (including Stankey *et al* (1985)) allocate land use zones in natural areas, are rarely made explicit. This procedure can never be completely objective, because of the complex of factors which define the ROC's, but a systematic approach to the allocation task which is open to scrutiny, can improve the process.

While considerable emphasis has been laid on providing a rigorous ecological basis for zone allocation by classifying the landscape into land units, the reader need hardly be reminded that ecological characteristics alone do not define recreation opportunity classes, hence criteria with social significance in addition to purely ecological ones, are necessary to determine the suitability of land units for inclusion in particular zones. In addition, recreational zonation plays an important role in protecting the conservation values for which national parks and nature reserves are established; the characteristics of ROC's are closely bound up with conservation requirements. The underlying purpose of this evaluation is, therefore, to ensure that the two sets of requirements are compatible "on the ground".

Most evaluations for recreational zoning proceed by the method of numerically rating the land in question on a number of factors relating to ecological characteristics and physical site requirements (Goodall and Whittow 1975). The contribution of each of the factors to the area's suitability for recreation is dealt with by weighting each factor, and the weighted scores are then added to give an aggregate score of suitability eg, Hugo 1984, 1981; Tivy 1980; Hogg 1977; A'Bear and Little 1976; Coppock and Duffield 1975; Allison and Leighton 1967; Tubbs and Blackwood 1971. Elaborate rating schemes may be developed to deal with negative and positive factors, eg., Hugo 1984, 1981; and an enormous number of factors may be considered, eg.., Hogg 1977. These scores are usually determined by subjective evaluations performed by planners and managers (Stankey *et al* 1985; Rogers and Steinitz 1969). Again, the apparently objective values may acquire a validity which they do not, in reality, possess[12] (See Appendix A for detailed discussion on this topic).

This approach has therefore been substituted here by the verbal description, in quantitative terms where possible, of criteria - literally, *decision rules*, akin to McHarg's or an expert systems's rules of combination - for allocating land units to one ROC or another, and thus for determining the boundaries between ROC's. The decision rules are applied by means of a structured reasoning process in the form of a **decision-tree**, which lays bare the sequence of decisions (the flow of information) used to allocate land units to recreation opportunity classes. This is consistent with behavioural decision theory, which indicates that people process information sequentially when attempting to reach a decision (Saaty 1986; Keeney 1982; Chapman 1981; Hansen 1976, 1972; Bettman 1971; White 1969). Turner (1988) has similarly observed that recreation resource allocation decisions are "iterative" in nature. Decision-trees have been applied in several different ways in resource allocation problems: as an aid to modeling vegetation distributions (Moore, Lees and Davey 1991); the Analytical Hierarchy Process applied to evaluating the conservation value of a number of sites (Anselin and Meire 1989); in energy policy decision procedures (De Jongh 1988; Keeney 1982; Chapman 1981); and as an aid to trail selection by hikers (Krumpe & Brown 1982).

Decision-trees are hierarchical structures which are used in decision theory to analyse and display decision sequences in such a way that patterns are recognized (Moore, Lees and Davey 1991). The tree has a pyramidal structure with a single apex: each level below the apex has a greater number of elements with branches linking the levels. Each link in the process is related to the next by a cause/effect or knock-out relationship, so that alternatives are eliminated at each *decision node*

12 A preferable approach, I believe, is to leave the scores disaggregated, so that the contribution of each factor can be reviewed independently, as has been done in other environmental planning applications, eg., Whitaker 1984; Beaumont, Carter and Gregg 1975; Hills 1966.

(Moore *et al* 1991; Chapman 1981). Decision-trees can be used either as a classification tool (a sort of "automated taxonomic tree" as Moore *et al* call it), or to structure a decision problem so that the consequences of alternative decision strategies can be followed through. While the outcome of applying the technique to allocating recreation opportunities will be a classification of the landscape into different recreation opportunity classes, the technique serves the dual purpose of laying bare the decision strategy used by the planner/s to reach that classification.

The decision-tree model used in this dissertation is essentially the same as that described by Moore *et al* (1991) and Krumpe and Brown (1982). Classification is performed by asking a series of questions about the attributes of an object or observation. Decision rules are formulated which determine the answer to each question. The answer determines the next question or identifies the object as belonging to a class (at a *terminal node*). The hierarchical structure, in eliminating alternatives at each stage, is an efficient way of sorting objects or observations (Moore *et al* 1991:61).

By using a decision-tree to display the ROC allocation process, the hidden criteria are made explicit and the process is accessible to scrutiny by any interested parties. In this way, the decision problem is structured more firmly and the accountability problem is dealt with.

4.2.6.1 STEP 6.1: Identify factors determining suitability

While the development of the decision rules and decision tree is described under sub-section **4.2.6.2 "Formulate series of questions and order as decision-tree"**, a preliminary step is to determine which factors are considered generally important in recreation resource allocations, and how and if they are used by managers when they make these decisions.

Those factors observed to be most important in zone designation are (see also discussion on ROS, Chapter 3):

a) the resource and spatial requirements of each recreation opportunity class;

b) natural attributes and cultural resources of the landscape;

c) past and present land uses;

d) ecological sensitivity

e) access.

This is simply common sense. Clark and Stankey's (1979) analysis of factors which defined recreation opportunity settings in the Recreation Opportunity Spectrum came up with a very similar list: access, non-recreational use, on-site management, social interaction, acceptability of visitor impacts and acceptable regimentation (Chapter 3).

Resource and spatial requirements of each recreation opportunity class

The resource and spatial requirements of each opportunity class are implicit threads underlying the evaluation. While some criteria may concern them explicitly, other criteria may serve as indicators for distinguishing one ROC from the other. For instance, since wilderness generally requires large areas - spatial requirement - of pristine natural landscape -resource requirement - (Nash 1982; McKenry 1977)[13], one criterion might relate to a minimum size, another to the condition of the vegetation. While the resource needs of ROC's are broadly defined at this level of planning, the requirements for the different recreational activities associated with each ROC must be considered to the extent that these requirements determine the relative severity of impacts[14]. Tivy (1980) in a detailed analysis of the resource needs of recreation activities at Scottish lochs, observes that it is obvious that the more facilities required by an activity, the greater will be its potential to transform and impact the landscape, and hence compromise conservation values. Activities are thus clustered in ROC's so that the requirements for wilderness recreation coincide with conservation values, but facility oriented activities are unlikely to be assigned to areas accorded a high conservation status. In the designation of high intensity use areas, which may be quite small in a totally transformed environment, ease of access and previous usage might be the most important factors. The basic resource needs of the ROC's are spelled out in Table 5.6.

Natural attributes and cultural resources

The primary attributes of landscape - soils, slope, hydrology and vegetation - ultimately determine its suitability for human use. In combination with aesthetic and cultural features, and their location and distribution relative to the human infrastructure of the area, they too are implicit in the evaluation, though attributes may not be overtly referred to in the criteria definitions in Step 6.3. Some attributes may, however, be useful in differentiating areas of high ecological sensitivity: thus steep slopes with a thin soil mantle may distinguish one type of "Special Area" from another. Derived properties of natural attributes, such as the diversity, area, rarity and representativeness of vegetation, are important in indicating conservation value (Margules and Usher 1984), which will in turn exert a strong influence on which recreational uses will be deemed appropriate to maintaining those conservation values. At this level of planning, informal

13 "The hallmark of wilderness is its naturalness - a place where the earth and its community of life are untrammeled by man, where natural ecosystems and natural processes are allowed to prevail as they have from time immemorial" (Krumpe and McLaughlin 1985:59)

14 The resource needs of individual activities can be described in enormous detail, eg., Hogg (1977), but such definition is unnecessary until the detailed planning stage where individual activities are being laid out.

evaluations of these parameters are likely to suffice, but at the detailed level, for instance, in routing a hiking trail, there might be a need for a more refined analysis.

Past and present land uses

Land uses are relevant inasmuch as they may have altered the natural attributes of the landscape, and users' perceptions of it and of the experiences to be gained there. Clearly, tranquillity and a sense of wilderness solitude would not be gained adjacent to an large cultivated land being reaped by a combine harvester! Areas considered suitable for development or concentrated use are those which have been most transformed or modified from their natural state (with the exception of ecologically critical areas - see next paragraph). Pristine natural areas would then be afforded the greater protection of a zone which allows only very restricted uses. A numerical rating may be given to the degree of transformation of each land unit, but this is not essential, since the relevant criterion will refer to specific indicator features.

.Ecological sensitivity

The concern with carrying capacity arises from a perception that different ecosystems are differentially sensitive to land use impacts. This phenomenon has been labelled variously as ecological *vulnerability, fragility or sensitivity*. It is conceptually related to the notion of ecosystem stability in that, theoretically, ecosystems respond to perturbations in such a way as to re-establish the equilibrium state. Successional changes may be steps along the route to the re-establishment of the local climax community, or to the development of a new climax (Odum 1971). However, as discussed in Chapter 2, more recent research into ecological dynamics has turned equilibrium theory on its head ((for examples, see Pickett and White (1985:5) who say that "equilibrium landscapes would ..... seem to be the exception, rather than the rule", Sprugel (1991) who shows that "natural" vegetation must encompass a wide range of states and processes; and Scholes (1989), who talks of the "*im*balance of nature"). Variation, dynamism and disturbance are regarded as the "normal" state in ecosystems; many are patchy, variations occur over a hierarchy of temporal and spatial scales, and some variables may be on long term trajectories, i.e., "moving baselines" (Sprugel 1991; Scholes 1989; Hansen and Walker 1988; Pickett and White 1985). Equilibrium is characterized by a range of compositional and functional states which is bounded by limits, beyond which changes will be *irreversible*. That is, within these bounds/limits, changes will not, in the long run, threaten the persistence of the system, but changes outside the limits will permanently change the system. The narrower these limits, the more sensitive the system is to disturbance (Siegfried and Davies 1982). All these factors make the definition of a baseline state against which to measure sensitivity to change (i.e. as a consequence of impacts), extremely difficult (Beanlands and Duinker 1983:52). They also call into question the entire notion of managing landscapes to preserve a (static) "natural" vegetation (Sprugel 1991).

In the environmental management literature reference is frequently made to "environmentally (or ecologically) sensitive areas", which are understood to fall at the "highly sensitive" end of the continuum. Environmentally sensitive areas are defined by Pierce, Gustafson and Koutsandreas (1978:273) as

> those lands which in their natural state provide ecologically important functions and which if improperly managed would have a **disproportionately large, adverse impact on environmental quality**. They have vital ecosystem support functions *[author's emphasis]*

Pierce *et al* (1978) identify as one of their most critical functions, the high *absorptive capacity* of many of these ecosystems: they act as buffers which ameliorate floods or extremes in physical and chemical inputs. Other conditions associated with "sensitive" areas are: fragile ecosystems with limited carrying capacity, because they are unable to adequately recover from unplanned development (for example, sand dunes, islands with limited water supply and areas with thin soil mantles); some are sensitive because of the potential for disruptions of ground water supply and quality; yet others are important because of their position in the food chain (estuaries, wetlands) or because they provide habitat for endangered species (Siegfried and Davies 1982; Pierce *et al* 1978). Heydorn and Tinley (1980), Kusler (1980), and Goldsmith, Munton and Warren (1970) identified areas of *inherent instability*, eg., floodplains, unvegetated mobile sand dunes, beaches and salt marshes as being highly sensitive[15]. Botkin (1982) states that systems which are dependent on external inputs, eg., estuaries, mountain streams, are vulnerable. Systems which are nutrient or energy limited are vulnerable because growth and self-recovery are slower, eg., mountain habitats. Similarly, arid ecosystems and ecosystems on wet, shallow or nutrient deficient soils have a limited capacity to recover (Kuss and Graefe 1985; Goldsmith, Munton and Warren 1970).

Clearly, the notion is multi-faceted, although there is wide agreement on the types of systems considered to be sensitive, namely wetlands, estuaries, sand dunes, tropical rain forests and alpine and tundra areas. In fact, so complete is this agreement that there is little comparative or critical discussion of the topic in the literature, except amongst theoretical ecologists, who appear to have little empirical data to corroborate or contradict their theoretical models (Scholes 1989). A particular problem is the lack of comparative data, data which would allow one to evaluate the relative sensitivity of different ecosystems. No one is able to say if an alpine system is more or less sensitive to land use impacts than an estuary, by how much and in what way. Pierce *et al* (1978) call for the development of a series of comprehensive indices for land quality, for comparisons from place to place, to ensure that carrying capacities are not exceeded. Siegfried and Davies (1982) have recognized the "crucial" necessity to investigate indicators of sensitivity which will

---

15 **There would appear to be a frequent association of instability and "buffering capacity"**

allow comparison of the sensitivity to man-induced treatments of different ecosystems.

As regards achievement of the goal of sustainable use (which appears to be a widely agreed goal amongst environmental managers), such distinctions may be important. While we have abandoned the objective of setting use limits (that is, limiting numbers) to achieve carrying capacity objectives, the need to determine indicators for the limits of acceptable change in recreational landscapes presents similar problems. Having identified a number of land units in the relevant landscape - and by definition they represent areas of land with some different characteristics - is one able to differentiate between them in terms of limits of acceptable change indicator standards? At this stage, no, not in a strictly quantitative sense: again, subjective evaluation is our only guide. In the long run, it seems it will be meaningless to insist on management within the carrying capacity LAC framework unless differential standards for different ecological units, eg., mobile dune fields *versus* old, consolidated dunes, can be developed. That this research was unable to extend to the detailed experimental work which would have been required to develop such standards for the Langebaan landscape, remains a limitation of this dissertation.

Attempts to quantify differential sensitivity have been hampered by ecological complexity - it is difficult to simulate field conditions and at the same time control all the variables - and by the complex mathematics of multivariate equations. To start with, responses to impacts are complex and operate simultaneously on different system components and processes. Sensitivity can be assessed in terms of susceptibility to physical changes, biological changes (changes in the relative abundance and diversity of species) and changes in processes, though the latter are closely linked to physical changes. Most attempts have looked at one or a limited number of variables for the development of indices of environmental sensitivity. Indices of soil erosion or soil productivity potential have received most attention: in South Africa, soil has been the only ecological attribute investigated as an indicator of land potential or vulnerability - Garland (1988), Hudson (1987), S.A. Dept of Agriculture (1985), Kuss and Morgan (1980). Very dynamic systems, such as the intertidal zone of rocky shores, present particular difficulties in attempting to establish acceptable limits of change associated with human use. This is because the natural fluctuations tend to be large, so that the detection of small shifts may be meaningless. For example, it may be unrealistic to detect less than a 25% shift in the populations of rocky shore species (Beanlands and Duinker 1983, citing Cowell 1978; see also: Sousa 1985, and Connell and Keough 1985)).

In the light of these complexities, the *critical factor* approach has been adopted in eliminating from consideration at the start, areas which have the characteristics of a highly sensitive area. This follows Terry's (1977) approach, in which the initial criteria act as filters which remove from further consideration a relatively large number of sites. The features of these sensitive sites will need to be described for each particular application, using the literature as a guideline, because of the wide variety of sites considered sensitive to human impacts (see above discussion). Attempts to distinguish between other communities - assumed to be in the middle or low range of sensitivity - have been unsuccessful, with ecological experts declining to attempt to do so. However, this might depend on the level of knowledge of particular ecosystems, some having been studied in far greater detail than others. [The study area of this project, namely Langebaan lagoon, is situated in one of the least understood vegetation types of South Africa, so that such refined distinctions are unlikely to be made for the Langebaan area.]

Access

The accessibility of recreation areas is an important aspect of the opportunity setting, relating to perceptions of remoteness or being close to civilization (Clark and Stankey 1979). Relatively large areas with only peripheral access and a sparse road network are considered most suitable for wilderness recreation areas, while those relatively degraded areas close to major routes and human concentrations will be most suitable for development of a more intense kind. However, in applying such a criterion one cannot be entirely consistent, and exceptions may have to be made.

4.2.6.2 STEP 6.2: Formulate series of questions, and order as decision-tree

How the decision-tree is put together depends to some extent on the purpose for which it is to be used. As a classification tool, eg., Moore *et al* (1991), Krumpe and Brown 1982, a top-down approach is adopted; as a means of structuring a decision problem or to display the outcomes of alternative decision solutions, eg., Saaty 1986, Chapman 1981, one might start at the bottom level of the hierarchy with the alternatives, moving up through levels of criteria to the objective or *focus* of the process (Saaty 1986:30).

The decision tree model deemed appropriate to allocating land units to ROC's is structured like that of Moore *et al* (1991). It is based on *splitting rules*, the efficacy of which are judged by how cleanly they divide the data set into sub-sets. Moore *et al*'s model is shown diagrammatically in Figure 4.2 overleaf.

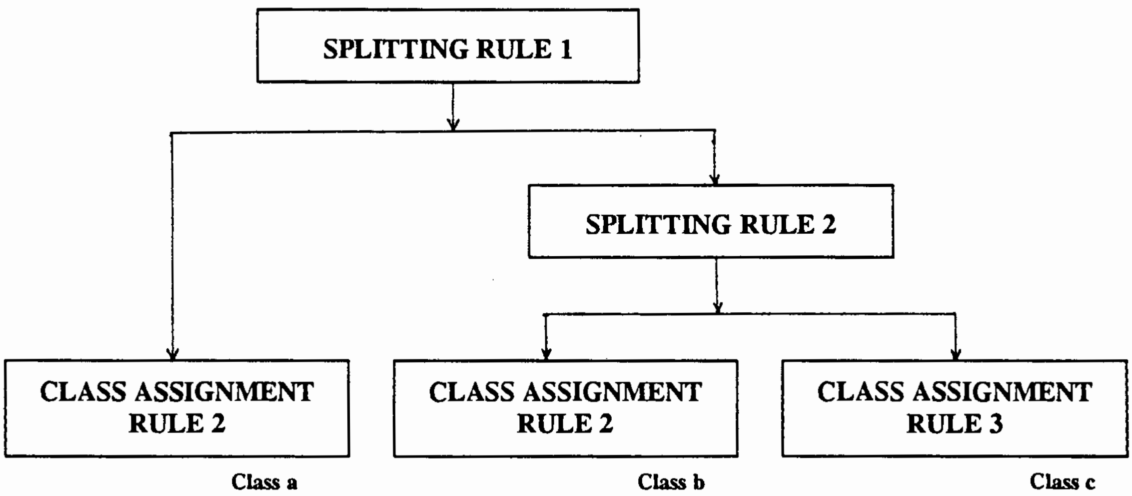


Figure 4.2: Model of a classification tree (after Moore *et al* 1991)

The construction of a decision-tree comprises searching for the set of questions that is most efficient at distinguishing between the classes on the basis of the observed factors (Moore *et al* 1991), that is, one is looking for questions which give the cleanest divisions and the shortest tree. This has been accomplished here by working with planners and managers and observing the **actual** factors which underlie the subjective decision processes used in designating recreational - and sometimes other land use - zones in the landscape. Guidelines from the literature, particularly papers on the Recreation Opportunity Spectrum and Limits of Acceptable Change planning system, were used, as indicated in the identification of factors affecting ROC allocation (4.2.6.1). These factors are formulated as questions in the decision-tree. By an iterative process, that rule which achieves the largest split in the *root node* is placed at the apex of the tree, and each subsequent splitting rule/question becomes a *branch node*. The questions are formulated as conditional statements, so that the decision rules for answering them will result in a YES or NO answer (equivalent to True or False). The questions are thus ordered by importance, and structured as an interlocking series of YES/NO pathways. The basic model of the decision-tree employed in this study is presented as Figure 4.3 below. The branch nodes are identified by a numeric symbol which denotes the level of the node, followed by the letters 'a' and/or 'b'. The first 'a' denotes a branch which follows a YES answer to the root node question, while 'b' identifies the NO route. All subsequent questions (from level 2 down) are denoted by a second 'a' or 'b' depending on the answer to the preceding question.

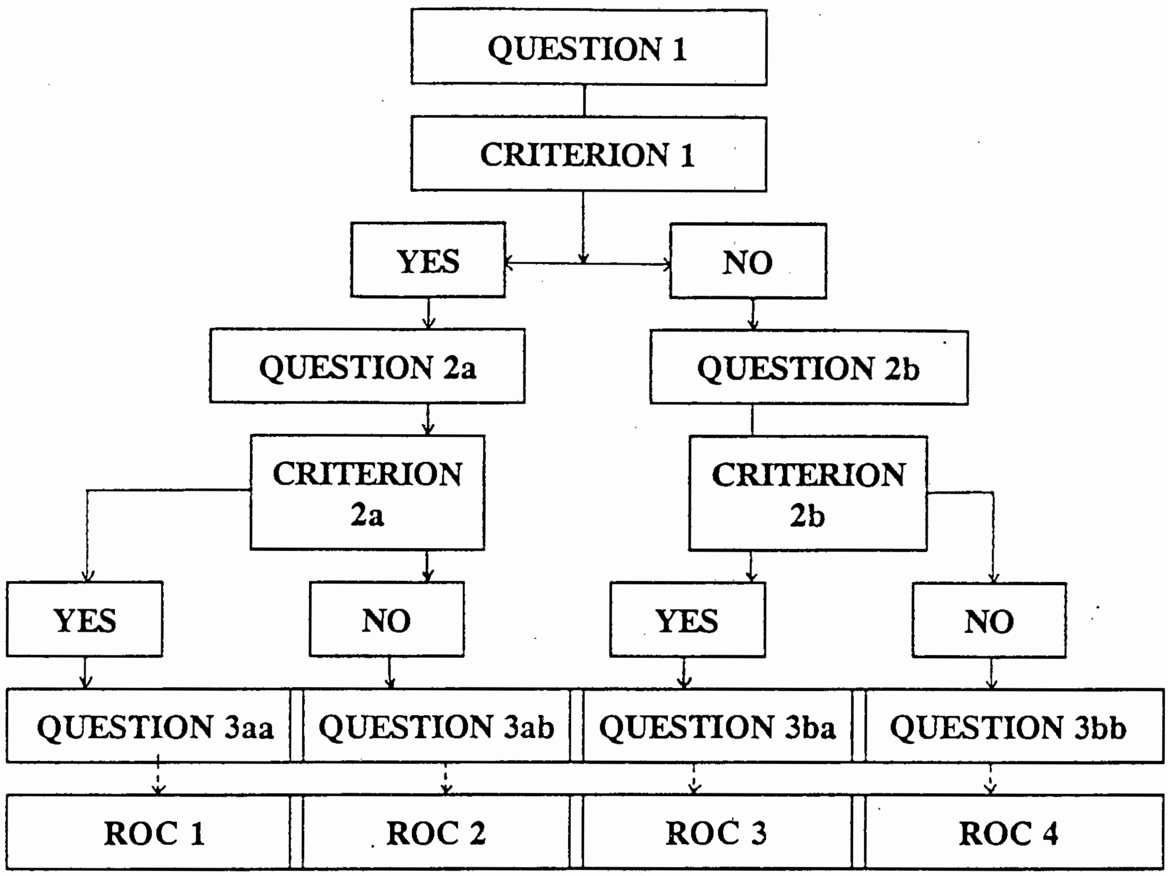


Figure 4.3: Conceptual model of Recreation Opportunity Class allocation decision-tree

<u>Formulation and sequencing of questions</u>

The size of the decision-tree, i.e., the number of levels of branch nodes, is at least partially dependent on the number of classes which must be distinguished. For a range of ROC's of four classes, it is suggested that six branch levels are sufficient. Six levels of questions addressing in sequence the following factors is proposed as a general model. The sequence is designed to identify early in the process those areas which would obviously be allocated to ROC's at the extremes of the spectrum, namely intensive use zones and areas of special conservation value. Successive questions then discriminate between ROC's intermediate between the extremes. The actual form of the questions may vary from application to application, depending on the particular history, natural and human, of the landscape under scrutiny. The terms used in the questions are defined in the decision criteria, the task undertaken in Step 6.3. The sequence of factors is only listed here, and the detailed rationale for each question is explored further in the worked example of the process, namely in the Case Study Methods text.

1 Current land use

2 Ecological sensitivity

3 Presence of severe degradation or permanent development on land unit.

4a The presence of constraints on either development or restoration.

4b Size of the area.

5a Proximity of the land unit to areas of human activity.

5b In large areas of "natural" landscape, the presence of infrastructure such as roads and buildings.

6 Location of land unit in relation to visibility of areas of human concentration.

The case study decision-tree is presented in Figure 5.6.

4.2.6.3 STEP 6.3: Define decision criteria

Each question is accompanied by a decision criterion specific to it. The decision criteria define terms utilized in the questions, such as "ecologically critical areas", and establish the cut-off point for distinguishing a "Yes" answer from a "No" answer. The formulation of criteria has in some instances been based on information gleaned from the literature, eg., definitions of "ecologically critical" or "inherently unstable" areas (see discussion 4.2.6.1). Where a question relates to land uses and degradation resulting therefrom, analysis is based on mapped information on these parameters (For the Case Study, these are the overlays in Appendix F). Earlier research in the study area and judgements by the evaluator or informed specialists might contribute to others, while assumptions about the resource requirements of ROC's provide the basis for yet others. In accordance with the philosophical basis of this dissertation, these criteria are based on subjective judgement, the rational basis of which is contained in the background information presented in other steps of the planning process. The purpose of the criteria is not to make greater claims to "objectivity", but to make explicit the basis for decisions. If interested parties are unhappy with the outcome of the decision framework, they are in a position to challenge the criteria. By changing the criteria, alternative allocations could be made, and these would have to be evaluated against the stated objectives of planning.

The criteria that have been identified in this study as being generally applicable are simple in content, but there may be other criteria pertinent in particular places in particular circumstances. The criteria should be expressed in quantitative units where feasible in order that there be no argument as to the outcome of each decision leading to allocation, but these cut-off points are essentially arbitrary. The criteria limits will be specific to each area under investigation and they will depend in part on the range of ROC's specified in Step 5, since the criteria are linked to the resource requirements of the ROC's. It is difficult to describe exactly the form of these criteria without referring to an actual example; the reader is therefore advised to refer to the Case Study Methods for a worked example of this process.

4.2.6.4 STEP 6.4: Allocate land units to Recreation Opportunity Classes

Land units are individually labelled. Each land unit is then "processed" through the decision-tree. Each question in turn is asked of the land unit. Whether it meets the criterion or not is assessed by inspecting the relevant mapped overlays. Again, the procedure is best illustrated by referring to the worked example Chapter 5, 5.7.

4.2.7 STEP 7: Allocate Opportunity Classes in the landscape and map the resulting zoning scheme

Once all land units are assigned to ROC's the resulting zoning scheme is mapped, with small boundary adjustments being made for pragmatic management reasons, eg. a road might go through a land unit, in which case the road, not the unit boundary, would probably form the division between two ROC's.

4.3 CONCLUSIONS

In focusing on the procedures for making decisions concerning the recreational use of natural landscapes, this work continues an increasingly prevalent trend in the wildland planning and management literature (see McCool *et al* 1988; Turner 1988; Ashor, McCool and Stokes 1985; McCool and Ashor 1985; McCool and Stankey 1986; Stankey, McCool and Stokes, undated;)

Analysis of the literature and field work have revealed the theoretical and practical difficulties and deficiencies of applying scientific and numerical methods to such assessments. The available evidence suggests that there is little to choose, in terms of cost effectiveness, between apparently sophisticated, so-called objective approaches and a reliance on the subjective judgements of experienced experts. The context within which this methodology has been developed is created by a combination of these difficulties, the constraints of time, personnel and money experienced by most public agencies, and the frequently informal processes of decision-making in such bodies.

There is thus a need for a simple, inexpensive approach to planning which is nonetheless systematic and explicit, and thereby accountable to the affected parties. It is also flexible, allowing the incorporation of a variety of numerical (or otherwise) techniques at any stage of the evaluation, should these be feasible and deemed desirable.

The procedure for recreation planning described here is based on qualitative values, but incorporates as a central feature a process for making its assumptions, and the criteria for its decisions, explicit. The procedure lays the emphasis on clear statements of objectives, the development of standards to meet those objectives and the identification of ecological units to improve the scientific basis for recreation resource allocation decisions. The decision-making procedure is thus accountable: it is open to scrutiny, criticism and modification in the light of new information or changes in values.

Much work remains to be done, particularly regarding the development of quantitative standards of environmental quality. This is, however, subject matter for a programme of research on its own.

CHAPTER FIVE

TOWARDS A RECREATIONAL MASTER PLAN FOR THE WESKUS NATIONAL PARK: A CASE STUDY

5.1 MASTER PLANS AND RECREATION PLANNING

In this chapter the results of the application of the procedure described in Chapter 4 are presented in the way in which they might be presented in a Park Master Plan. The purpose of doing so is to extend the recreation planning process one step beyond the "technocratic, rational" stage, which is what we have been concerned with in Chapter 4, into the "political, bureaucratic" component of Turner's (1988) conceptualization.

At the Second World Conference of National Parks in 1979, Erz, rapporteur of a session on Planning and Management, reported that there was wide agreement on the great importance of the *interpretive* function of National Park services, *on the necessity to base interpretive programs in the Master plan* and on this being done, firstly, by involving the public directly in the planning process[1]. Public involvement either in drafting a Master Plan or in commenting on a provisional plan, would be a crucial step in park development. Such a process would also satisfy the objective of the planning procedure proposed in Chapter 4 to design a decision-making procedure which would be accountable and explicit. The presentation of this "product" would be an important element in the overall planning process.

---

1 As McCool and Ashor (1985) have done in adapting transactive planning approaches to park planning;

There is also a wide degree of overlap between the requirements for a Master Plan and the approach to planning adopted in this dissertation. According to Keenan (1979) the Master Plan is a written statement of policy and objectives for the given area. Master Plan aims have been defined as (a) outlining the main areas (zones) of the park and their principal functions within the overall park objectives and (b) laying down the degree of development and of management (within those areas) (Keenan 1979 : 178).

A Master Plan should

a) be as simple as possible;
b) take into account relevant environmental, social and economic issues;
c) conform to the resources, powers and techniques available for its implementation; and
d) be flexible and frequently updated (Erz 1979 :153).

For a contractural[2] park such as the Weskus Park, where much of the land is privately owned and which has a resident human population, the presentation of the park Master Plan should be seen as *critical.* Since it is the responsibility of the park authorities to open and maintain lines of communication with the public (Hartzog 1979), any aids to this communication must be carefully formulated. In laying down guidelines for development in the Park, descriptions should be precise and, most importantly, should explain very clearly how the resulting plan was derived. Documentation is an essential step in making the basis of any decisions explicit (Turner 1988:10). The difficulty here, of course, lies in achieving a balance between conciseness, readability and informative explanation. (The LAC's Area Issues and Concerns is a direct attempt to accomplish such a task.) This chapter is therefore written with this task in mind, with the objective of "telling a story" which will lead the reader easily through to the recreation plan proposed in the final sections of the chapter. To facilitate understanding of the discussion, a brief introduction to the geography of the study area is given overleaf in Box 5.1. As explained in Chapter 4, the case study methods will run as a parallel text to the results of applying the proposed procedure. The methods will be boxed on the even pages; results will generally be on the odd pages, but will follow on where the methods end before the end of a page. Each Step of the procedure will, however, commence at the top of a page.

2 Recall Chapter 1, 1.2

Box 5.1: Introduction to the geography of the study area

The reader is referred to Figure 5.1 overleaf and Overlay 4, Appendix F, to supplement the following description.

Langebaan lagoon forms a 13 km long arm attached to the southern side of Saldanha Bay. The semi-circular, 17 km diameter Saldanha Bay is situated at 33^{o}S 18^{o}E on the West coast of South Africa. It connects with the Atlantic Ocean on its western side. Within the ambit of the bay lie the islands of Jutten, Malgas and Marcus, home to large seabird breeding colonies. The commercial port of Saldanha lies on the north shore of the bay; to its east is a large ore-loading terminus.

The land-locked lagoon lies parallel to the Atlantic coast, from which it is separated by a narrow (3 to 4 km) wedge of land known as the Langebaan or Churchhaven peninsula. The orientation of the lagoon is SSE\NNW. The junction of Langebaan lagoon with Saldanha Bay is "plugged" by Schaapen Island so that two narrow, deep channels connect the lagoon with the bay. Opposite Schaapen Island on the eastern channel lies the town of Langebaan. Behind Langebaan on the eastern shores of the lagoon lie the farms Oosterwal, Mooimaak, Seeberg and Bottelary. Geelbek occupies the southern end of the lagoon, adjoined to the south by Abrahamskraal and to the west by Schrywershoek. To the east it is connected to Kalkklipfontein,which joins Elandsfontein, these two farms lying largely to the east of the West coast road (R27) and the only farms not adjacent to the lagoon which are included in the Weskus National Park. Next to Schrywershoek on the Churchhaven peninsula is the farm Stofbergsfontein, which carries the hamlets of Churchhaven and Bossieskraal (also called Stofbergsfontein) on two promontaries overlooking the lagoon. Between Churchhaven and Schrywershoek lies the cluster of houses known as Boereplein. Several kilometres north of Bossieskraal is the rock called Preekstoel which marks the end of the popular, half-moon shaped Kraalbay. Just south of Preekstoel is a parking area and beach called Second or Tweede Stop. Buoyed lines mark the demarcation of use zones on the lagoon: two lines run, respectively, from Second Stop to Oosterwal on the opposite shore, and from Boereplein across to Seeberg. These lines divide the lagoon into three zones (Figure 5.1) with increasing restrictions on use and access as one moves from Zone 1 to Zone 3.

Behind the north shore of Kraalbay the topography rises sharply to the granite outcrops of Konstabelkop (Constable Hill) and Vlaeberg which dominate the privately owned Postberg Nature Reserve, also known as Oude Pos. A popular site for rock lobster diving, Kreefte Bay, lies on the ocean (western) shore of the Postberg reserve. The Postberg Reserve straddles the peninsula for 5 kms before being connected by a very narrow isthmus to the Donkergat Peninsula. This is a military base and is out of bounds to the public. The sub-region is within rapid and comfortable access of Cape Town, 120 km away via the "West Coast Road" (R27). A gravel district road runs down the east shore of the lagoon, at the southern end of which it splits to produce a branch which runs the length of the Churchhaven peninsula, and one that runs south to join the R27 and the road to Yzerfontein, a small fishing and holiday village 20 km down the coast from Langebaan.

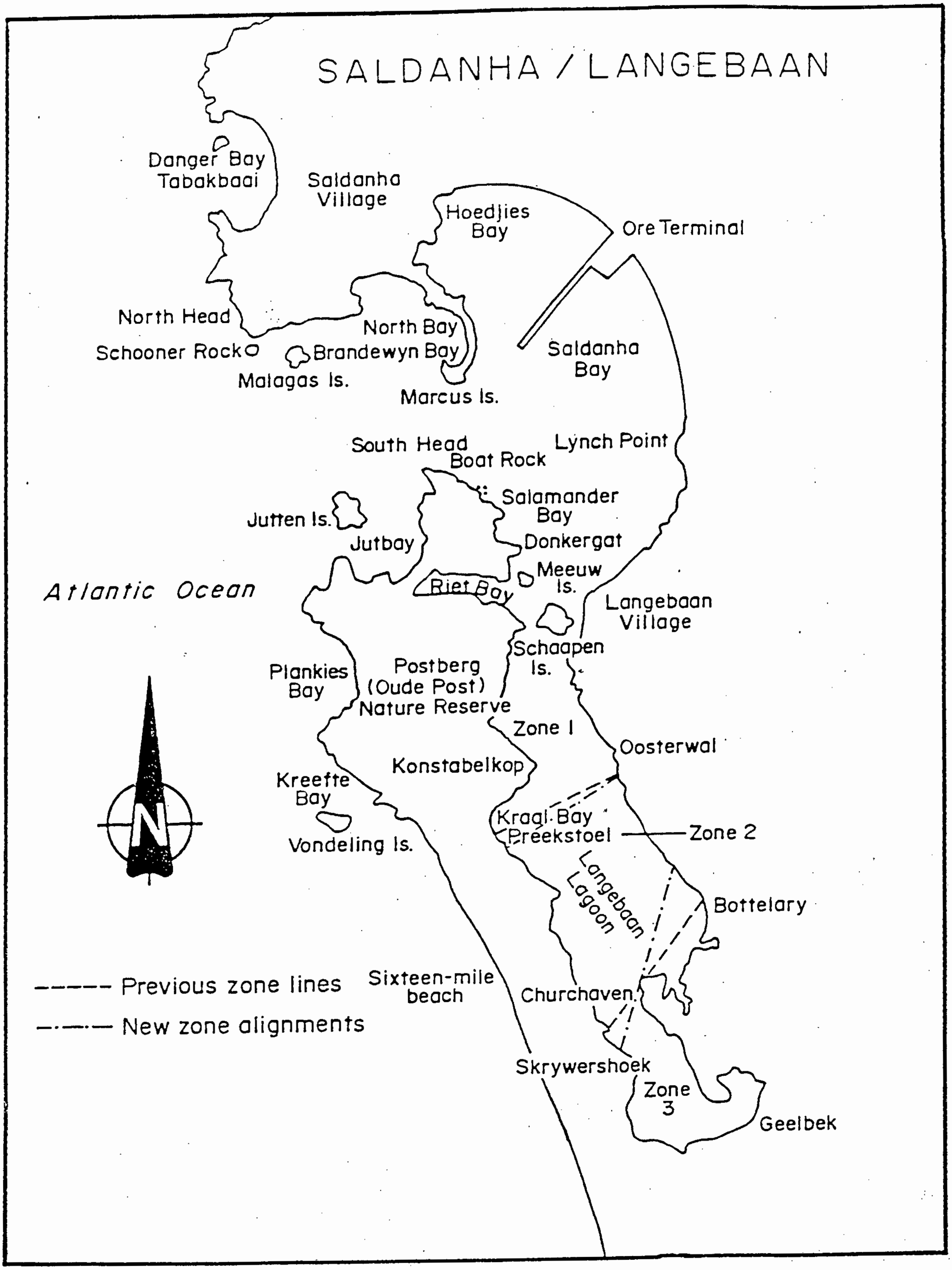


Figure 5.1 Geography of the study area.

CASE STUDY METHODS
STEP 1: RESOURCE INVENTORY

Boundaries of the study: setting the limits.

Boundary definition in any research project is important, but may be problematic (Beanlands and Duinker 1984). For spatial analyses a number of options for limiting the aerial extent of the research focus are available, such as natural boundaries (catchments, geological formations, ecological divisions), political-administrative, technical, logistical, cadastral or a combination of these (Beanlands and Duinker 1984; Rogers and Steinitz 1969).

Although the entire projected area of the Weskus Park extends well inland of the lagoon (an area of some 24 000 ha, refer Figure 1.2), there was a paucity of data, particularly on the important parameter of vegetation, available on lands to the interior (east) of the lagoon. Lack of this data might compromise the quality of the analysis (analyses are only as good as the weakest part of their data base (Rogers and Steinitz 1969)). Finally, the boundaries were limited to the north and south boundaries of the nature area/National Park and the east\west boundaries of Boucher and Jarman's (1977) study of the area's vegetation. Their study encompassed an area approximately 22 kms long and 10 kms wide, which included the Churchhaven peninsula and all the farms surrounding the lagoon to about 4 kms inland of the lagoon, at places approaching the west coast road.

This limitation is acceptable, because the lagoon will undoubtedly continue to be the focus for recreational activities in the area, while the study area includes all the land within visible range of the lagoon's shores. It is the carrying capacity of the lagoon and its immediate surroundings which is critical. Nevertheless, certain aspects of the analysis, namely the allocation of land suitable for primitive use zoning, could not be undertaken without taking cognisance of the likely incorporation, in the long term, of a much greater park area.

Data collection

During the course of 1985 and 1986 data on the biophysical and socio-economic environment of Langebaan were collected following Sowman's (1987, 1984) procedure for assessing the recreational carrying capacity of coastal resort towns, shown in Figure 5.2 overleaf. Data were collected as inputs to Sowman's procedure and to provide the data base for the application of land classification techniques; parameters selected thus reflect the requirements of the above two procedures, but are generally applicable to recreation planning. *[Step 1 continued on pages 134 and 136]*

5.2 RESOURCE INVENTORY: THE WESKUS PARK ENVIRONMENT

5.2.1 The Biophysical Environment

5.2.1.1 Physiography and Scenic resources

[The significance of natural attributes for planning, in terms of the procedure being illustrated here, **are highlighted in bold type** *in succeeding sub-sections.]*

The landscape in the vicinity of Langebaan lagoon is not very varied, comprising a low, flat to gently undulating, topography of sand covered plains, vegetated dunes, surface limestone ridges and some mobile dune fields (See Figure 5.5) which do not exceed about 100m elevation (Timmermann 1985). This undulating topography is composed of aeolian sands and, along the coastal margin, of marine deposits, all of geologically recent origin (Flemming 1977; Timmermann 1985). The sands are punctuated by outcrops of the Cape Granite suite which provide the only significant relief in the area. The most prominent features in the vicinity of Langebaan lagoon are the granite outcrops of Vlaeberg (193m) and Konstabelkop (189m) which lie at the northern end of the Churchhaven Peninsula. The summit of these hills offers superb vistas over the entire sub-region, from Saldanha and Paternoster in the north to Table Mountain 100 kms to the south. A lower range of granite outcrops, including the scenic Seeberg, forms the skyline and effective catchment boundary of the eastern side of the lagoon.

Early travellers described the region as barren and bleak (Axelson 1977; Wiley 1985). **The scenic resources lie in the contrast created by the juxtaposition of the blue waters of the lagoon and nearby Atlantic Ocean with the arid, dull topography, and in the expansive vistas offered from the granite hills. Outstanding scenic features in the area are the Postberg Nature Reserve area, Kraalbay, Donkergat Peninsula and Sixteen Mile Beach, which fronts the ocean on the western margin of the Churchhaven Peninsula.**

The generally low lying coastal topography makes this landscape sensitive to "visual intrusion" (Smardon 1988), the aesthetic impact resulting from insensitively located or scaled structures. (For example, a new house remains startingly visible in the landscape for a long time).

The lack of relief makes for easy hiking, but the paucity of landscape contrast once away from the lagoon is likely to detract from its appeal (other limiting factors for hiking are discussed under Climate and Vegetation).

STAGES	ACTIVITY	SOURCES OF DATA
1	Acquire information on bio-physical environment	Literature review, on-site surveys, aerial photographs, discussions with local people and ecologists, field checking
2	Acquire information on socio-economic environmental	Local authorities, questionnaire surveys, interviews, direct observations
3	Identify major recreational activities	Questionnaire surveys, direct observations
4	Ascertain current recreational pressure	Questionnaire surveys, local authority records, visitor records, literature review
5	Project resource demands	Questionnaire surveys, local authority statistics and plans; literature review
6	Determine space requirements per activity	Literature review, interview sportsmen and managers
	Physical constraints identified	
7	Assess ecological carrying capacity for each activity	Questionnaire surveys, literature review, consult ecologist, air-photo interpretation
	Ecological constraints identified	
8	Ascertain acceptable levels of crowding per activity	Questionnaire surveys, interviews
	Social constraints identified	
9	Determine optimum level of recreational use	Activity zoning, application of physical space standards

Figure 5.2: A procedure for assessing the recreational carrying capacity of coastal resort towns (after Sowman 1987).

5.2.1.2 Climate

The area falls into the winter rainfall region of the Cape Province (Fuggle 1981; Boucher and Jarman 1977). Long, hot, dry summers, with the highest monthly average maximum temperature in Februaruy of 21,0°C (Weather Bureau 1972), although temperatures of 40,4°C have been recorded at Cape Columbine, 3 kms northwest of Saldanha (Weather Bureau 1981). These extremes are moderated by the frequent occurrence of coastal fog, which occurs annually on an average of 1 in 3 days (Gasson, pers comm.). **The fog can bring about rapid changes in the weather which are potentially dangerous to inexperienced boat users.**

Winters are mild with an average daily temperature of 10,0°. The average minimum is 8,7°C (Fuggle 1981). Eighty percent of precipitation falls between April and September with annual rainfall rarely exceeding 300 mm and an average of 47 rain days per year. The annual average runoff in the Langebaan lagoon catchment is zero - soils are generally highly porous (Midgley and Pitman 1969). Evaporation rates are high during summer which, in combination with the low rainfall results in high water stress to plants in summer (Fuggle 1981).

Water resources have been a limiting factor for human settlement in the area. The low rainfall in combination with sandy, highly porous soils, make water mediated erosion an insignificant problem. **Although the hot summers and mild winters should make this area attractive for recreation all year round, in fact recreational use has been heavily concentrated in the summer and ends fairly abruptly after the Easter long weekend.**

Strong southerly and south-westerly winds predominate throughout the year, though northerly winds are frequent during winter (Timmerman 1985; Fuggle 1981). Typically high wind velocities in all months exceed the minimum required to cause sand erosion (5,4 m/sec) (Oberholzer and Van Papendorf 1986). **The low topography makes this environment susceptible to the unpleasant effects of strong winds, but the wind is a major attraction for boating and boardsailing. It creates, by contrast, potentially dangerous conditions for power boating. Strong winds and soil exposure (see Soils) make for a high wind erosion hazard throughout the region (Talbot 1947).**

Insolation is high with a yearly average of 7 hours of sunshine daily - this rises to 11 hours in summer and drops to 5 or 6 in winter. Summer conditions generally mean long, hot, dry and often windy days. **The implications for recreation, in combination with the natural lack of trees (see Vegetation), are that it is a harsh environment in the peak season with shade at a premium. People are thus unlikely, during the peak visitor season, to stray far from water or pursue vigorous activities away from the water.**

Since research in the natural sciences had been extensive in the Saldanha Bay and Langebaan lagoon area, existing literature, mapped information and discussions with informed scientists formed the basis of data gathering on biophysical parameters. Details of the data sources are provided in Appendix C1.

Data on the geology, soils and vegetation of the Langebaan area were mapped at a scale of 1:50 000 on transparent sheets (Overlays 1, 2 and 3, Appendix F). Information on land use, infrastructure and the visible impacts of such uses was likewise mapped (Overlay 4, Appendix F), as were sites of biotic and conservation significance (Overlay 5, Appendix F). This scale was chosen for convenience, since much of the information available was at this scale, including topocadastral maps.

[*Case Study Methods: Socio-economic factors** picks up on page 146, opposite the inventory description on this subject]

5.2.1.3 Hydrology

Surface water resources are scarce, though several farms in the area were named after springs found on them. Oostewal, on the eastern shores of the lagoon, has become an important historical resource by virtue of the large spring there which until into the 1930's provided water for virtually the entire district. **The old dammed spring is now a haven for birds with great potential for bird hides.** There is evidence of fresh water seepage along much of the south-eastern verge of the lagoon which creates conditions necessary for the growth of large beds of *Phragmites australe*. This large reed in turn provides breeding sites for a variety of bird species, thereby contributing to the importance of the farm Geelbek, at the southern end of the lagoon, in terms of the bird populations it supports.

This seepage may be linked to the proximity of a large, recently explored acquifer, the Elandsfontein acquifer, which underlies land to the southeast of the lagoon (Timmermann 1985). Its point of closest approach to the lagoon is to the east of Geelbek; in the absence of surface drainage, this may be the source of fresh water seepage into the lagoon. This extensive acquifer is the source of many of the springs in the area (Timmermann, pers comm).

Groundwater resources on the Churchhaven peninsula are poor. There is a well at Bossieskraal (Stofbergsfontein), but the water quality is sub-standard. Borehole water at Abrahamskraal, just south of the lagoon, had total dissolved solids of 900 mg/l, while the South African Bureau of Standards limit for potable water is 500 mg/l (Oberholtzer and van Papendorf 1986). Timmermann (pers comm) reports that there is a shallow fresh water table which is underlain by saline water (because of the proximity of the sea to the lagoon here). At Abrahamskraal the water table lies at 5,5 m (Oberholtzer and van Papendorf 1986).

On the Churchhaven peninsula the fresh water segment would, Timmermann predicts, be rapidly depleted by abstraction. The peninsula is thus likely to continue to have a shortage of potable water.

5.2.1.4 Geology and Soils

Parent materials are recent sands, granites and Malmesbury shales. The Darling granites which dominate relief are roughly 500 million years old. Calcrete sheets of Pleistocene origin and sands of Quaternary coastal/marine origin occupy the intervening low-lying areas. Along the coastal margin, unconsolidated Holocene dune sands occur (Flemming 1977; Visser and Schoch 1973) (Overlay 1, Appendix F). These sands are underlain by metasediments of the Malmesbury group (Timmermann 1985), which appear on the surface at small, isolated sites at sea level on the Donkergat Peninsula and near Langebaan town.

Several different granites occur in the area, providing resources for interpretation: exposures of Saldanha quartz porphyry occur on Donkergat peninsula and Postberg Nature Reserve, while Hoedjiespunt and Darling granite domes overlook Langebaan town.

Steep screes of Langebaan limestone back the shoreline at Preekstoel (part of Kraalbay), Churchhaven and Schrywershoek, making access at these points undesirable because of the fragility of the limestone (vulnerable to mechanical damage). Surface exposures of limestone occur elsewhere on the Churchhaven peninsula making for thin soils and possibly drainage problems (Schlomms pers comm).

On granite outcrops soils are thin and stony, making them susceptible to erosion. These soils also have a higher clay content which exacerbates their erosion potential. The steeper slopes on the granite hills are considered sensitive to development, because of problems in stabilising grades and the likelihood of slumping. Isolated patches of duplex soils of the Kroonstad Form may be undesirable for building (Schlomms, pers comm). The more nutrient-rich granitic soils are also those which have traditionally been cultivated, so that much of the Postberg Nature Reserve, Mooimaak and Bottelary (2 farms on the east side of the lagoon) now bear highly disturbed plant communities on old fallow lands in these areas.

Generally, fine to medium grained sandy soils with no more than 0,3 percent clay predominate. They have a low water retention capacity, low natural fertility and are well drained except where calcrete or limestone are present close to the surface. Deep, regic, calcareous sands of the Fernwood (Motopi series on unconsolidated coastal dunes; Langebaan series inland) and Villafontes forms alternate with shallow Mispah form (Kalkbank series) sands on limestones. To the interior, the acid sands (Constantia, Fernwood, La Motte forms) of the Sandveld come in, but these lie just to the east of the project boundary (Overlay 2, Appendix F). Soils are named according to the South African Binomial Soil Classification.

All soils are nutrient poor, have a low agricultural potential and when vegetal cover is removed they are susceptible to wind erosion (Oberholzer and Van Papendorf 1986; Schlomms pers comm).

5.2.1.5 Vegetation

The vegetation around Langebaan lagoon has been described in detail by Boucher and Jarman (1977) - their map of plant communities is reproduced in Appendix F, Overlay 3. Boucher has subsequently compared the vegetation of the Langebaan area, sampled in several transects, with transects conducted 40 km down the coast at Buck Bay. However, the methods used were different, so that the community types described are somewhat different. Since it is more comprehensive, the original Langebaan vegetation survey has therefore been adhered to. The vegetation at a community level will be described in detail in relation to land systems and land types in section 5.4.

There is a close correlation between substrate type and vegetation community type, so that the area comprises a mosaic of plant communities associated with the three substrate types, granite, surface limestone and deep, calcareous sands. The exception is along the immediate coastal (oceanic) margin where the marine saline influence dominates over substrate type (Boucher pers comm).

The general vegetation type is West Coast Strandveld (Acocks 1975; confirmed by Boucher and Jarman (1977)), which falls into the mediterranean-type shrublands found on more fertile soils in the Capensis region of the Cape Floral Kingdom (Taylor 1978). Coastal Fynbos is confined to the acid sands of the interior. West Coast Strandveld is usually referred to as a broad-leaved sclerophyllous scrub, but it is in fact very variable (Boucher 1983). Certainly mature communities are dominated by a fairly continuous canopy of sclerophyllous, nanophyllous to mircrophyllous, highly branched shrubs 1.0 to 2.5 m tall. Typical species are *Chrysanthemoides incana, Colpoon compressum, Euclea racemosa, Olea exasperata*and *Pterocelastrus tricuspidata*. Also common are deciduous, succulent-leaved shrubs *Othonna floribunda* and *Zygophyllum morgsana*. A layer of chamaephytes generally form a lower dwarf shrub stratum: *Ehrharta calycina, E. villosa, Limonium Perigrinum, Ruschia caroli, Tetragonia fruticosa* and *T. spicata* are typical. Spaces inbetween the bush clumps and shrubs support perennial grasses, a large number of deciduous-leaved geophytes and annuals (Boucher 1983). These annuals, especially in areas where the shrub layers have been removed, provide startling displays of colour in the spring.

This vegetation lacks a true tree component. Theories relate this to the aridity of the area and extensive human influence for at least the past 2000 years. Khoisan pastoralists moved into the area some 2000 years ago and used extensive burning to improve grazing for their herds (Axelson 1977; Fuggle 1977; Klein 1974). European settlers arrived 300 years ago and indiscriminately continued the same practices even more intensely. The impacts of European settlement are today very obvious (Overlays 3 and 5, Appendix F). The conclusion has been drawn that Cape western coastal vegetation is the product of disturbance which took the form of short interval fire regimes, overgrazing and collection of wood for fires (Boucher 1983:672).

Granitic soils in the Postberg Nature Reserve and Donkergat peninsula bear more succulent-leafed bushes and more grasses (Moll 1985), possibly because of the greater soil fertility. Of special interest are the remnants of Afro-montane forest (Moll 1985) which grow around the bases of large granite outcrops in sites protected from the north wind. These forest remnants on the Churchhaven peninsula represent the northernmost distribution point of the Hottentot cherry, *Maurocenia frangularia*, and the Cape tree, *Philippia chamissonis* (Moll 1985). Also confined to the rock outcrops is a low (15-35cm), sparse succulent and bulbous flora which is unique and contains a number of endemic species (Boucher and Jarman 1977). **These granite outcrops should thus have a high priority rating for conservation. The low succulent and bulbous flora will be vulnerable to damage by trampling** (this is already in evidence at picnic sites on Konstabelkop in Postberg).

Granitic soils in the area have also been extensively cleared and cultivated. These cleared areas, where they have gone fallow, bear spectacular displays of annuals in the spring. **Postberg Nature Reserve has thus become famous for its spring flowers, drawing thousands of visitors over spring weekends.** It also has a varied game population which will no doubt help to keep the disturbed areas 'disturbed'; they are also an attraction to visitors.

Limestones bear small, tough, evergreen broadleafed dense scrub up to 1,5m tall (Moll 1985). Limestone areas have, according to Moll (1985), been patch-burned for centuries, and Boucher and Jarman (1977) state that they are frequently heavily trampled, so that their vegetation is considerably disturbed.

The variability of the vegetation is especially evident in the calcareous dunes which comprise the major portion of the landscape. Dune communities grade from a sparse, prostrate succulent community on unstable dunes along the oceanic margin, through a dwarf shrub community to closed canopy scrub up to 3 m tall on inland, consolidated dunes. Old, calcareous sand dunes bear drought-deciduous shrubs, often spinescent, and they have a conspicuous restiose element, the 2m tall Cape reed, *Willdenovia incurvata* (previously *W. striata*), and *Thamnochortus spp*. On the eastern side of the lagoon the restiose element may become even more prominent as the vegetation grades into Coastal Fynbos.

Coastal dune fields are very susceptible to wind erosion following mechanical disturbance eg ORV tracks. The inland dune communities can be dense and spiky, making walking difficult and at times painful. Direct impacts will fall on the forbs, grasses and annuals of the interspaces, but certainly the annuals will recover readily. Mature scrub, once cleared, will not grow back (Boucher pers comm)[3], so clearance should be kept to a minimum.

All these communities lack a tree component, making this a very shadeless environment. Long hikes may thus require artificially created shade.

The vegetation, except in the spring, also does not have a great visual appeal. As Brian Lello, longtime visitor to the lagoon has said (Lello pers comm.), the value of the place lies in "nature at your toecaps", in an understanding of the intricate ecological relationships in this diverse environment. **In a park, the stress might thus be laid on the provision of interpretive services which would encourage visitors to get out and experience nature at close quarters, detractions of shadelessness, etc. notwithstanding.**

The most undisturbed stands of Strandveld occur on the Churchhaven peninsula, which has been identified as a high priority for conservation (Boucher and Jarman 1977).

5.2.1.6 Physical characteristics of Langebaan lagoon

Langebaan lagoon is not an estuary or lagoon at all: it is a deep coastal embayment which, because of its shallowness and wave-protected waters, displays estuarine characteristics (Day 1959). The lagoon is some 13 km long from Schaapen Island, which divides the "mouth" of the lagoon into two deep channels, to the salt marshes at Geelbek at its southern end. It has a tidal range of 1,7 m at the mouth and 1,4 m at Geelbek (Day 1959); Shannon and Stander (1977) observed a 1,5 m tidal range. Circulation is current controlled, and ebb tide dominated. Surface current speeds in the northern outlet channels reach 1,30 m/s, but are reduced to a maximum of 0,85 m/s off Churchhaven (Flemming 1977). During the ebb tide boardsailors and paddleskiers may be swept into Saldanha Bay, particularly if the current is enhanced by a strong southerly wind (Ferreira pers comm). Swimming off Langebaan beach may therefore be hazardous. Salinities and temperature increase in summer towards

3 This is evident in the Postberg Nature Reserve where large expanses of veld have been fallow since 1969, but the shrub component has not grown back, especially under fairly heavy grazing by game. (*Veld* is a South African word which means the natural vegetation of an area).

the southern end of the lagoon, because only about half the water in the lagoon is exchanged at each tidal cycle through the entrance channels (Shannon and Stander 1977).

The lagoon can be divided into four physiographic units: tidal channels, subtidal flats and submerged sandbanks, intertidal flats and salt marshes. The channel system of the lagoon is a stable feature controlled by the location of fossil oyster beds which developed during the Flandrian transgression, when sea levels were 3 to 4 m higher than today (Flemming 1977). The deepest waters are in the northern tidal channels on both sides of Schaapen Island. A tongue of deep water sweeps up the western side into Kraalbay, separated from the Langebaan channel by intertidal sandflats. Bait collection occurs on this northern, central bank. From Kraalbay south there is one main central channel and the lagoon becomes rapidly shallower. The expanse of intertidal mudflats, particularly on the eastern side of the lagoon, increases. Off the farm Bottelary, for instance, the water may recede over 1 km at low tide (Summers 1977). Intertidal flats along the western shores are much smaller, although the 30 m recession at Kraalbay restricts activities such as waterskiing to high tide. This east/west distinction is related to the distribution of sediments in the lagoon: the eastern half is dominated by fine sediments, while the western half consists of medium sands. There are biotic correlations with these sedimentary patterns which will be discussed in section 5.2.1.7.

The shallowness of the lagoon renders much of it hazardous and impractical for boating except at high tide. The northern section of the lagoon between the northern National Park boundary and a line drawn from Oostewal to Preekstoel (Figure 5.1), which is zoned for all forms of boating (see discussion of lagoon zonation below in 5.2.1.7), comprises a total of 1544,1 ha to the High Water Mark. Of this, 887,1 ha has a depth of 2 m or less. With a tidal range of 1,5-1,7 m, this means that at least 50% of the lagoon's available area is off-limits to boating at low tide, since 2 m minimum is required for keelboat sailing (Melck pers comm), and 1,5 m for powerboating (Fraquet pers comm). The extent of possible penetration into the lagoon by these craft is naturally limited: most powerboats and yachts would not reach Churchhaven at low tide, according to Mr Visser, Sea Fisheries Inspector at Langebaan. Although sailing is allowed south of Kraalbay, few boats go there. High tides present different problems: Kraalbay beach at spring high tides is reduced to a strip 1 m wide at the most along the base of the dune.

5.2.1.7 Marine resources and wading birds

Langebaan lagoon is a world famous haven for migrant wading bird species and other waterbirds, a fact related to the diversity of coastal habitats incorporated in the small area of Saldanha Bay/Langebaan lagoon (Hockey 1985:14). There are also a number of other wetlands and estuaries up the arid south-western Cape coast which support palaeoarctic wader and resident avifaunal populations. There is evidence to suggest that seasonal intra-regional migration occurs so that the birds optimize the opportunities provided by this range of systems. Langebaan lagoon, as the largest and most productive of these systems, is crucial to longterm conservation in the region.

The habitats found within Saldanha Bay/Langebaan lagoon range from salt marshes and tall reedbeds to open sandflats and mudflats, rocky shores and long, wave-pounded sandy beaches. The 6000 ha lagoon has 1750 ha of intertidal sand- and mud-flats (Day 1959) which provide rich summer feeding grounds for over 30 000 waders (Charadrii) of 23 species (Underhill 1987). Summers (1977) listed 24 species, of which 15 are long-distance migrants which breed in the northern hemisphere, and 9 are resident or short-distance migrants within southern Africa. Other important groups are the cormorants (Phalacrocoracidae), gulls (Laridae) and terns (Sternidae) (Summers 1977). A list of birds frequenting the lagoon is provided as Appendix E1. Species which breed in the vicinity of the lagoon and which are listed in the South African Red Data Book on Birds (Brooke 1984) are the Chestnutbanded Plover (*Charadrius pallidus*), Caspian Tern (*Hydroprogne caspia*) and Damara Tern (*Sterna balaenarum*).

Of all South African estuaries, the lagoon's biological productivity is second only to that of the Knysna lagoon on the southern Cape coast.. In the 600ha of salt marsh which lie at the top of the tidal range (Puttick 1977), there are 6 distinct halophytic communities (Boucher and Jarman 1977) which are favoured by waders as high tide roosting sites. At the intertidal level, beds of *Zostera capensis* and *Spartina capensis*, and *Gracilaria verrucosa* communities (a benthic algae which was harvested in vast quantities until the late 1970's) contribute to the lagoon's high productivity. However, benthic diatoms appear to be the chief 'powerhouse' of the system (Fielding, Damstra and Branch 1988). The waders are an integral part of the system, turning over 150 tons of sand- and mudprawns, snails and worms, and returning 20 tons of nutrients to the system annually (Hockey 1985).

Two-thirds of these seasonal visitors are curlew sandpipers, but knots, turnstones, greenshanks, several species of plover, avocets, stilts, stints, sandpipers, bar-tailed godwits, whimbrels, terns, sanderlings, oyster-catchers and curlews are common. These are only a fraction of the species found here. Flamingo, pelican and gulls frequent the shallow lagoon waters too, as do many other species (*Scientific names are listed in Appendix E1*).

The most productive feeding grounds (fine-grained sediments) and most suitable breeding areas occur in the south-eastern part of the lagoon along the boundaries of Bottelary and Geelbek farms, so that these are the most strictly protected areas on the lagoon. There is one important feeding area in the northern part of the lagoon, namely a large intertidal flat off Oosteval farm.

The lagoon's sand- and mudflats support a seemingly inexhaustible supply of prawns (*Callianassa kraussi*, *Upogebia africana* and *U. capensis*), bloodworm (*Arenicola loveni*) and white mussels (*Mactra lilacea*). However, bloodworm numbers have declined in sandbanks where there has been heavy exploitation by bait collectors (Pringle pers comm). Recent research on the impacts of bait collection and the associated trampling on sand and mud prawn stocks (*Callianassa kraussi* and *Upogebia africana* respectively) in Langebaan lagoon, indicate that there is a longterm decline in stocks where collection is sustained perennially, but that recovery would be probable with a minimum rest period of 3 years. Current bait collection levels of some 12 000 people annually are having localised effects, but the size of the resource in the lagoon as a whole means that the system is not yet threatened (Wynberg 1991; Wynberg, Glassom, Harris & Pringle 1990).

The lagoon also supports considerable fish populations, though the fishing is not particularly good (Christie & Moldan 1977). Nevertheless, it remains a popular sport angling venue, with annual competitions taking place. A survey started in 1975 identified 29 species of fish in the lagoon. Cartilaginous fish dominate the larger species, and of these the sand shark, *Rhinobatis blochii* is the most prevalent. Sand sharks are found throughout the lagoon and may reach densities of 1 per 4 m^2 in the island inlets near the bottom of the lagoon. Females favour shallow water and are frequently seen in clear water of less than 0,5 m over the lagoon's sandflats, where they may startle wading people. The spotted gully shark *Mustelus nigropunctatus*, frequents the deeper channels at the entrance to the lagoon near Langebaan town; the skate *Raia clavata*, and stings rays *Dasyatis pastinacus*and *Myliobatis cervus* also occur in the lagoon.

The remnants of a once flourishing fishery in the lagoon now comprise 22 permit holders, who may fish using nets (but not gill nets) in the lagoon. Their major harvest is haarder (*Liza ramada*, a species of mullet), but steentjies, elf, white and Cape stumpnose, kob, Hottentot, Cape salmon (=geelbek), garrick (=leervis) and galjoen[4] are caught too. Concern over the decline in fish stocks is reflected in articles in the local newspapers - a concern shared with the rest of the South African coast - but the evidence is ambivalent. While no quantitative analyses have been done on changes due to exploitation or changes in patterns of exploitation, some records are available. In 1974 nearly 600 000 fish were netted in the lagoon. Some suggest that there is no sign of depletion of fish stocks in the lagoon. When interviewed in 1986, the longest operating local commercial fisherman, Mr Vincent Ferreira of Langebaan, was adamant that fish stocks in the lagoon had improved due to effective protection offered by the permit system and the division of the lagoon into 3 zones (see Figure.5.1). Only the northernmost zone is open for sport angling (Ferreira pers comm.).

The distribution of biotically important areas of the lagoon are mapped on Overlay 5, Appendix F. On the basis of this map, natural scientists recommended the division of the lagoon into 3 zones. Regulations to this effect were promulgated under the Sea-shore Act (No. 21 1935) by the Division of Sea Fisheries in 1979.

---

4 Respectively: *Spondyliosoma emarginatum, Pomatomus saltatrix, Rhabdosargus globiceps, Rhabdosargus holubi, Argyrosomus hololepidotus, Pachymetopon blochii, Atractoscion aequidens, Lichia amia, Coracinus capensis;*

They have been instrumental in severely curtailing use of, and therefore the impacts of use on the lagoon. The southernmost zone (Zone 3, Figure 5.1) includes the most productive intertidal flats and salt marshes where waterbirds concentrate to feed, roost and breed (Summers 1977). Until very recently[5], no recreational activities were allowed in this zone. The middle zone (Zone 2) off Churchhaven permits sailing and fishing by permit holders. All recreational water-based activities are permitted in the northernmost zone (Zone 1) which includes Langebaan town and Kraalbay[6], but which excludes most of the Oostewal sandflat. Some two-thirds of the lagoon's surface area is thus protected from the most severe human impacts.

Saldanha Bay, although not in the study area has some resources which must be mentioned. The bay's rocky shores are home to a popular delicacy, the Cape rock lobster (*Jasus lalandii*), but the bay is a marine reserve. The rock lobster may, however, be taken from the oceanic shores of the Churchhaven peninsula: Kreeftebay is a popular locality for this activity.

In addition, several islands (Jutten, Malgas, Marcus and Schaapen) dotted about in Saldanha Bay are famous for their breeding colonies of seabirds, particularly Cape gannet (*Morus capensis*), several species of cormorant and jackass penguins (*Spheniscus demursus*). Eleven percent of the world population of African black oystercatchers (*Haematopus moquini*) are known to inhabit this area and breed on the islands; black-backed or kelp gulls (*Larus dominicanus*) and swift terns (*Sterna bergii*) also breed here.

These islands are a potential tourist resource, but breeding colonies of birds are likely to be sensitive to disturbance by human approach. Breeding kelp gulls were found to suffer egg loss through predation when parents left the nest on the approach of people (Hockey and Hallinan 1981). These authors found the breeding behaviour of jackass penguin to be particularly sensitive to human approach. They suggested on the basis of their observations that small numbers of people should not approach the edge of colonies to closer than 30 m.

5.2.1.8 Fauna

It is generally difficult to incorporate data on fauna into planning because of animal mobility, and sparse knowledge of individual species habits. Terrestrial vertebrate fauna is of relatively minor significance at Langebaan, because there remains little naturally occurring game in the Langebaan area. All the large mammals have been eliminated since the advent of European settlement (David 1981). What remains is largely classified as 'small mammals'. David (1981) states in describing the fauna of the Cape coastal lowlands, that it is generally poorly known and endemism is limited; in other words, there are few species whose conservation is critical. Little

5 The National Parks Board plans to allow guided nature trails, including canoe trails, in this area.

information specific to Langebaan exists. The greatest variety is amongst the rodents, but several species of small antelope (grysbok , steenbok, grey duiker and grey rhebok[7]), cats (African wild, caracal[8]), large-spotted genet, mongoose (small grey and yellow), striped polecat[9], hares (Cape and scrub), rock dassies, porcupines, bat-eared fox and black-backed jackal[10] are found throughout the area.

Postberg Nature Reserve bears the greatest concentration of game in the area, much of it re-introduced. In addition to the above, it carries considerable herds of eland, kudu, gemsbok, blue and black wildebeest, Burchell's zebra, bontebok, springbok and mountain reedbuck[11]. (Source: Postberg Nature Reserve permit form). **These herds, seen most frequently in the old fallow lands which also support the spectacular displays of annuals, are an important tourist resource.** The reserve is also renowned for the large numbers of bat-eared foxes found there.

Access on foot in the game area should be strictly controlled in order not to disturb game. Some species, particularly eland (and ostrich) are potentially hazardous to hikers.

Reptiles are well-represented in the area, with 2 species of tortoise, 17 species of lizard occurring and 16 species of snake probably occurring there. Two species of lizard found on the granite outcrops are considered rare (Mouton, unpublished data: species list given in Appendix E2). **Recreational visitors are unlikely to be a problem with respect to reptiles.**

5.2.1.9 Regional Conservation Perspectives

Langebaan lagoon is one, but the most valuable one, of a strip of coastal wetlands on the Cape West coast. Evidence indicates that this series of wetlands acts in concert with the open coast to support an enormous population of palaeartic and resident waders, a system in which each wetland plays a part, since the birds migrate during the season intra-regionally to feed and breed (Ryan *et al* 1987; Cooper, Summers and Pringle 1976).

The conservation of Langebaan lagoon must thus be seen as the kingpin of a strategy of regional wetland conservation.

---

6 Kraalbay is the least important area of the lagoon as regards waterbirds (Hockey pers comm).

7 Respectively: *Raphicerus melanotis, Raphiceris campestris, Sylvicapra grimmia, Pelea capreolus;*

8 *Felis lybica, Felis caracal;*

9 Respectively: *Genetta tigrina, Galerella purverulenta, Cynictis penicillata, Ictonyx striatus,*

10 Respectively, hares to jackal: *Lepus capensis, Lepus saxatilis, Procavia capensis, Hystrix africaeaustralis, Otocyon megalotis, Canis mesomelas;*

11 Respectively: *Taurotragus oryx, Tragelaphus strepsiceros, Oryx gazella, Connochaetes taurinus, Connochaetes gnou, Equus burchelli, Damaliscus dorcas dorcas, Antidorcas marsupialis, Redunca fulvorufula;*

Although falling outside the actual study area, the Saldanha Bay bird islands are an integral element in the ecological web of the area: they are an acknowledged priority for conservation.

The vegetation of the Churchhaven peninsula is of equally important regional conservation status. As part of one of the largest, most undisturbed stretches of the West Coast Strandveld Veld Type, it is a priority for conservation because only 12,4% of the remaining extent of this veld type has formal conservation status. The veld type now covers a fraction of its original distributional range, depleted by the depredations of farming and urban development (Jarman 1984). There are few nature reserves in the sub-region, they are all small and many are privately owned.

The Weskus National Park is thus of national and regional strategic importance to conservation. Its unique complex of habitats, rich marine resources and vegetation types, make it one of the gems of the national park network in South Africa.

STEP 1: CASE STUDY METHODS (CONTINUED)

Socio-economic factors

Regional concerns

Information on regional factors which might affect the development of the Weskus National Park were gleaned from unpublished government reports, the literature and interviews. Sources of socio-demographic data are described in Appendix C1.

Recreation participation and user preferences at Langebaan lagoon

Two different types of data were required to assess the existing recreational situation at the lagoon and users' preferences regarding the anticipated National Park. The first data set comprised descriptive, enumerative data, a census of user participation in different activities, the distribution and seasonal timing of use, recreation pressure at peak holiday times, socio-demographic profile of users, etc. The second data set concerned the less concrete parameters of attitudes[1] *to present conditions and facilities, and preferences for future recreational opportunities.*

[Section continued on page 148, 150 and 152]

1 Attitudes are "a person's ideas, convictions, or liking with respect to a specific object or idea" (Churchill 1983); in market research parlance they are synonymous with opinions.

5.2.2 The Socio-economic Environment

5.2.2.1 Regional Infrastructure

The sub-region under scrutiny here comprises the Cape metropolitan region, the Swartland Division and the coast as far as Saldanha (Figure 1.1, page 5).

Comfortable and rapid access to this part of the west coast is afforded by the west coast road, R27, which has since its completion to Velddrif in 1979, played a major role in the development of the entire sub-region and in the growing popularity of coastal towns such as Langebaan as destinations for recreationists from the Cape Town metropolitan area.

Tarred roads connect Yzerfontein, a mere 5 kms from R27, Darling, Langebaan, Saldanha and Vredenburg to this road. A gravel road runs north from the Darling - Yzerfontein road towards the lagoon, at the southern end of which it splits, one branch running along the Churchhaven peninsula, the other continuing along the east shore of the lagoon to Langebaan town. There are no other public roads in the study area, but farms are criss-crossed by gravel tracks, some of which pass through sensitive areas such as the mobile dune fields behind Sixteen Mile beach. Most of these tracks are impassable to anything other than four-wheel drive vehicles and tractors.

All municipalities in the area are supplied with ESKOM[12] power, as are some of the farms, but there is no power on the Churchhaven peninsula except at Donkergat (military base). A 60 km pipeline from the Voelvlei dam supplies Saldanha-Vredenburg and Langebaan with water. A small branch from Saldanha supplies the Donkergat military base and a supply from this point has been taken to the Postberg Nature Reserve manager's house on the Vlaeberg. But to the south of this on the Churchhaven peninsula there is no reticulated potable water supply. In the hamlets on the peninsula rainwater tanks are supplemented by brackish water from boreholes and wells.

Saldanha has an extensive, deep harbour which is home to a commercial fishing fleet, but Langebaan and Yzerfontein are equipped only with launching ramps for small boats. Langebaan has two slipways, one for larger boats at the yacht club and another off the southern end of the main Langebaan public beach. All slipways are now under considerable pressure, especially that at Yzerfontein which is dangerous in heavy weather and is used by large numbers of small commercial and semi-commercial fishermen. Saldanha and Langebaan both have yacht clubs; the Langebaan Yacht Club has 60 moorings in the deep channel on the southern boundary of the town. The 40 additional moorings which have been available at

---

12 ESKOM is the parastatal electrical utility supply company which generates and maintains a national electricity grid.

Collection of both types of data, enumerative and relational, were combined by using public opinion surveys at peak holiday times. While there are many informal and formal techniques available for researching the perceptions and preferences of the public, survey techniques are necessary in order to obtain statistically manipulable data pertaining to a large population.

Administration of questionnaire surveys

Two surveys were conducted at different times at Langebaan lagoon. During the initial phase of the research in 1985 when Kraalbay, which had little infrastructural development, was the focus of the study, a survey of visitors to Kraalbay beach was undertaken over the Easter weekend. Kraalbay was the only site on the lagoon outside of Langebaan town to which there was public access; Easter is the busiest weekend of the summer season apart from Christmas-New Year. The second survey was conducted chiefly at Langebaan town's beaches on peak holidays, Boxing Day (26/12/85) and New Year's Day (1/1/86), the following summer. A small sample was also administered at Kraalbay for comparison, since it was postulated the two sites were so different that they would attract different visitor types.

Copies of the two questionnaires - called the Kraalbay '85 and Langebaan '86 surveys - are included in Appendix C2. Response rates in the two surveys differed markedly, possibly due to the method of administration. The Kraalbay questionnaire was personally distributed by the author to every ***group*** *on the beach (entire survey population surveyed), then collected later in the day. The Langebaan questionnaire was distributed by officials of the National Parks Board, and the randomly selected, individual respondents returned them via boxes placed at exit points from the beach. The Kraalbay '85 response rate was 78.6 percent (sample of 103 questionnaires) which is considered good (Babbie 1973). The Langebaan '86 survey was just adequate at a 43% response rate (sample size of 86) obtained on one survey day; results of the New Year's Day were ignored because of the low response rate.*

At Kraalbay the entire population of beachgoers, yacht and houseboat residents present over three days was surveyed, following Sowman's (1984) approach. The questionnaire was targeted at the group as the recreational social unit, as prior observations at the beach corroborated suggestions made in the literature (O'Leary et al *1982). The saturation survey technique therefore provided absolute numeric data. Because of the large estimated population at Langebaan town in the peak holiday season which included a significant proportion of day visitors, a similar saturation survey was logistically and financially impossible. A random survey of individual beachgoers was therefore selected, so that the resulting enumerative data are statistical in nature. At Langebaan the beach was divided into zones for questionnaire distribution: from the Yacht Club to the Navy base, the main beach, and Linkjiesklip beach which is adjacent to the black campground.*

Kraalbay on the lagoon are now under the control of the Parks Board. Spokesmen for the yachting fraternity maintain there is considerable demand for more moorings in this area, partly because the Cape peninsula yacht basins are all beyond capacity and partly as stopover points on coastal cruises. Countrywide and on the West coast, a need for more small boat harbours has been identified (Zwamborn 1978). The local need has been partially filled by the development of a sizeable marina at Club Mykonos, a private holiday resort between the towns of Langebaan and Saldanha and some 8 km from Langebaan.

Langebaan is adequately supplied with retail shops for essential supplies and banking facilities. There are several cafes, restaurants and a hotel (90 beds). Although most of the town consists of holiday homes, there is a small resident population (population is discussed in section 5.2.2.2). Public accommodation have increased by 400 percent in the last few years because of increasing demand and now comprises several municipal resorts which include 34 chalets, 28 mobile homes, 236 caravan/camping sites (for whites) and 98 caravan/camping sites for blacks in a separate resort. Facilities for different race groups were strictly segregated, but have been de-segregated within the last two years. In-season occupancy rates at all public resorts are reported to be practically 100 percent, but drop to 15% for whites and to 1% at black facilities during the off-season (Mr Brand, Langebaan Town Clerk, pers comm).

Saldanha is larger and more sophisticated. Yzerfontein, although it has almost as many homes as Langebaan, has few permanent residents and only two or three shops, a camping ground, privately owned; and holiday homes. It does not in the past appear to have attracted many transient vacationers and recreationists.

Public access to the seashore proper (that is, not the lagoon) is afforded at only 4 places outside the urban/semi-urban areas in the region's 70 km stretch of coast between Saldanha and Cape Town, namely, at Kreeftebay on the Churchhaven peninsula, at Yzerfontein, at Grotto Bay several kilometres north of Bokpunt, and at Silverstroomstrand just south of Bokpunt. Public access to Langebaan lagoon is only at Kraalbay and Langebaan town.

5.2.2.2 Regional Economy

The region's economy is based largely on two enterprises, farming and fishing, with transport (Saldanha iron ore loading terminal), industry and mining (phosphates occur in large deposits in the Sandveld with extensive mining in the Langebaanweg area) playing a lesser role. Plans for industrial expansion in the Saldanha area (S.A. Department of Planning and the Environment 1975) have not materialised to any large extent. Saldanha is the centre of the local fishing industry: two fish processing factories operate there. Most commercial fishing occurs in the waters of the cold Benguela current outside of Saldanha Bay, especially since the banning of seine and "treknet" fishing in the bay and lagoon. However, 22 fishermen operate by permit in the lagoon, most of them based at Langebaan and Churchhaven.

Questionnaire design and analysis

Questionnaire were designed according to well established principles (eg. Churchill 1983; Bailey 1978; Babbie 1973; Oppenheim 1966; Goode and Hatt 1952), but as Churchill (1983:211) has said, designing questionnaires is still an art, not a science. Several actual examples of questionnaires used in recreational surveys were obtained and contributed to questionnaire design (Sowman 1984; Drake 1982; Butler-adam 1980; Kaplan 1980; Hugo undated). Closed format questions were used for the most part, although the Langebaan '86 questionnaire included several open-ended questions as a cross-check.

Questionnaire data were entered on the Sperry Univac 1100 mainframe computer and analysed using the BMDP-2D statistical package. BMDP-3D was used to compare two groups (eg., Kraalbay and Langebaan) by side-by-side histograms. But statistical comparison of small samples of non-parametric data had to be performed using the BMDP-3S module, which computes the Mann-Whitney U-test. This test is suitable for comparing two non-parametric groups which may have very different sizes; it is particularly suitable for small sample sizes (Hammond and McCullagh 1974; Conover 1971).

Direct observations

Survey data were at all times supplemented by direct observations. The Easter '85 survey at Kraalbay included recording twice daily, at 11.00 hours and 16.00 hours, the number of people present in different sectors of the area and engaged in different activities. Because Kraalbay was a day visitor area, with many users coming from the Cape Town metropolitan area 1,5 hours' drive away, it was found that the majority of people did not arrive at the beach until 10 or 11 in the morning, and most left in the late afternoon.

At Langebaan during the Christmas 85/New Year 86 period, manpower to make daily, systematic observations was not available. Following Ashton and Chubb's (1972) method, oblique aerial photography was used to provide details of visitor numbers, distribution and activities. An aerial survey of the lagoon area was flown at 11.00 hours and 15.00 hours on each of the two survey days. Unstructured observations were made during a number of visits to the lagoon at different seasons of the year, so that a comprehensive picture of the recreational milieu *of the lagoon was built up. In addition, interviews were conducted with leaders of sporting clubs and with knowledgeable local residents.*

by permit in the lagoon, most of them based at Langebaan and Churchhaven.The coastal strip which comprises the proposed park area is not of major importance to farming, because of the inherently low potential for agriculture of this zone (S.A. Department of Agriculture, Winter Rainfall Region 1985). The sandy soils are nutrient deficient, the climate too dry to support most dry land cultivation, although wheat is cultivated in scattered patches. Most of these farms are owned by farmers who have properties in the more fertile lands of the Swartland proper and keep their coastal farms for grazing supplements during the cultivation season. The Postberg Nature Reserve was originally owned by 3 Franschhoek farmers who moved stock there every winter to graze, a practice which continues on many other farms in the district. The Reserve is no longer used for farming, having been declared a private Nature Reserve in 1969, although a flock of sheep were grazed there until recently. Although the value of the land for agriculture is low, farming activities in marginal areas have wrought significant changes in the vegetation. On the other hand many local farmers have done much to conserve their veld.

Nationally this sub-region is of minor economic importance, its contribution to the national domestic product has been steadily falling, and it has had a poor record of growth in job opportunities. In recent years, however, recreation has played an increasing part in the area's economy. In Langebaan especially it is a major factor: in an analysis of Saldanha Bay's economy Henderson, Jackson and Lipschitz (1990) found that 30% of the annual turnover of the one large supermarket in Langebaan occurred in December and January, the peak holiday period. Langebaan and Saldanha Bay are at present the major recreational attractions in the sub-region probably because of their well developed facilities. Public accommodation between Melkbosstrand (just north of Cape Town - see Figure 1.1) and Langebaan is almost non-existent; between Saldanha and St Helena Bay 7 small, privately owned chalet resorts or campgrounds have been developed, and this stretch of coast is popular for informal camping in the summer. Recreation and tourism, in an area of low economic performance, have the potential for sustainable development in the region.

5.2.2.3 Regional population and recreation demand

Sub-regional population statistics are shown on Figure 1.1, page 5. Langebaan has a resident population of between 400 and 500 whites and over 2000 "coloured" persons; Churchhaven is home to 22, mostly elderly people. It can be seen from the projected population statistics that the population of the Swartland Division is growing at half the rate of the Cape metropolitan area (1,32 percent versus 2,6 percent per annum), which is probably considerably lower than that envisaged when

Langebaan town: census estimation

Since outdoor recreational participation is fundamentally linked to weather conditions, there are inherent limitations in relying, for census data, on a sample obtained on one or two days of a peak holiday season. Indeed, the counts obtained on New Year's Day, normally the busiest day of the year according to Langebaan municipal officials, were low, possibly because the weather was windy and unpleasant. Therefore indirect methods of estimating peak recreation pressure at the lagoon had to be employed. A random survey of fifty white households in the town was conducted to establish a peak season household average: this was found to be 9,6 persons per household. (Sowman (1984, 1986) had established a summer holiday average of 6,9 persons per household in two southern Cape resort towns). This standard was applied to the 506 houses in the town.

There has been a general failure in South Africa by authorities at all levels to keep track of "non-white" population numbers, and to assess trends in their participation in leisure activities. Consequently, occupancy figures from all public accommodation in the town were added, and calculations of day visitor numbers were made from the proportion of survey respondents who were day visitors. Public accommodation in the town consisted of a total of 224 caravan sites for whites and 80 sites for "non-whites" (the two groups displayed different occupancy rates and numbers of people per site), 50 Plettenburg bungalows (mobile homes), 36 municipal bungalows, 15 "Boere" bungalows (privately owned cottages along the beach), and a 90-bed hotel (Table 5.1). Estimates of the likely growth in demand were made from projections of increases in the number of holiday accommodation units, and the annual growth rate in real estate sales in the town. In 1985/86 several large township extensions were planned. The municipality was selling 150 erven, and two private developers planned developments of 121 units (Owen Wiggins) and 1021 units (Myburgh Park) respectively. The latter development has recently (1991) been halted by a court order, but there is no reason to believe that development of similar dimensions will not take place within the next 20 years (Table 5.2).

the Saldanha industrial development was planned. Certainly Saldanha-Vredenburg, which was projected to reach an urban population of 1 000 000 by the year 2010 has fallen drastically short of the mark. Nevertheless, the growth of metropolitan Cape Town, combined with improving economic circumstances for many of its inhabitants is likely to put ever increasing pressure on the West coast from leisure seekers. Ninety percent of recreationists on this coast are resident in the South-western Cape. Taljaard (1984) has made some projections of recreation pressure on the West coast - shown on Figure I.1, page 5 (Cape Provincial Department of Local Government 1988). By the year 2000, the West coast hinterland will play host to 221 500 day visitors, 897 800 weekend visitors and 976 100 holiday-makers (long summer holidays). These figures will rise respectively to approximately 242 000, 106 000 and 1 200 000 within a decade to the year 2010. They are alarming when viewed against the existing number of resorts and accommodation units in the region - it is going to be hard pressed to come anywhere close to meeting this demand. In 1990 there were estimated to be 6500 beds available in the whole of Saldanha Bay including Langebaan and Club Mykonos (Henderson, Jackson and Lipschitz 1990), by far the largest accommodation centres on the entire West coast.

5.2.3 Langebaan lagoon: recreation destination

Langebaan, as the most popular resort in the area, is likely to be subject to heavy pressure. 1985/86 peak season population estimates and projections of future growth at Langebaan, presented in Tables 5.1 and 5.2 respectively, below , give an indication of the problem. Langebaan's summer holiday population in the 85-86 season, including day visitors, amounted to some 10 000 people at any one time. Of these, 12,8% were permanent residents, up to 20% were day visitors, and the remainder were seasonal holiday-makers. Extensions planned for the town over the next 20 years, which will make more accommodation available, could push the total figure to over 30 000.

This does not, of course, include Club Mykonos whose projected 1500 resident visitors are likely to utilize the National Park's resources at times. Since Langebaan and Club Mykonos lie on the border of the Weskus National Park the question must be asked what impact this will have on the park. And in the light of figures given in the recent report by the Cape Provincial Department of Local Government (1988) of the number of erven available and the number built on in townships on the west coast, the necessity for more subdivision and residentialdevelopment in the near future in this region is questionable. For Langebaan the figures are 250 developed erven and 1 200 existing sub-divisions; Saldanha has 616 developed to 1500 available. What the Local Government report does identify is a serious shortage of public holiday accommodation, especially moderately priced accommodation. This, however, is true for most of the South African coast where, traditionally, second homes have been the order of the day.

It should be clear by now that the Weskus National Park occupies a key point in terms of the region's recreational resources. The demand on it is likely to be such that relatively large numbers of people will have to be accommodated, possibly more than conservation managers would like to see. However, the regional analysis shows

Also not included in these figures are the additional visitors to Kraalbay. Counts and estimates on New Year's Day for 3 consecutive years showed a slow decline in visitor numbers: in 1984 Mr P Haumann of the Postberg Syndicate estimated that there were some 8000 people on the beach, but using a conservative calculation (777 cars @ 4 persons/car), one could confidently put this at a more realistic 3 108 people; this dropped to 2 600 in 1985 (Brink and Marais 1985, direct count), and to 1 600 on New Year's Day 1986 (aerial photo count - author). Although by this time the National Parks Board had assumed control of the area and was discouraging busloads from picnicking at Kraalbay, survey responses suggested that crowding was a strongly perceived problem at the beach, so that people had started avoiding peak holidays. (The social carrying capacity of the beach may have been exceeded). There were approximately 3 km of shoreline available for use, but the beach is extremely narrow, being a maximum of 17 m wide at the jetty and narrowing to 3-4 m in the vicinity of Preekstoel (See Map 1, Appendix D).

Private ownership and lack of devlopment around the rest of the lagoon ensures that there are unlikely to be more than 200 or 300 people elsewhere on the lagoon's shores at any one time. This includes the fishing hamlets of Stofbergsfontein and Churchhaven, and the Postberg Nature Reserve. With a total lagoon shoreline length of some 60 km, dispersion of recreational use could be accommodated, were it not for the necessity to protect waterbird feeding and breeding areas from disturbance.

TABLE 5.1: Potential peak season recreational population at Langebaan town, as at Christmas season 1985/86.

506 white households @ 9,6 persons/house	4858
resident black population (Municipal figure)	1100
Caravan parks: 224 sites @ 5 persons/site (assume 100% occupancy)	1120
80 sites @ 8 persons/site (black caravan park)	640
Rented bungalows: 86 @ 5 persons/unit	430
"Boere"bungalows: 15 @ 7 persons/unit	105
Hotel: 90 beds	90
Day visitors: 20% of total (85/86 survey result, assuming beachgoer ratio residents:day visitors holds for town as whole	1669
TOTAL:	**10 012**

TABLE 5.2: Projected future holiday population of Langebaan town.

Low Projected Estimate (LPE):	
(a) 85/86 total + 271 additional erven @ 9,6 persons (Municipal = 150; Owen Wiggins = 121)	12 614
(b) 20 year projection: As above, but assume 5% increase/ann in residential development (Cape Province Dept. of Local Government statistics), total visitor and resident black population for next 20 years	25 226
High Projected Estimate (HPE):	
(a) 20 year projection: = LPE + full development of scale of Myburgh Park (1021 units @ 9,6 persons)	22 416
(b) As above, but adding 5% growth only in visitors and resident black population over 20 years	32 724

5.2.3.1 Recreational user characteristics, Langebaan lagoon

The material presented here is a synopsis of the results of the public opinion surveys conducted at Kraalbay over the Easter weekend 1985, and at Langebaan town at Christmas 1985/86.

People who recreated at Langebaan lagoon in 1985/86 tended to be white, affluent, well educated, active, fairly young and present in family or multiple family groups[13]. Kraalbay in particular attracted a complement of young people, 82% of respondents there at Easter '85 being younger than 40 years (modal age was 19-40 years). The modal age at Langebaan was slightly older at 35-55 years, presumably because many Langebaan visitors are homeowners in the town, while a majority of Kraalbay's users are day visitors from Cape Town: 61,2% had come for the day from the Cape metropolitan area. In total 85,4% gave Cape Town as their home town - this included some of the 13,6% who had come across from Langebaan for the day. Another 11,7% arrived from the West coast (defined as the town of Darling and everything north of it on the coastal foreland to Lamberts Bay - see Figure 1.1).

In the Langebaan '86 survey only 2.9% of respondents came from places beyond the South-Western Cape. In addition, 45% of Langebaan visitors were spending a long holiday (longer than 10 days), and 21% were spending a short holiday at the lagoon. This suggests that Langebaan is primarily a regional recreational or holiday destination rather than a tourism destination, although publicity about the national park could change that. [Certainly the area is on the tourist routes during the spring flower season, when hundreds of carloads drive through the Postberg Nature Reserve to see the displays of annuals.]

A significant proportion (39,6%) of Kraalbay visitors at Easter were black, and their recreational patterns and preferences were different. While whites at Kraalbay spent the day with small family groups (average 6,3 persons per group), blacks arrived by minibus or bus, so that group size averaged 16,5 persons. The sharing of transport was regarded as a cost-saving device. Observations at Kraalbay by Brink and Marais (1985) showed that on-water sports, involving waterborne craft, were the almost exclusive preserve of whites. Their counts of beach visitors, and my own observations, showed that white visitor numbers were at a maximum on Saturdays and just before major public holidays, while blacks occupied Kraalbay on Sundays and major public holidays such as New Year and Easter Monday.

---

13 Since then dramatic political changes in South Africa have resulted in the desegregation of all facilities and deregulation of property ownership, so that a vastly increased range of leisure opportunities are now available to so-called non-whites. The impact that this has had on Langebaan is not known, since field work for this study was concluded in 1986. I would speculate that the proportion of black day visitors to the area would have increased, but in early 1990 it looked much the same as it had in 1985 and 1986 (pers. obs.). The residential component is likely to remain heavily dominated by whites, due to persistent racial prejudice (most properties in Langebaan town are still owned by whites) and expense.

Comments by whites related this to the habit of blacks to arrive in large groups rather than being a matter of racial prejudice. Blacks accounted for only 10,5% of Langebaan '86 respondents, because at that time the main beach at Langebaan was for whites only, whereas no such restriction had ever been imposed at Kraalbay. Kraalbay thus played host to two major recreational groups: one prepared to accept a greater degree of crowding, the other preferring the peace and tranquil beauty of uncrowded days (see Attitudes and Preferences, 5.2.2.3).

The recreational population is well educated. Both at Kraalbay and at Langebaan over 20% of respondents had at least a Bachelors degree, while another 40% had some sort of tertiary education (diplomas or technical). Since nationally the proportion of graduates amongst people over 25 years old is 2,3% (South African National Census 1985), we are dealing here with a very small sub-stratum of society. The occupations listed corroborated the information on education. "Professionals" accounted for 20,45 of Kraalbay and 22,1% of Langebaan respondents, and an additional 25% of both samples were self-employed or worked "in commerce". The 20,4% in trades were mostly blacks. Farmers accounted for 7,4% of the Langebaan '86 survey: this reflects the local tradition of farmers of the West coast interior having holiday homes at Langebaan.

Taylor (1984) in a major survey in the Cape Metropolitan area of white recreational patterns and preferences, found the use of coastal areas to be overwhelmingly high compared with any other recreational *milieu* in the South-West Cape. The importance of coastal areas was confirmed in this study (Question 2(i), Langebaan '86): 30% of whites at Langebaan visit coastal areas regularly and another 30% do so frequently, and pay multiple visits to the lagoon annually. Black respondents, however, tended to visit Langebaan for a single annual holiday, although day visitors to Kraalbay visited several times. Also interesting was the relatively recent rise in popularity of Kraalbay. While 51% of Langebaan visitors had been acquainted with the lagoon since before 1975 and a further 20% put their first visit between 1975 and 1979, 70% of Kraalbay respondents made their first visit between 1980 and 1985; 10% were on their first visit at the time of the survey. Langebaan visitors have thus been long acquainted with the lagoon, and are likely to know it well and to love it.

Several sub-groups amongst recreational users of Langebaan lagoon are thus apparent. The recreational population is dominated by white, well educated, affluent white collar workers and their families, who have had a long association with the lagoon, know it well and love it. Amongst these, Afrikaans and English-speakers may form sub-groups with slightly different preferences[14]. However, the

---

14 An interesting distinction between the Langebaan and Kraalbay recreational populations is the dominance of Afrikaans-speaking whites at Langebaan (52,2%), while Kraalbay attracted more English-speaking whites (62,1%). In the Western Cape attitudes of farmers to environmental conservation have been shown to be correlated with home language, as a surrogate for cultural differences, with English-speakers being more conservation aware than Afrikaners (McDowell 1988). The preference of English speakers for an undeveloped beach over a resort town beach might be related to their greater environmental awareness.

other group which must be catered for is the less affluent blacks, whose preferences will be shown to be different from those of the majority of white visitors to the lagoon.

5.2.3.2 Patterns of recreational use of Langebaan lagoon

Recreational use of the lagoon is restricted both spatially and temporally. The spatial division of the lagoon which restricts recreational boating in large measure to the northernmost section of National Park waters, has been described. In combination with the restriction of public access to the lagoon's shores at Langebaan town and Kraalbay, this means that activity is centered between these two sites. This analysis therefore ignores the southern two-thirds of the lagoon.

The major difference between Kraalbay and Langebaan, of course, is that Kraalbay, with the exception of the yachts and houseboats moored there, is for day use only. In addition to two small carparks, the only facilities provided are pit toilets and rubbish bins. A jetty is used to moor small powerboats used by yacht owners, but there is no public launching of powerboats at Kraalbay. Langebaan, by contrast, has all the amenities and facilities of a resort town. Although it is a popular destination for day visits, day visitors account for no more than 20% of the recreational population in the town.

Use of the lagoon is strongly seasonal. The Town Clerk of Langebaan, Mr Brand, defined the summer season as being from 15 December to 15 January, with a lesser peak over the Easter weekend. My surveys revealed that 70% of Kraalbay visitors did not visit the beach at all during the winter, but this trend was less pronounced amongst Langebaan homeowners/renters. Of this group 40-44% reported visiting during spring, autumn and winter, but the frequency of visits or length of stay dropped sharply. The spring flower season, however, draws thousands of people to the Postberg Nature Reserve. Visitors are confined to their cars except at three designated picnic and viewing points. The only hiking which occurs in the vicinity of the lagoon, except that by property owners and along beaches, is small group trails allowed in Postberg during the spring.

The extreme seasonality of use is important in ameliorating impacts on the lagoon system. Peak use occurs in the hot, dry season when vegetation is likely to be heat and water stressed (Fuggle 1981), therefore vulnerable to physical damage. But use levels are low during two-thirds of the year including the rainy season, so that the system is able to recover from some impacts sustained during the short periods of intense stress. In addition, any limitations placed on use levels in order to maintain environmental quality standards may have to be imposed only for short periods of the year.

Activity patterns and peak recreation pressure are strongly correlated with diurnal tidal fluctuations and the weather, particularly wind. The strong southerly wind is a major drawcard to the lagoon for sailing enthusiasts. Sowman and Fuggle (1987) in an excellent and detailed analysis of recreation patterns on the Kromme River estuary, South Cape coast, found optimal board and dinghy sailing conditions to be when windspeeds were between 15 and 25 knots and the tide was high. Observations at Langebaan suggest that the lower end of the range is preferred. The aerial survey of the lagoon on 26/12/85, when a 19 knot southerly wind was blowing, showed fewer people on the beach or active in the water on all types of craft than on New Year's Day 1/1/86, when a 14 knot wind was recorded. The protection of the lagoon from oceanic swells (Day 1959), and the presence of areas in the lee of steep slopes where the water surface is sheltered from the wind, are the reason for this being the most suitable coastal location for waterskiing in the South-western Cape (Fraquet pers. comm.). The influence of tidal levels on the surface area available for boating has been discussed in 5.2.1.6.

As stated before all summer activities are centered on the lagoon. Particpation rates in recreation activities at Langebaan town and at Kraalbay are shown as histograms in Figure 5.3 overleaf. Quite clearly, littoral[15]activities are pursued by almost everyone, ie., relaxing, sunbathing, picnicking and *braaiing* (a South African term for barbeque). At Kraalbay 95% sunbathed and braaied. The lower proportion of respondents at Langebaan who pursued these activities on the beach (61,7% and 60,5% respectively) is probably attributable to the high proportion of Langebaan beachgoers who were staying at a house/caravan site/etc. and who would undertake these activities at home rather than on the beach. Picnicking did not rate so highly possibly because respondents saw it as synonymous with braaiing.

The other most popular activities were walking on the beaches and swimming, the latter being less common at Langebaan than at Kraalbay. This is evidently because water temperatures at Langebaan are colder and because of the danger from motorboats which pass at speed up and down the deep channel off the Langebaan beach. People had said informally that swimming was not an important activity at Langebaan because of the accompanying dangers, but this survey showed clearly that it is ubiquitous.

By contrast, fewer people participate in on-water activities[16], although fishing (50%; almost entirely off boats at Langebaan)) and boardsailing (41%) remain very popular amongst Langebaan respondents. Kraalbay is less suitable for these activities, so participation is correspondingly lower: 15% for fishing and about 27% for boardsailing. Protection from the southerly wind by the high dune which backs the southern side of Kraalbay makes the bay generally very calm, hence highly suitable for moorings, waterskiing, rowing and paddling, but less so for boardsailing;. There is wide agreement that the mechanically powered watersports create most disturbance to other types of users, consume the most space and are

15 *Littoral* activities are pursued on land close to water where the focus is the water (Jaakson 1970)

16 *on-water* activities are described by Jaakson (1970) as occurring in the water body, but with some sort of craft intervening between the user's body and the water, such as boardsailing, waterskiing, powerboating, etc.

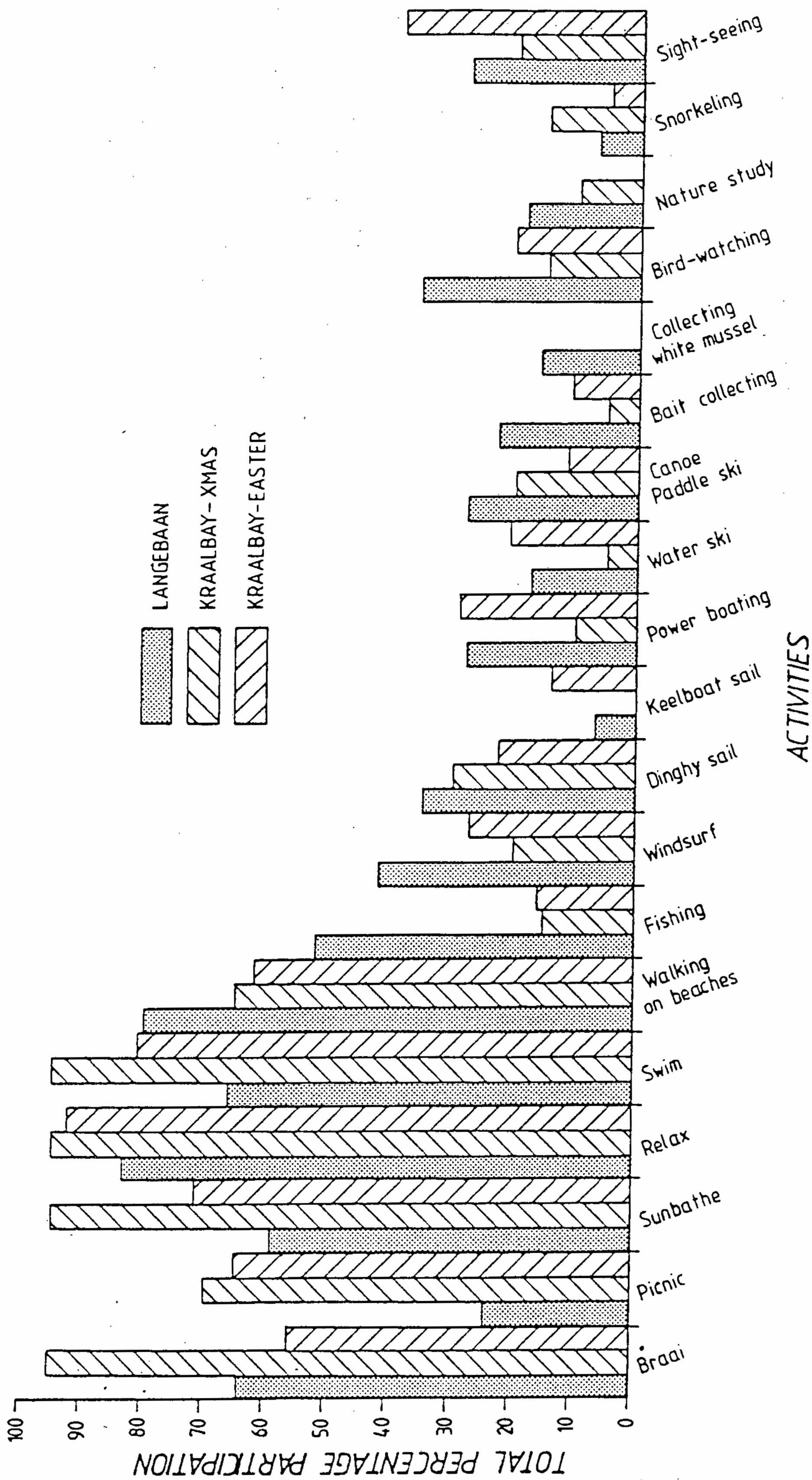


Figure 5.3: User participation in recreational activities at Langebaan lagoon

themselves most "invulnerable" to interference from other users (Jaakson 1970). This was a feature of the Langebaan area, particularly as reported by Kraalbay respondents. It is therefore interesting to note that a relatively small proportion of the total recreation population at the lagoon participate in these aggressive activities: the average of both survey sites was 18,9% and 13,7% for powerboating and waterskiing, respectively.

Dinghy sailing (30% average) and canoe or paddleski paddling (25% average) are pursued almost equally at Langebaan and Kraalbay. Keelboat sailing is obviously confined to those who have moorings at Langebaan or Kraalbay: these amounted to a total of about 100 moorings on the lagoon. Dinghy sailing occurs at high tide throughout Zone 1 and into Saldanha Bay, while keelboats stick to the main channels. A popular round trip is to sail between Langebaan and Kraalbay. Powerboats tend to follow the direction of the deep channels, ie., parallel to the Langebaan shoreline, while boardsailors traverse the channel between the beach and Schaapen Island. At peak season there may be conflict between powerboats and boardsailors. In Kraalbay conflicts have arisen between waterskiers doing a circuit of the bay, boardsailors and swimmers. The implications of these data and others for existing boating densities and the physical carrying capacity of the lagoon for water activities, are discussed at length in Appendix D.

Of interest to a National Park are activities associated with appreciation or interpretation of the natural resources of the area. Only 15% of Kraalbay respondents recorded birdwatching as an activity, but this figure was double at Langebaan (30,9%). This difference may be attributed to the dirth of wading birds at Kraalbay, while the main Langebaan beach is an important overnight roost (Summers 1977). "Nature study" was listed by 10% of Kraalbay respondents, and by 19% at Langebaan. This level of interest in nature and, in an area renowned for its waterbirds, in birds specifically, is not encouraging. While the National Parks Board have emphasised the potential of the park for environmental interpretation (see Step 4, Set Management Objectives and Park Character), the people who use the area see it as a place in which to relax and pursue a variety of watersports; for the majority, birdwatching and nature study are at best incidental; at worst, users are indifferent to or unaware of these natural treasures.

5.2.3.3 User preferences and attitudes

What Langebaan lagoon meant to current visitors, why they liked it, what they perceived to be problems there, perceptions of and attitudes to crowding, and their preferences for future facilities at the lagoon were explored in the questionnaires.

In the Langebaan '86 questionnaire an attempt was made to distinguish between factors generally influencing recreationists' choice of venue for a holiday (Qu 3), and what brought them specifically to Langebaan (Qu 4(i). It was found that the general choice factors were rated in order of descending importance as follows:

water surfaces available, scenic beauty, distance from home, suitability for children, silence/peaceful atmosphere, contrast from normal environment, low admission fee or lack of such fees, and popularity of resort. Clearly, money is not a major concern, and the moderate importance of distance from home is more likely to be linked to convenience and accessibility than to expense. Besides the availability of water surfaces, scenic beauty, the suitability for children, and a peaceful atmosphere are also important. Of little concern is the contrast from one's normal environment, and the popularity of the resort.

These trends continue through the attitudes towards Langebaan itself. Responses to question 4(i), an open-ended question, were grouped into major factor categories to make the data more manageable. Hence each major category listed below in Table 5.3 includes a number of sub-categories, details of which will be discussed in the text where interesting trends are apparent.

Table 5.3: Ranking of factors affecting general choice of a holiday venue, compared with factors determining choice of Langabaan specifically.

PERCENTAGE RESPONSE PER REASON	R1	R2	R3	R4
FACTOR				
OPPORTUNITIES FOR WATER SPORTS	29.4	26.2	22.0	13.9
EXPERIENTIAL OPPORTUNITIES[1]	10.6	6.5	13.9	9.0
CONVENIENCE(DISTANCE FROM HOME)	9.8	9.0	6.5	4.9
FAMILY RELATED FACTORS[2]	13.1	4.0	3.2	4.9
SOCIAL FACTORS[3]	3.3	6.5	4.8	7.4
FACILITIES/LEVEL OF DEVELOPMENT[4]	11.4	25.4	18.8	8.9
NATURE/UNSPOILT NATURAL BEAUTY	2.4	9.8	4.1	5.7

1 *Experiential opportunities* include peace and quiet, opportunity for solitude, "getting away from it all", and a "relaxing atmosphere".

2 *Family related factors* include having properties in Langebaan, long-standing holiday location and/or family involvement.

3 *Social factors*: friendly people present, relaxed social atmosphere, opportunities to meet people, orderly behaviour of people, have friends at Langebaan.

4 *Facilities/level of development*: this relates to aspects of facility provision or management and includes, good management and clean beaches, adequate and convenient facilities, good accommodation, facilities for watersports (slipways, moorings), facilities to ensure safety of children, and "uncommercial character".

Both generally and in their reasons for choosing Langebaan, survey respondents rated opportunities for watersports top[17] of the list. Fully 29,4% listed this as their most important reason, 26,2% rated it second, and 22,0% listed it as their third reason for coming to Langebaan. No other reason was scored as frequently nor as highly. Of the sub-categories, the safety of the lagoon for watersports consistently got the greatest response, while the availability of good fishing and of good conditions for sailing/boardsailing were the next most cited reasons for coming to Langebaan. The safety of the area was again singled out as something which recreationists especially liked about the particular site at which they received the questionnaire (Qu4(ii)), but the suitability for watersports scored highest amongst respondents on Langebaan's beaches. At Kraalbay, the safety for swimming and the aesthetic appeal rated highest in features especially favoured.

Beyond watersports, the next most important reason for visiting Langebaan is the level of facility development there. Clearly, people like the convenience of modern amenities, but the "uncommercial character" of the town is a corollary of that preference. This became clear where respondents were asked what improvements they thought abosolutely necessary and which would be desirable (Qu 9, Langebaan '86). Few identified any desired improvements beyond those they thought necessary, and of the latter, only basic amenities attracted more than a single figure percentage response. Of basic amenities (day use facilities), a single item, more and cleaner toilets, drew by far the largest vote at 34,4%. A full 18,9% stated that no improvements were required. All the suggestions for improvements related to improving the amenity of existing facilities, or to additional day use facilities, but no one at Langebaan suggested more elaborate resort-type facilities.

The response of Kraalbay '85 visitors to similar questions was even more pronounced. In question 18 they were asked to rate the importance they attached to a list of suggested improvements or developments at Kraalbay, including some "wild cards" like hotels, golf courses and water slides. Again, the majority was strongly in favour of improving simple day use amenities at the beach, such as water taps, flush toilets, rubbish bins, braai places (for barbeque fires), and increased parking, but most resort-type developments were strongly rejected. Intermediate facilities, such as a shop or cafe drew a divided vote (40,0% for; 50,6% against), and a rest camp or houses for rent drew only slightly more No than Yes votes (27,7% Yes, 47,1% No for a rest camp; 38,8% Yes, 42,3% No for houses to rent). However, whereabouts at the lagoon they might favour such accommodation was not probed. Even a tarred road to Kraalbay drew a divided reaction: 37,6% in favour, and 32,9% against.

Question 19 probed the experiential qualities Kraalbay visitors sought at the beach, by asking them to rate from Very Important to Very Unimportant the contribution of a number of possible reasons for their choosing Kraalbay. Those qualities which

17 This is perhaps tautological: presumably someone who was disinterested in water and watersports would not choose Langebaan as a holiday venue, although there are other things to do there.

drew the greatest response as Very Important are listed in descending order as follows: unspoilt natural beauty (80%); getting away from it all (72,5%); safe swimming for children (71,3%); lack of regulations and control (66,3%); peace and quiet (65,0%); and the presence of water for watersports (63,8%). Other clues to their preferences come from the Langebaan '86 survey in which respondents were asked to position themselves on a drawing of a beach with varying user density (Qu 8). The densest part of the beach was defined as having groups of 4-6 people spaced 2 m apart. While Langebaan respondents were evenly divided between those preferring a medium-dense site (39,7%) or a sparsely populated site (38,2%), the Kraalbay respondents, although a small sample (20 people), showed a strong preference (60%) for the sparsely occupied section of the hypothetical beach.

Clearly, visitors to Kraalbay liked its undeveloped character and, besides a few additional amenities to improve the convenience and comfort of day use, there was poor support for further development there. Further regulation was also not favoured: 3 Kraalbay respondents were in favour of zoning, as opposed to 13 against, in response to question 7, Langebaan '86 survey. At Langebaan town, more people voted in favour of zoning than against.

Langebaan respondents were also, however, wary of further regulation and control. Although 48 said yes to zoning, 28 of them did so for reasons of safety, while only 10 were concerned about protection of the natural resources of the lagoon. 38% were against zoning, so that for the lagoon as a whole, ie., including Kraalbay, opinion was split 40%:43% for:against zoning. There were 19 (approx. 20%) respondents who commented that things were good enough as they stood and that there was no need to change traditions of use at the lagoon, unless it could be demonstrated that improvements would result.

Table 5.4: Rating of recreational experience by Langebaan lagoon visitors (Langebaan '86 survey).

RATING	LANGEBAAN %	KRAALBAY %
Excellent	30,3	15,0
Good	39,4	25,0
Average	13,6	16,4
Could-be-better	12,1	18,9
Awful	0.0	0.8

Recreationists at Langebaan were content with their experiences there. Although problems were experienced, their overall rating was positive. When asked to rate their experience at the lagoon on a qualitative scale, the results were as shown in

Table 5.4. The table shows that Kraalbay visitors were less satisfied, but this was a small sample. This may have been related to crowding: 40% of Kraalbay respondents thought the beach was crowded that day (although 60% thought it was acceptable), while only 13,2% of Langebaan respondents felt the Langebaan beach to be crowded. Most Langebaan users found conditions on the beaches, in the water and at the launching ramps to be acceptable. Kraalbay respondents were happy with the level of use of the water (89% found it acceptable), and only the beach there was perceived to be crowded by a significant number of people.

Problems reported by visitors to the lagoon tended to stress a few common complaints: inadequate or poorly kept public amenities, particularly parking and toilets respectively, were a general complaint (39-40% response), as was litter, especially at Kraalbay. Noise from motorboats and interference in other activities by motorboats were the only other significant complaints, although only one respondent suggested the banning of motorboats from the lagoon.

5.2.3.4 Conclusion

While there are a number of additional details available from analysis of the questionnaires, the purpose of this discussion has been to develop a broad picture of use patterns, user characteristics, attitudes and preferences. What has emerged is that Langebaan town and Kraalbay attract people with different preferences, and that there was a strong preference for keeping Kraalbay undeveloped, except for improving day visitor facilities. Langebaan town users prefer more modern amenities, like the social aspect of a resort experience, and are reasonably content with the product. They too, however, have an antipathy to change in the form of interference (increased regulation) and further development. A sense of the lagoon being ruined by overcrowding did not emerge from the survey results.

Use is centered around a wide variety of watersports for which the protected waters of the lagoon are well suited. The natural resources of the area are appreciated for their overall aesthetic, but detailed awareness of and interest in natural history is the preserve of a minority of recreational users. The preservation of unspoilt natural beauty remains, nevertheless, a widespread reference point.

5.2.4 Human Impacts on Langebaan lagoon

Some references have been made to human impacts on different components of the lagoon environment. This section is intended to review concerns regarding human impacts and the evidence corroborating or contradicting those concerns, leading to a conclusion on the state of the natural resources of the system. Recall that deciding on the *acceptability* of ecological impacts is a component of RCC, but that the quantification of impacts is rendered difficult because of the complexities of environmental responses, the dynamic nature of the environment, and the difficulties of isolating impacting factors in order to measure their effects precisely. This section makes a subjective assessment of the level and acceptability of human impacts on the lagoon environment as it was in 1985/86, in an attempt to distinguish between existing *impact* and *damage*, in accordance with Turner's (1988) definitions. For as Heberlain (1977) noted, demonstrable impacts may be trivial; we must distinguish between impacts which are impairing ecological processes and functions, and those that are "cosmetic". Nevertheless, "cosmetic" impacts cannot be dismissed, because they are part of people's image of a landscape, and it is widely accepted that people respond to their mental image of the environment, not to the environment itself (Sutcliffe 1981). This exercise will therefore establish a baseline against which environmental quality guidelines can be formulated.

Recreation impacts on the biophysical environment arise for the most part from non-harvesting, non-consumptive uses, with the exception of fishing, bait collecting and hunting. Impacts are therefore primarily physical, eg., trampling or sediment disturbance, while by-products of human activities, such as exhaust fumes from powerboats and pollution by sewage, may cause chemical changes, which in turn lead to biotic changes. In addition, fauna may be directly disturbed by human presence or noise. Avifauna appear to be particularly sensitive to such disturbance.

The zonation of the lagoon has confined intensive activity to the northern section, so that there is little evidence of impacts on the lagoon itself south of Preekstoel/Kraalbay, except in localised areas surrounding the settlements of Churchhaven and Stofbergsfontein. In addition, cattle had trampled small saltmarshes on this western shore. For the rest, only impacts associated with Kraalbay and Langebaan town will be further discussed.

5.2.4.1 Kraalbay

The accompanying matrix (Figure 5.4) summarises the interaction of recreational and associated activities, undertaken mostly in Kraalbay, and different components of the lagoon environment. A qualitative assessment of the relative magnitude of impacts was made and is represented by dots of three sizes. The meaning of the dots is as follows:

Smallest dot: "mild/low impact"; impact is unlikely to have significant effect on biotic communities; impact not extensive, usually confined to localised area or time; damage reversible; potential for damage exists, but has not yet been demonstrated;

Medium dot: "moderate impact"; localised impact may be considerable; numerical participation in activity quite high; impact probably not irreversible; degradation not yet unacceptable; impact has social significance; potential to generate conflict moderate.

	WATER	BEACH (above HWM)	MUD/SAND FLATS	SALTMARSH	DUNE-CLIFF (Preekstoel 2de stop)	LIMESTONE ROCKS/RIDGES	BACK-SHORE (Carpark-Shore Kraalbaai)	VEGETATION	BIRDS	HUMAN VISITORS	KEY Degree of Impact
FACILITIES (toilets rubbish bins carparks jetty)		bins → litter overflow ●	jetty — initial disruption •		toilets, clearing ground → sand blow-outs •	people walking up and down to toilets → paths → sand-slump •	insufficient toilets → people excreting in bushes ●	clearing for toilets → bush removal → • path creation ●		design + position → athetic impact ● → complaints of filth ●	• Mild/low ● Moderate ⊙ Severe
WALKING	turbidity increase in shallows •	compaction •	compaction • disruption of prawn burrows •	trampling vegetation ● animal kills • disturb birds ●	path proliferation → sand slips ⊙ → blow-outs ●	path proliferation ⊙ → erosion •	mechanical breakdown ● erosion ●	reduction in cover ⊙ loss of forbs ●	disturbs birds from feeding ●	narrow beach → walkers impact on Picnickers •	
BRAAIING	ash washing into water → organic pollution •					blackening of rocks ● removal of rocks for fire places ●		bush cutting for firewood ● fire hazard •		fire ash → nuisance ● → athetic impacts ●	
SUNBATHING		compaction •									
PICNICKING	littering → organic pollution • → solid wastes ●	littering ●	smothering burrows • (litter)	litter clearing space at base for picnicking	litter ● clearing space at base for picnicking ●	people drawing → defacement of rocks by engraving ●	litter ●		attract gulls •	litter → athetic impacts ⊙	
SWIMMING	bottom disturbance → turbidity ●		low tide walking to swim — disturbance •								
POWERBOAT -PLEASURE CRUISING	propellor → turbulence → turbidity • → fish disturbed •	wash → erosion at shoreline → • compaction where pulled up •	when shallow sediment and burrows disturbance; anchors — disruption ●	plants damaged by propellors ● anchors damaging ●				propellors cutting sea-weed •	noise rapid dispersal disturbance ●	noise → loss of ● peace and loss of 'primitive atmosphere, danger to swimmers ●	
WATERSKIING	as above	as above	as above	as above					as above ●	as above + clashes with windsurfers ●	
WINDSURFING / DINGHY / HOBI-SAILING		compaction • dragging → disturbance •	dragging → damage to burrows ●	dragging and trampling → damage ●	dragging down → sand slips ●			when carrying to beach → damage •	disturbance ●	conflict with powerboats ● 'consume' beach space ●	
KEELBOAT SAILING	release wastes → organic pollution ○ provide substrate for organisms		anchors/ moorings → damage to benthos ●	anchors/ moorings → destruction Zostera •				interference from floating algae •	disturbance ●	loss of primitive atmosphere ● occupy potential space for other uses ●	
PADDLESKIING / CANOEING	disturbance of fish •	pulling up → sand disturbance •	shallow water paddling → sediment disturbed ○ dragging distur. •	low tide possible damage to plants •				paddles possibly catching in seaweeds, Zostera beds •	disturbance •		
FISHING	loss of lines → fouling craft ○ removal fish ●	tangled lines → litter • dragging nets benthic disturbance ○ offal → pollution ○							offal attracts birds → possibly develop dependence •	competition for fish • crowding at favorite spots •	
BAIT-COLLECTING			removal of organisms ● physical disturbance ●								

Figure 5.4: Relative severity of recreational impacts at Kraalbay and in Langebaan lagoon.

Large dot: "severe impact"; quantities involved are large; extensive transformation or degradation has occurred; impact may be irreversible without intensive management intervention; socially unacceptable; potential to generate conflict high.

Perusal of the matrix will reveal that the most serious impacts at Kraalbay are:

1 *Erosion of dune face and limestone ledges, and destruction of vegetation* due to the proliferation of paths around access routes to the beach from the carparks and road. These impacts are concentrated at the three entrance points to Kraalbay, at Tweede Stop, Preekstoel and the jetty. At Preekstoel slumping of the dune and the blow-out at the top of the path are effectively irreversible, though closing this path might prevent further damage. Sand dunes are considered to be amongst the most sensitive ecosystems to disturbance (McDonnell 1981; Wall and Wright 1977).

2 *Noise, danger from and disturbance by powerboats*: while the ecological impacts of powerboating are not well understood, it is widely agreed that, with the exception of disturbance of avifauna, powerboat impacts are surprisingly small (Bate and Crafford 1985; Liddle and Scorgie 1980; Wall and Wright 1977). Bate (pers comm.) is confident that water pollution due to the release of engine exhausts and spilling fuel from outboard motors can be discounted; Liddle and Scorgie (1980) report that disturbance of bottom sediments by propellor generated turbulence is, at worst, a temporary phenomenon which quickly returns to normal, and fish populations do not appear to be disturbed. However, powerboats, of all forms of boating, are the worst offenders with respect to waterbirds (Rowlands 1984; Batten 1977), causing them to move away rapidly. However, because the density of waterbirds on the intertidal flats near Preekstoel is the lowest at the lagoon (Summers 1977) and it is considered the least important area for waders (Hockey pers comm.), this impact was assessed as being moderate.

Powerboats also have a high potential for conflicts with other users. Recreation researchers have called powerboating an aggressive sport (Hugo 1980; Tivy 1980), intolerant of other uses of the same water area, or the most incompatible with other uses of water bodies (Hugo 1980; Baud-Bovy and Lawson 1977), and the greatest consumer of water space because of their speed (Jaakson 1970). Powerboating has certainly generated conflict at Langebaan lagoon: powerboating as a danger to other pursuits was a persistent complaint of Langebaan survey respondents; 26,5% of Langebaan respondents said powerboat noise was a problem. Clearly, the issue has social and safety components.

3 *Litter left by picnickers on the beach*: Between 2 and 3 tons of litter was collected on Kraalbay beach between Christmas and New Year 1985/86, according to Kraalbay Conservation Club spokesman Mr M Boer. Again,

while the ecological impacts in a situation like this are likely to be insignificant (Liddle and Scorgie 1980; Wall and Wright 1977), the social and aesthetic impacts are significant. Almost every respondent in surveys conducted at Kraalbay complained about litter. It was widely regarded as being out of keeping with what most people saw as an unspoilt, undeveloped natural landscape.

4 *Water quality changes*, allegedly due to organic pollution from anchored keelboats in the bay: Complaints were made of human faeces washed up on the beach, and the growth of the algae *Enteromorpha lingulara* and *E. acanthophora* along the shoreline. These species can be associated with sewage outfalls or high nutrient levels (Brink and Marais 1985). However, Dr J Bolton, an algal specialist at the University of Cape Town, was of the opinion that it would be very difficult to attribute the appearance of these algae to organic pollution. Aerial photographs of Kraalbay in 1968 showed seaweed to be present in similar positions, although the species could not be thus identified[18]. Regrettably there are no water quality data from Kraalbay to add to the picture. Huizinga (pers comm.), however, who has mathematically modelled the system, points out that the volume of water exchanged at each tidal cycle is so enormous that it would neutralize the domestic waste produced by 40 yachts and houseboats.

5 *Damage to intertidal sandflats by walking and dragging small sailing or rowing craft across them:* The significance of these impacts is difficult to assess. Recent research on the impact of bait digging at Langebaan (Wynberg *et al* 1990) suggests that the pumping of sediment has a persistent impact on sediment structure, and that burrow dwelling organisms are affected by human trampling. On the other hand, flamingos and sand sharks turn over huge amounts of sediment in foraging. McLusky *et al* (1983) found that sediments exploited for bloodworm were rapidly reconstituted and re-colonised by worms. Wolcott and Wolcott (1984) found that burrowing macrobenthos on a high energy sandy beach were completely protected at depths of only 5 cms from impacts due to off-road vehicle passage. The apparent resilience of the sandy beach may, of course, be due to different sediment particle size composition compared with a lagoonal sediment. Dragging sports equipment across sandflats is likely to have a more severe impact than walking and should, as a precautionary measure, be discouraged.

6 *Depletion of bait and fish stocks*: These concerns apply to the whole of Zone 1, rather than to Kraalbay. Wynberg *et al*'s (1990) results regarding the impacts of heavy exploitation of bait stocks on the central sandbank off

---

18 These earlier seaweeds could have been *Gracilaria verrucosa* which is widespread in the lagoon and had been reported from Kraalbay by Simon (1977). Simon (1977) also reported *Enteromorpha* sp. on Schaapen Island, but he did not identify which species.

Langebaan have been discussed. Because bait collection is largely confined to this area and, to a lesser extent, the Oostewal sandflats, the lagoon's stocks as a whole are not threatened. However, these authors recommended that the daily limit of 25 prawns per collector should be strictly enforced, since gross over-collection of up to 2000 had been witnessed. Pringle (pers comm.) reported that bloodworm (*Arenicola loveni*) stocks along the Langebaan beachfront, where bloodworm has been collected for many years, were depleted, but that stocks recover quickly if exploitation is not repetitive. Little bait is collected in Kraalbay.

The situation regarding fishing has also been discussed. The sparse information available suggests that fish stocks in the lagoon are good. Dr B Bennett, who has studied the effects of recreational fishing on the Cape coast for a decade, suggested a detailed assessment of the situation at this stage would be completely unrealistic, because sufficient data were simply not available and a long time span would be required to obtain meaningful data (Bennett pers comm.).

5.2.4.2 Extraneous Impacts: Water Pollution

Activities outside the boundaries of the National Park could affect the park's ecosystems. Langebaan town, as a transformed environment in which a range of urban activities occurs on the border of the park, could be problematic. The only potential problem mentioned to me was sewage disposal. Old septic tanks in houses built close to the beachfront had been known to overflow when the watertable was high, and an unpleasant smell permeated the beach (Koen pers comm.). Although there was no evidence of pollution in the lagoon, in 1985/86 the Municipality were investigating the feasibility of installing a reticulated sewage system, and stipulated that any new township developments would have to make provision for reticulated disposal (Brand, Town Clerk, pers comm.).

In the late 1970's it was feared that the development of the iron ore loading terminal and other industries at Saldanha Bay would affect the lagoon both by the introduction of industrial effluents and by the deposition of dredge spoil released during construction. Willis and Fortuin (1979), looking at deposition rates in the lagoon of suspended matter originating from the dredging operation, found that most of the added material was removed from the system on the stronger ebb tide. Likewise, monitoring of iron oxides during 1977 and 1978 showed up no evidence of penetration into the lagoon (Willis and Fortuin 1979; Moldan pers comm). The then Division of Sea Fisheries regularly monitored water chemistry in Saldanha Bay, and continues to do so. It is surprising, however, that despite the concern expressed about the lagoon, no monitoring at the lagoonal end of the bay has been conducted since the late 1970's.

5.2.4.3 Conclusion

The conclusion of this brief review is that the lagoon remains in good condition. Evidence of persistent changes due to recreational activities in and around the lagoon is ambivalent at best. Indications are that changes have been localised in extent and have not impaired ecological processes in the system as a whole. External influences too have remained within acceptable limits.

> **CASE STUDY METHODS**
> **STEP 2: AREA ISSUES AND CONCERNS.**
>
> *Issues raised by managers, planners, scientists and the public were identified and reviewed to produce a succinct description of essential features of the area and the important issues and concerns arising therefrom. There is no method as such; it is an interpretive exercise which focuses the subsequent planning steps, and in the context of which observers can examine planning decisions. If clearly and precisely expressed it will let interested parties know what the thinking of the planning agency is on the area under question.*

5.3 AREA ISSUES AND CONCERNS

5.3.1 Conservation Importance of Langebaan Lagoon

The diversity (23 species) and size (up to 50 000) of the palaeoarctic wader population which inhabits Langebaan lagoon during the summer months are, collectively, the single most outstanding feature of the lagoon. Langebaan is the most southerly destination of migrant arctic wading birds which use the Eastern flyway (Underhill 1987); it is also the most important wetland for waders on the entire South African coast. In 1988 the lagoon was declared, in terms of the 1975 RAMSAR Convention, as a Wetland of International Importance. **Its conservation is thus of national and international importance.**

On the lagoon itself, the sand and mudflats and salt marshes of the southeastern part of the lagoon, adjacent to Bottelary and Geelbek farms, are both biologically the most productive areas of the lagoon and are the major feeding grounds for waders (Overlay 5, Appendix F). Extensive reedbeds in this area also provide breeding sites for many species. The shoreline in the vicinity of Oosterwal farm is valuable for the high tide roosts its raised marshes provide. Conservation of the waders will, obviously, require protection of these habitats. They have been under protection since 1979 by the division of the lagoon into three zones, the southernmost zone of which is off-limits to people and all types of boating.

As far as the terrestrial environment goes, the area is nationally important for its vegetation . West Coast Strandveld, which is unique to the Cape West coast is rapidly disappearing and exists over most of its range in a degraded state (Jarman 1984; Boucher 1983; Boucher and Jarman 1977; Acocks 1975). The

Churchhaven peninsula supports some of the least disturbed stands of Strandveld left in the Western Cape. The granite outcrops of the Postberg Nature Reserve, exposed limestone ridges and more recent, calcareous sand dunes each provide a different habitat for a different plant community, resulting in a rich floral mosaic which belies the apparent topographic homogeneity of the landscape. The granite outcrops of Konstabelkop represent the northernmost point in the distribution of Afro-montane forest remnant species, *Maurocenia frangularia* and *Philippia chamissonis* (Moll 1985). Also confined to these outcrops is a low, sparse succulent and bulbous flora which is unique and contains a number of endemic species (Boucher and Jarman 1977).

Scenically, the peninsula, dominated by the granite outcrops of Konstabelkop and Vlaeberg, is outstanding. This is even more so in the spring, when spectacular displays of flowering annuals carpet the old, fallow lands of the Postberg Nature Reserve. In the few years this reserve has been open to the public in the spring it has become a major tourist attraction of the Western Cape. Its considerable population of game, reintroduced since 1969, including gemsbok, wildebeest, eland, springbok, zebra and bontebok, is an added drawcard. Another spectacular feature of the peninsula is Sixteen Mile Beach, the unbroken sandy beach backed by an extensive dune field which runs the length of the peninsula. These dunes play a vital role in coastal sediment dynamics, but their equilibrium is sensitive to mechanical disturbance. Sixteen Mile Beach also provides a potential opportunity for "wilderness" experience.

The Churchhaven peninsula has thus a high conservation value and its preservation in as pristine a state as possible will be a priority for management.

5.3.2 Local character and cultural-historic values

The lagoon is set in a rural environment of stock farms (ranching, with pockets of cultivation), small villages and scattered towns. The privately owned Postberg Nature Reserve has been stocked with game since 1969, its old wheat lands left to lie fallow. The small holiday resort town of Langebaan lies at the entrance to the lagoon; it has a permanent population of some 500 whites and up to 2000 black people. There is a conspicuous military presence in the area, with the South African Defence Force in possession of the Donkergat peninsula, making this scenic and amenable area off-limits to the public. The remains of the Donkergat whaling station which ceased operation in the 1930's, lie within the military area.

Across Saldanha Bay lies the fishing harbour and ore loading port of Saldanha, now an important regional center. The two fish factories and ore-loading facility have the potential to generate pollution which would almost certainly affect the lagoon (Shannon and Stander 1977). However, this threat has not yet materialised, largely because the anticipated industrial development of the Saldanha area has not occurred.

The bay and lagoon have a rich maritime history which is evident in submerged wrecks in the bay and in historic buildings and artifacts still found in the area. A unique feature of the lagoon are the fishing villages of Churchhaven and Stofbergsfontein. The "indigenous" inhabitants of these settlements - the fishermen, ex-whalers or "lagooners" as they call themselves - are now few in number and advanced in years (there are 22 permanent residents, the majority over 60 years of age). However, their villages have developed into unique recreational settings: city people, either descendants, friends or otherwise acquainted , have bought into the community (the Pottebakkery syndicate at Churchhaven) or have leased houses for some time. The result is a closely knit association of "lagooners" and city people in communities which are largely content to do without running potable water, waterborne sewerage and electricity. It is a place which time and progress seem to have passed by. The sense of community is an important element, according to those involved, in the hamlets' uniquely special atmosphere. Their character, the opportunity for relaxation and contrast from city pressures which they represent are values worthy of conservation in the fullest sense.

Colonial history in the region is well represented in the number of surviving and restored historic farmsteads in the area: Geelbek, Oosterwal, Bottelary, Oudepos (the latter is the site of the original Dutch military presence in the area), many of them associated with springs of water, a scarce commodity in this area. Of more significance perhaps is the wealth of archaeological sites in the region: the coast north of Saldanha, the Donkergat peninsula and Sixteen Mile beach are richly endowed with Strandloper sites, producing unparalleled evidence of man's early use of marine resources (Robertshaw 1978, 1977; Axelson 1977). Strandlopers lived a nomadic life along the Cape coast. Many sites have been identified, but not excavated, so their preservation must be ensured (Smith pers comm.).

Clearly, this settled landscape has more of a rural character than of a wild, pristine landscape. It could be classified as a *cultural landscape* (Melnick 1983), an "ordinary landscape which people have settled, lived in, manipulated, altered and developed". Such landscapes "display the imprint of human occupation and the cultural response to natural forces and elements in the landscape" (Melnick 1983:85). It is as important to preserve such landscapes, suggests Melnick, as it is to conserve pristine wilderness. As regards the Saldanha/Langebaan area, Siegfried (1985) has argued that these cultural and historic resources represent a rich and varied regional heritage, in which vivid reminders and examples of both past and present man-land interactions are present. As such, the area contains a literally vital museum of the intimate association of man with his environment which holds tremendous educational and recreational potential.

5.3.3 Recreational Mecca

Langebaan lagoon has become regionally well known for the superb opportunities it offers for a variety of watersports. Its proximity to metropolitan Cape Town has played a pervasive role in its development, Cape Town being the source of the majority of recreational visitors to the Cape West coast (Cape Provincial Department of Local Government 1988). The existence of comfortable, rapid access via the west coast road, R27, to the area has also been a significant factor in its increasing popularity. Over the past 10 years it has become a mecca for yachting (it offers one of the few sheltered anchorages on the West coast), dinghy and hobicat sailing, windsurfing (boardsailing), waterskiing and powerboat enthusiasts. This has brought ever-growing numbers of day visitors and stimulated the development of holiday homes in the town. There has been simultaneously an enormous increase in the demand for public facilities over the summer season. Between 1980 and 1985 the capacity of public accommodation in Langebaan increased by some 400 percent and summer occupancy rates kept pace at virtually 100 percent (Brand, pers comm). The flip side of this coin, however, is that the town's economy is almost entirely dependent on an extremely brief, intense season (lasting from mid-December till about the end of January), while the lagoon is subjected to intense pressures during this period. Like many other coastal resorts, the very resource which attracts holiday-makers is endangered by them. The rapid development of Langebaan has also entrained infra-structural problems and costs which must be borne year-round.

Land oriented activities do not play an important role in the recreational character of the area, with the exception of beach activities and motorized viewing of Postberg Nature Reserve in the spring flower season (refer to Figure 5.3). This is partly due to the limits placed on public access by private ownership of most of the land surrounding the lagoon. Even if this were not so, however, the climatic aridity and coarse vegetation would be constraints on hiking. The beauty of the area rests in the contrast of this arid topography with the blue waters of the lagoon and nearby ocean.

Public recreation on the lagoon and nearby seashores has been limited to a few localities where public access to the water has been easy , namely Langebaan, Kraalbay and Kreeftebay. Kreeftebay on the Atlantic shore of the Postberg Nature Reserve, is a popular crayfishing spot. Kraalbay, a beautiful, sheltered half-moon bay on the lagoon, has drawn thousands of day visitors (there are no overnight facilities here) on summer weekends; during the week it is usually quiet. It is valued by those who use it for its natural beauty, the lack of development, its calm waters suited to swimming, waterskiing and the mooring of yachts. It has also played host for some 15 years to six houseboats. In the past, because of the restricted surface area of the bay, potential for conflict between different active users of the water was high. Zoning uses may be necessary, at least at peak holiday periods. **Maintenance of the unspoilt, unaltered, natural character of the bay**

is of chief concern, although a minority of members of the public wish to see leisure facilities developed.

The only public accommodation on the Churchhaven peninsula, apart from a handful of cottages at Stofbergsfontein which are available to rent, was the camping resort for blacks, Flamingo Farm, at Boereplein. This has now been closed. This resort, with an official capacity for some 260 people, was at times grossly overcrowded with between 500 and 1000 campers over holiday weekends. This reveals a tremendous demand for accommodation for blacks in the area, but since all racial barriers are now off the statute books, they are able to compete equally for leisure accommodation.

High density recreation opportunities of an urban type are provided for in Langebaan, which lies on the boundary of the National Park. While the water body adjacent to the town and part of its beaches are under the control of the National Parks Board, the rest of its beach area is controlled by the municipality, giving rise to a situation of divided control. Potential for conflict between different activities on the lagoon here is high, particularly between powerboats and sailboards.

Regionally, Langebaan and the lagoon are of major recreational importance. No other sites on the West coast so close to Cape Town offer the same mix of sheltered water, scenic beauty and public facilities. North of Saldanha several small, privately owned, chalet resorts have developed and there is the Port Owen marina on the Berg River estuary. However, none of these can cater for large numbers of people. South of the lagoon Yzerfontein is the nearest point of public access to the coast. However, it has only one campground, while holiday homes in the town are privately owned. In addition, bathing is dangerous, as is the boat slipway. This slipway, used by commercial and semi-commercial fishing boats from the entire sub-region, is already overcrowded (Cape Provincial Department of Local Government 1988). There are two other points of access, for day use only, between Yzerfontein and Melkbosstrand, namely Grotto Bay and Silverstroomstrand. The former has a small capacity, is unsafe for swimming and is situated in an area of considerable botanical importance (Littlewort pers comm.). Silverstroomstrand is being developed into a major resort for use by the expanding population of the city of Atlantis, which is situated just inland from it. Atlantis is projected to be a city of over a million people by the year 2000 and will be the source of additional recreation pressure on the Cape West coast.

5.3.4 Management Concerns

Generally, at the lagoon private ownership of land will constitute an institutional and legal constraint to co-ordinated management of the area's resources. However, this may be circumvented by the activities of the Langebaan Nature Area Management Committee and by the extension of the national park by contractual agreements with landowners. Nevertheless, landowners are concerned with maintaining their private rights, while public pressure will be in favour of increasing access to localities presently off-limits to the public. The role of management will be to ensure that the privacy of landowners is protected at the same time as the park fulfills one of its primary functions, that of providing for the enjoyment and benefit of the people.

In addition, "old timers" in the area are concerned with the loss of freedom associated with Parks Board control of the area: they fear that increasing regulation of activities will destroy traditional patterns of activity. Since the sense of freedom from restriction is an important element in recreational experience (Lime and Stankey 1979; Tocher and Driver 1974), management may well need to be affected in an unobtrusive manner and careful examination of regulations will ascertain their efficacy in protecting conservation and recreational values.

However, the paramount concern of management is the preservation of the internationally important natural resources of the lagoon. This means that, where a balance must be sought between public demands and the protection of the natural resource supply, management will tend to err on the side of conservation values. Projected increases in recreational demand in the West Coast hinterland, estimated to be over one million persons per holiday season in the year 2010 (Cape Provincial Department of Local Government 1988), are cause for concern.

So far evidence about human impacts on the lagoon suggest that impacts have been localised and have not yet reached a level where they will impair ecological processes in the lagoon. Bait collecting on the central sandbank needs monitoring, but overall bait stocks in the lagoon are not threatened. Fish stocks too appear to be robust. Caution must be exercised in Kraalbay to ensure that organic pollution, possibly from yachts and houseboats, does not affect water quality in the bay. The lagoon itself remains in good condition. The zonation of the lagoon into three zones of different use intensity has been effective in protecting the biotic resources it was designed to do. There is therefore no reason to change this system.

The same cannot be said of the terrestrial vegetation surrounding the lagoon. Here, modifications of the vegetation are longstanding, and in places impacts have transformed it. Localised trampling of vegetation and reduction in canopy cover as a result of recreational activities has occurred on the dune slope behind Kraalbay and around the granite outcrops on Konstabelkop at viewing sites. Some damage has been sustained by salt marshes at Bottelary due to cattle trampling, but recovery is possible if the cattle are removed. Nevertheless, good stands of Strandveld persist on the Churchhaven peninsula, to the south of the lagoon and in the interior on the farms Kalkklipfontein and Elandsfontein.

5.4 LAND SYSTEMS AND LAND TYPES

CASE STUDY METHODS
STEP 3: IDENTIFY LAND SYSTEMS AND LAND TYPES AND MAP THEM.

Land systems are visually identifiable on aerial photographs or other remote sensing products at a regional or smaller scale (Mabbutt 1968; Brink and Partridge 1967). In this case a small part of a region was under scrutiny.

The analysis of the landscape in the Langebaan area (with which the author is familiar and for which good aerial photographs and detailed information exist) was based on the interpretation of stereo pairs of airphotos supplemented by mapped information on the geology, soils, vegetation and land uses (Appendix F, Overlays 1-4). Generally this landscape has a high degree of topographic homogeneity, so that differences observed to distinguish land types were related more to changes in the appearance of the vegetation than to physiographic variation. Differences in colour tone and texture on aerial photographs were interpreted in terms of detailed information available on the vegetation and soils. Boundaries drawn for these individual parameters could not always be corroborated on the airphotos, but where the latter were unclear, the detailed data were used as a guide. Colour tone and textural differences were not described in absolute terms, but were interpreted relative to each other, because of the high degree of variation in these characteristics from one photo frame to the other.

Since vegetation is the ultimate integrated expression of changes in the landscape, and since any uses may profoundly affect the vegetation - to the extent of transforming or removing it - land uses were mapped (Appendix f, Overlay 4) as an initial step. Stereo-photo pairs were examined and land uses and their impacts mapped from the same sets of airphotos as those used for the land systems identification. The land uses mapped in this way were checked against the distribution of land uses on the 1: 50 000 topocadastral sheet (Sheet 3317BB and 3318AA Saldanha). For the most part, agreement was excellent, but some additions were made to the topocadastral 1: 50 000 sheet (the latter does not include fallow lands or stock paths).

The most recent black-and-white airphoto coverage of the Langebaan area was a 1979 Trigonometrical Survey done at a scale of 1:30 000 (Job 498\114, Strips 5 and 11, flown on 10\5\79). However, this job stopped just short of *the southern (Geelbek) end of the lagoon, so that a 1977 set at 1:50 000 (Job 786, Strip 4, flown on 28\3\77) had to be used to cover the Geelbek area. A superb set of full colour airphotos at a scale of 1: 10 000 was flown in 1976 as the data base for Boucher and Jarman's (1976) work on the vegetation of the area, but this set was unobtainable for this project. It is unfortunate that only relatively old airphoto coverage of the area is available. To minimize this problem, land use data were ground checked by walking the entire area very thoroughly. Where changes in the appearance of the vegetation due to land use practices were very obvious on the airphotos these were in all cases confirmed on the ground. The only differences observed were sometimes in matter of degree, for instance, where lands apparently cultivated on the airphotos are now fallow, or very recently strip cut lands had several additional years of growth on them. In both cases the vegetation remained significantly altered from its natural state.*

Land systems and land types were mapped at a 1:50 000 scale (Figure 5.5), named and described with the aid of information on the natural attributes mentioned above. Land systems were named after their parent material; land type names refer to any feature which will distinguish the land type from others: this might be land form, soil type, topographical position, or a dominant feature of the vegetation. The land systems, land types and descriptions of their salient features are given in Table 5.5, and their distribution mapped in Figure 5.5.

The delimitation of the landscape into land systems and land types is shown in Figure 5.5 (at end of dissertation text) with an explanatory key. A transparent overlay over Figure 5.5 identifies each discrete area (unit) of each land type by a unique label, eg., L2.3, C4.1. The alpha character denotes the land system (Basement Granite=G, Dune Sands=C, Limestone=L). The first first numeric suffix identifies the land type (L1=Surface Outcrop; C4=Reed Clump, etc.), the second character identifies the particular unit of that land type. It is these uniquely labeled land units which will be evaluated for their inclusion in Recreation Opportunity Classes in Step 6.4.

The area includes three principal land systems associated with parent materials of different origin, process and age. These land systems are:

1. <u>Basement Granite:</u> The oldest formation in the area, the dome-like outcrops of Cape Granite are some 500 million years old (Flemming 1977) and provide the dominant relief in the landscape.

2. <u>Surface Limestones:</u> This system comprises calcrete sheets occupying low-lying areas and shallow basins between granite outcrops on the Churchhaven peninsula.

Aeolian sands deposited during the Pleistocene have been calcretized and consolidated (Flemming 1977). This system includes surface exposures of limestone ridges along the lagoon and shallow, calcrete sands underlain by limestone.

3. Dune Sands: The origin of these sands, which now cover large expanses of the sub-region, are Holocene and Quaternary sediments of predominantly marine origin. The mobile dune fields which are a prominent feature in this landscape and older, consolidated and vegetated sand dunes which form the bulk of the landscape are included in this land system. The deep, older sands of this system may be highly calcretized, while in the interior acid, leached sands appear.

[A fourth formation, the Malmesbury Shales, appear in the study area as two very small outcrops on the seashore of the Donkergat Peninsula. This land system has therefore been ignored in this study.]

The subdivisions of these land systems into land types,largely on the basis of visual differences in vegetal cover is described in Table 5.5 below. All plant community names used are from Boucher and Jarman (1977), as are most of the details pertaining to vegetation and soil characteristics.

5.4.1 Basement Granite

The granitic land system is divided into two land types, Coastal Shelf (G1) and Granite Outcrop (G2), the names describing their position in the landscape. The granite outcrops (G2) form prominent, steep sloped hills, usually topped by large bare granite domes.

Occupying steep granitic hillslopes [G2, Granite Outcrops] between 3 and 40 m with a south-easterly aspect, is *Galenia-Senecio* Hillside Closed Dwarf shrubland. A bi-stratified community, the shrub layer 0,5 m tall is dominated by *Rhus glauca, Zygophyllum morgsana* and *Tetragonia spicata.* A grassy and low succulent element 15-35 cm high completes the picture. Canopy cover during the dry season varies between 50% and 75%. Cartref, Estcourt, Hutton and Fernwood Form soils are characteristic. All Series of the Clovelly and Estcourt soils have a poor water absorption ability, and are therefore unsuitable for septic tanks and for road stability. Cartref soils are poor for light building, but on granite they are moderately suitable for heavy building. Fernwood and Hutton soils, which are dominant, have few limitations for development.

At the base of the rocky outcrops (G2), where moisture accumulates on the protected south-east to south-west aspects, the small forest remnants occur, featuring small, gnarled trees of the species *Maurocenia frangularia.* These forest remnants are part of the *Ehrharta-Maurocenia* Hillside Dense Shrubland which occupies the south-east and south-west hillsides below the outcrops. Stratified into three layers in its mature form, isolated clumps of trees 1,2 to 4,0 m high occur amongst the shrub layer of 1.0 to 2.0 m tall stands dominated by *Rhus glauca, Zygophyllum morgsana* and *Ehrharta erecta*. The shrub layer consists of a mixture of leathery-leaved evergreen shrubs and drought-deciduous shrubs. A herbaceous layer, dominated by annuals in the wet season (winter/spring), occupies the interstices. In autumn canopy cover is 80%: this is the driest time of year when bare patches of unvegetated ground develop. The herbaceous layer and annuals are most vulnerable to mechanical damage; shrubs are hardy. Stony, undifferentiated soils on granites predominate: Hutton and Nomanci soils (the latter are shallow, very highly organic soils) are characteristic. Hutton soils are generally well drained and have no limitations for development. The two communities described above could not be differentiated on black and white airphotos, hence their inclusion as one land type.

On the Coastal Shelf (G1) below the granite hills two communities occur: located on the coastal boulder shelf where it is exposed to salt spray and on-shore wind is the *Atriplex-Zygophyllum* Coastal-shelf Dwarf Shrubland. There is a 5-10 cm tall, matlike groundcover of deciduous succulents, and an upper layer of drought deciduous succulent shrubs up to 1 m tall, dominated by *Zygophyllum morgsana* and *Othonna floribunda* (previously *Senecio floribunda*). Soils are shallow, gravelly or sandy and may have a prominent shell fraction. The vegetation is robust and withstands trampling.

The second Coastal Shelf community lies slightly inland of the *Atriplex-Zygophyllum* community up to an altitude of 3 m, where Fernwood Form soils accumulate at the base of granite hills. The vegetation is similar in structure to that above, comprising prostrate succulents and dwarf shrubs 15-50 cm tall. There is a conspicuous grassy element in which *Ehrharta calycina* is prominent. The type will be resistant to trampling.

5.4.2 Limestone

Communities of the *Nenax-Maytenus-Zygophyllum* type occur on wind-exposed hillslopes or limestone ridges [L2, Shallow Sands]. Although the mature community has a 2-layer structure of shrubs varying in height from 0,8-2,0 m, and dwarf layer 5-25 cm tall, most of this type is heavily trampled and grazed by stock and game. Shrubs are both evergreen and drought deciduous. Annuals are abundant in disturbed areas in the spring. Mispah Form (Kalkbank Series) soil predominates.

The *Pteronia uncinata* type, a shorter scrub, is confined to exposed limestone ridge crests on the lagoon side of the Churchhaven peninsula [L1, Surface Outcrop]. *Pteronia uncinata*, a 30-50 cm tall ericoid shrub, is dominant. It forms conspicuously displays of yellow flowers in the autumn when very few other species flower. Very shallow soils belong to the Mispah Form (Muden Series).

Table 5.5: Land systems and land types of the Langebaan lagoon area.

Land System	Land Type	Landform	Vegetation	Soils	Characteristic Appearance
BASEMENT GRANITE	Coastal Shelf G1	Lower slopes towards foot of granite outcrops and along rocky coastal margins	*Atriplex-Zygophylum* and *Pelargonium Muraltia* Dwarf Shrubland	Deeper granite-derived soils and sands on granite Fernwood and Villafontes Forms	Medium-grey tone, smoother texture
BASEMENT GRANITE	Granite Outcrop G2	Dome-shaped hills	*Galenia-Senecio* Dwarf Shrubland on steep slopes and *Ehrharta-Maurocenia* forest remnants at base of granite domes	Stony, shallow, undifferentiated soils on granite	Dark tone and rough texture with highly visible rock outcrops
LIMESTONE	Surface Outcrop L1	Exposed limestone ridge crests confined to the lagoon side of the Churchhaven peninsula	*Pteronia uncinata* Limestone Dwarf Shrubland	Shallow soils on limestone (Mispah Form (Kalkbank Series))	Distinctive rounded mounds with a smooth grey surface and separated by paler, stippled areas
LIMESTONE	Shallow sands L2	Low, sloping plains occupying the basin between granite outcrops on the Churchhaven peninsula	*Nenax-Maytenus-Zygophyllum* Evergreen Shrubland	Shallow sands of Mispah Form (Muden and Kalkbank Series)	Speckled, mottled texture of two-tone streaks running East-West

Table 5.5 (continued)

DUNE SANDS	High Dune C1	Semi-consolidated, irregular, steep dunes inland of or associated with mobile dune fields	(a) On Churchhaven peninsula: A mosaic in which dune crests occupied by *Didelta - psoralea* Littoral, Dwarf communities; slopes by dense, evergreen, consolidated dune communities (b) Interior dune plumes S. of lagoon: Metalasia - Myrica Dense, Evergreen Ericoid Shrubland	Deep, regic, calcareous sands of Fernwood Form (Langebaan Series) predominate	Distinctive, streaky irregular patterns and patchy, stippled texture
DUNE SANDS	Dune Slack C2	Vegetated, dune slacks and valleys behind the mobile dune fields on the Churchhaven Peninsula	*Hermannia pinnata* Littoral Dune Succulent Shrubland	Deep sands of Fernwood form (Langebaan Series)	Pale grey tone, smooth texture
DUNE SANDS	Mobile Dune C3	Sparsely vegetated coastal and inland dune plumes which are mobile and highly unstable	*Didelta-Psoralea* Littoral Dune Open Grassland on undulating dune crests along coast; inland dune plumes unvegetated	Deep, unconsolidated sand of Fernwood form (Langebaan Series)	Prominently white features in the landscape

Table 5.5 (continued)

DUNE SANDS	Reed Clump C4	Isolated pockets confined to rear margins of coastal dune fields, marking the division between littoral and consolidated dune communities	*Thamnochortus spicigerus* Dense Restioid Herbland comprising almost single species stand of *Thamnochortus*	Fernwood form (Langebaan Series)	Very dark, dense patches with sharp boundaries
DUNE SANDS	Deep Sands C5	Consolidated dunes of deep, regic sand mostly inland of shallow sands on limestone, gently undulating slopes	*Willdenowia incurvata* Dense Evergreen Restioid Shrubland	Fernwood (Langebaan) and Clovelly form soils predominate	Even, prominent stippling due to large bush clumps; medium grey tone
DUNE SANDS	Disturbed Mosaic C4	Undulating, consolidated slopes inland of the lagoon	Mosaic of Dense Evergreen Shrubland and Dense, Evergreen Restioid Shrubland but indistinguishable as separate communities	Fernwood (Langebaan) Mispah (Kalkbank) and Clovelly Form soils are found	Very irregular patchiness with patches of bare tracks highly visible; pale, blotchy grey tone
DUNE SANDS	Lime-rich sands C7	Consolidated sand dunes underlain by limestone	*Maytenus-Kedostris* Dense, Evergreen Shrubland predominantly (occasional patches of *Willdenowia incurvata* Restioid Shrubland)	Shallower sands on limestone of Mispah (Kalkbank) and Fernwood Forms (Langebaan Series)	Relatively dark grey and finely stippled or smooth texture

Table 5.5 (continued)

ALL LAND SYSTEMS	Trans-formed Lands T	Any areas which are visibly transformed or highly disturbed from the surrounding natural areas	Natural vegetation non-existent (cultivated land) or highly depauperate, making it indistinguish-able as a natural community type	Shallower sands on limestone, of Mispah (Kalkbank) and Fernwood Forms (Langebaan Series)	Texture very smooth in cultivated land and old, fallow lands, or regular pattern as in strip-cut lands; colour tones distinct from, and usually paler than, those around them
ALL LAND SYSTEMS	Wetland	Tidal, waterlogged or seasonally waterlogged communities on edges of lagoon	Mosaic of types of Sedgeland, Dwarf succulent Shrubland and reedbed	Halophytic soils - champagne - Latspruit and Fernwood Forms	Whirly, mottled appearance dark tones associated with tidal drainage lines

5.4.3 Dune Sands

Old, calcareous sand dunes bear drought-deciduous shrubs, often spinescent, and they have a conspicuous restiose element, the 2m tall Cape reed, *Willdenovia incurvata* (previously *W. striata*), and *Thamnochortus spp.* Some characteristic communities on these dunes are:

(1) *Maytenus-Kedostris* Dense Evergreen Shrubland on stable, inland dunes [C7, Lime-rich Sands]. This is a single layer community of dense, spiny shrubs forming an almost closed canopy. It is uncomfortable for walking unless bush is cleared. The soils are Fernwood (Langebaan Series) and Mispah (Kalkbank Series) on a limestone base. The land type forms a west-facinig wedge along the lagoon margin of the Churchhaven peninsula.

(2) *Thamnochortus spicigerus* Dense Tall Restioid Herbland, which forms dense, almost monospecific stands along the boundary between littoral and consolidated dune communities [C4, Reed Clump]. The reeds have pencil-

thick, straight, 1,2-2,0 m tall stems, and are difficult to walk through. These clumps provide good cover for small antelope.

(3) The dune slacks behind the unstable dune fields which front the ocean along the Churchhaven peninsula, are occupied by *Hermannia pinnata* Littoral Dune Succulent Shrubland communities [C2, Dune Slack].

(4) The pioneer communities of the coastal mobile dune fields, *Didelta-Psoralea* Littoral-dune Open Grassland [C3, Mobile Dunes], also occupying the crests of the high dunes on the Churchhaven peninsula behind Kraalbay. This is a community of beach colonizers, characterized by dwarf shrubs and grasses. The distribution is irregular and patchy, but canopy cover in the patches is typically high (85%). Beach litter helps to stabilize the substrate for plants to obtain purchase. The land type is very sensitive to rapid blow-outs if the surface is disturbed, or beach litter removed.

On the interior dune plumes this gives way to *Metalasia-Myrica* Dune Dense Evergreen Ericoid Shrubland around the edges of the bare, unvegetated dune fields. This community forms on Mispah (Fernwood Series) soils. It has an upper stratum 1,0-1,6 m tall with a characteristic ericoid appearance, and a lower layer, which is a mixture of ericoid-leaved, graminoid, restioid and succulent plants. This community is fairly robust, with a canopy cover which varies from 65% to 85%, but the unvegetated dune plumes are similar to the littoral dune fields as regards responses to surface disturbance.

(5) On consolidated dunes to the interior, on deep, regic sands, *Willdenowia incurvata* Dense Evergreen Restioid Shrubland [C5, Deep Sands]. This occupies gently undulating slopes and slight drainage lines inland of the *Maytenus-Kedostris* community, and is characterized by scattered clumps of the reed *Willdenowia incurvata*. A deep Clovelly Form (Sandspruit Series) soil is general, but Fernwood Form (Langebaan Series) also occurs. These sands are more acid than those on which *Maytenus-Kedostris* thrives.

A Disturbed Mosaic [C6] has been identified as a separate land type, because it comprises a highly disturbed part of the eastern shores of the lagoon in which other vegetation units cannot be identified or are present in a highly depauperate and disturbed form.

5.4.4 Wetland communities [W]

Six different marsh communities occupy areas with a high water table round the fringes of the lagoon. These communities have not been differentiated as land types because the entire wetland entity would be managed as one unit.

5.4.5 Sensitivity rating of land types

Boucher (pers comm) has ranked the land types on the following qualitative scale of sensitivity to disturbance.

[High Sensitivity] -- [Low Sensitivity]

C3 -- W - L1 --- C1 --- C2 -- C4 -- C5 -- C7 ---- L2 ---- C6 --- G2 ---- G1

C3, the Mobile Dunes, are unvegetated, unstable dune fields along the coastal margin and dune plumes into the interior. Highly sensitive to blow-outs.

L1, Surface Outcrops of limestone have brittle, slow-growing plant communities on them which regenerate with difficulty.

C1, the High Dunes, bear mature bush communities which, if cut, do not grow back again; once exposed, soils may be susceptible to blow-outs.

The remainder of the consolidated dune are resilient where shrub species are prevalent, but the forbs and annuals are susceptible to mechanical damage. The real danger in this landscape is the exposure of large areas of ground surface. The sandy soils are easily blown out by the high prevailing winds.

CASE STUDY METHODS
STEP 4: DEFINE PARK CHARACTER AND MANAGEMENT OBJECTIVES FOR RECREATION.

From an overview of the area issues and concerns, and literature on the resources and character of the area (eg., Hockey 1985; Moll 1985; Siegfried 1985), a composite image emerges of conservation priorities and the type of landscape character to be preserved. The National Parks Board's stated (Robinson 1984) objectives for the area are refined and modified where necessary.

5.5 MANAGEMENT OBJECTIVES AND PARK CHARACTER

5.5.1 Management Objectives

Management objectives are an essential prerequisite to zoning and setting environmental quality standards. The objectives of the proposed West Coast National Park have been laid out by Robinson (1984) as follows. They are:

* To ensure the perpetuation of the flora, fauna and ecological processes characteristic of the West coast region by protecting the natural resources of the park from impairment by man.

* To preserve representative examples of the cultural heritage resources of the Park which are important for the interpretation of man's presence and activities in the Park.

* To provide opportunities for education, appreciation and awareness of the natural and cultural resources of the Park.

* To provide a diversity of outdoor recreation opportunities **compatible with the character of the Park** and to encourage visitors of varying interests and skills to experience and enjoy the Park.

* To operate and maintain the Park to maximize public safety and convenience; to achieve optimum environmental quality and resource protection.

* To promote and encourage the establishment of land uses, developments and activities in the Park **which are compatible with and complementary to the Park.**

In order to make these attainable objectives, the phrases highlighted above require a more explicit description of the Park character envisaged by management than had been the case in written discussions[1] of the Park's objectives. Following an analysis of the area issues and concerns, the following addendum relating to a recreation policy for the proposed park has been formulated:

* The Park's role in the regional recreational setting is acknowledged so that use will be encouraged, but on a strictly controlled basis.

* In keeping with its National Park status the longterm protection of ecological processes and features will take precedence over the satisfaction of short-term recreational pressures.

---

1 **Especially the unpublished 1984 document circulated to government departments, "Management Policy Guidelines for the Proposed Langebaan Lagoon and Islands Nature Area"; also Robinson (1985).**

* The Parks Board, recognising the integral role of people in this environment will endeavour to:

(1) provide a **variety** of recreation opportunities in the Park which are compatible with the park character;
(2) allow, as far as is ecologically sustainable, multiple use of the Park's resources, from intensive use to total protection;
(3) zone the Park for different uses, but with the emphasis on low density, nature oriented uses;
(4) set carrying capacity guidelines to achieve these objectives and to maximize visitor satisfaction, with as little disruption to existing patterns of use as possible;
(5) maintain a flexible approach which is capable of responding to changes in the natural resource base and in the perceptions of Park visitors, so as to ensure both the protection of environmental and recreational quality.

5.5.2 Park Character

The overall character of the park is seen as comprising the inseparable integration of human settlements with the natural environment to produce a landscape of *rural* character which is worthy of conservation in its own right. This rural character is, nevertheless, susceptible to destruction by the development of modern infrastructures.

This landscape has been described as "harsh" and "bleak"; early travellers called the vegetation grey and unattractive; and with its arid climate and lack of topographic diversity, the West coastal plain offers little by way of spectacular scenery, with the exception of its spring flowers and the contrast provided by its wild coastline and the tranquil Langebaan lagoon. The real value of the place lies, in author and longtime visitor to Langebaan, Brian Lello's, words in "nature at your toecaps": the beauty is revealed only in close scrutiny of the area's intricate ecological webs.

Furthermore, arid environments once damaged are slow to recover (Kuss and Graefe 1985) so that human impact should be kept to a minimum if the park is to fulfil its conservation function.

The unique cultural "time warp" epitomised by the simple fishing villages of the Churchhaven peninsula is part of the essential character of the area.

The general principle guiding the overall provision of recreational and other opportunities in the Weskus Park will then be **minimal disturbance of the natural or human environments by the provision of resource-oriented recreation opportunities**, as opposed to facility or technologically dominated opportunities which are reasonably well catered for at adjacent localities such as Langebaan. **These opportunities will aim to stimulate active participation in and interpretation of the environment.**

The presence of simple fishing communities in the Langebaan lagoon area offers opportunities for simple, rustic accommodation complexes in which the visitor will be able to appreciate the lifestyle of byegone times. The carrying capacity of the park should be low and visitors encouraged to get out on their feet and experience the landscape at close quarters.

CASE STUDY METHODS
STEP 5: DEFINE AND DESCRIBE RECREATION OPPORTUNITY CLASSES

The range of recreation opportunities to be provided in the area was determined by: (1) what resources, both conservation and recreation, exist in the area and the extent to which Park authorities consider existing conditions acceptable; (2) considering the regional context and the extent to which it would be desirable and feasible to provide opportunities not found elsewhere, or scarce, in the region and appropriate to the area's status as a National Park; (3) the indications given by users, in response to public opinion surveys, of their preferences regarding recreational opportunity settings in the area.

A number of foreign Park zoning schemes were reviewed for their appropriateness to Langebaan. These included Clawson's Area Classification, Parks Canada, the U S Bureau for Outdoor Recreation, IUCN "Categories , objectives and criteria for protected areas" and Seribu Islands Marine National Park (Indonesia) schemes. Stankey et al's *(1985) "opportunity classes" were also considered. I concluded that the Bureau for Outdoor Recreation's zones and the Stankey* et al *scale were most applicable.*

The Bureau of Outdoor Recreation's classification consists of the following categories:

(1) High Density Recreation Areas
(2) General Outdoor Recreation Areas
(3) Natural Environment Areas
(4) Unique Natural Areas
(5) Primitive Areas
(6) Historic and Cultural Sites.

Surveys of recreational users of the lagoon environment at Langebaan town and Kraalbay indicated that there was a demand for a variety of recreational opportunities, from resort to natural areas with motorized access, to unspoilt wild areas without modern conveniences. **[continues overleaf]**

The Bureau of Outdoor Recreation's zoning scheme was modified and simplified for application at Langebaan for the following reasons:

(1) the elongated configuration of the Weskus park makes the effective space in any one area too small and narrow for the juxtaposition of too many zones, that is, their proximity to each other would render the designations rather meaningless. This report then proposes the minimum number of zones on land considered necessary for effective management. [Public attitudes may also be a reason to limit the number of zones - Stankey et al(1985) found that users were confused by any more than four zones.]

The configuration of the area also makes the application of the term wilderness inappropriate: while there is much debate on what constitutes a wilderness experience, most writers would agree that remoteness and isolation are important elements of wilderness. At Langebaan one is almost always within sight, sound or half an hour's walk from human settlement or activity. The use of the term primitive is therefore proposed to indicate those areas designated suitable for a wilderness-type of recreational experience. Primitive here refers more to the level of facility provision than to conjuring up images of a specific type of recreation experience.

(2) Separate classifications for land and water areas (ie Langebaan lagoon) in the park have been drawn up, because the land use zonation scheme could be only clumsily applied to water areas, in which the resource characteristics and use requirements are quite different. The primary classification is the land use zonation scheme, since this is where most recreational activity is based or occurs. Water surface zonation is a complementary adjunct to land zonation, that is, the water classification scheme does not stand on its own.

5.6 DEFINITION OF RECREATION OPPORTUNITY CLASSES

The accompanying table (Table 5.6) lays out the Recreation Opportunity and Land Use classification scheme. The table is largely self-explanatory. It describes the purpose and desirable characteristics of the different use zones in terms of natural resource conditions, recreational character and management style in accordance with LAC concepts. Broadly defined environmental quality standards are generally specified. Quantitative standards will have to developed at a more detailed level of planning. However, some quantitative standards for Primitive Use Areas have been stipulated on the basis of experience gained elsewhere. In this case several standards, applicable to different aspects of activities appropriate to that zone, have been suggested.

Table 5.6: (Land Based) Recreation Opportunity Class and Land Use Zone Classification Scheme

ZONE PURPOSE AND DESCRIPTION	RECREATIONAL CHARACTER AND USE	USER TYPES	MANAGEMENT AND SERVICES	ENVIRONMENTAL QUALITY STANDARDS
1. Special Areas/Sites *				
Preservation in pristine state of ecologically critical, rare, outstanding or endangered sites and areas which are sensitive to human impact, is priority. Usually falling within other use zones. Visitor restrictions and resource exploitation prohibited.	Nature observation, interpretive trails, research, under strict on-site management control. No overnighting. Visitor prescriptions may apply	Recreational visitors educational, research.	Non-mechanised access only, interpretive services, simple observational facilities or no facilities at all, no permanent structures; control may be by guided trails, visitor control also affected by good information display at access points, monitoring program critical.	Very low impacts, should recover annually; no intentional modification of environment tolerated.
2. Primitive Natural Areas				
Protection of sensitive landscapes, pristine natural plant communities representative of west coast region are priorities. Low density, resource-oriented recreational uses only permitted to ensure conservation of essential ecological processes. Resource exploitation limitations will apply.	"Wilderness-type" experience promoted to enhance solitude and participant observation of nature; hiking trails, horse riding, primitive camping. (Further restrictions apply where Special Areas occur). Visitor behaviour controlled by education before entering area; regulation and on-site management presence minimal.	Recreational visitors educational, research, day visitors.	Vehicular access mostly to perifery, "wilderness-type" campgrounds and ablution facilities at scattered sites; water points; guided trails. Veld management to protect diversity of biota. Monitoring of impacts essential. Management by indirect, subtle means to promote sense of freedom.	No detectable changes in species composition of plant communities. Campt sites restricted to 10 sites each, partial annual recovery expected. No solid structures except overnight huts on trails. Location of camps for solitude. Maximum party size 12; encounters with maximum 2 other parties per day
3. Semi-primitive Natural Areas				
Natural landscapes where human presence is integral and longstanding, allowing for 'extensive' agri- and low to intermediate levels of outdoor recreation with simple facility development. Includes provision (in the long term) for simple, 'rustic', overnight accommodation. Motorised access to intermediate use areas assured.	Camping,'rustic' camps,serviced picnic areas; interpretation; supervised beaches, walking/horse trails. Zoning may be necessary to reduce conflicts; management presence is obvious, but not obtrusive; activities will be regulated to some extent.	Recreational day and overnight visitors, educational.	Ablutions, car parks, picnic areas, boat launches, interpretive facilities, motorized access. Veld degradation controlled by active intervention (design and modification). Quality control enforced.	Moderate design modification of environment permitted to prevent ecological degradation,eg., lawns, hardened parking lots. Impacts not to impair essential ecological processes, eg., current flow sediment transport, groundwater movement. Aesthetic & scale control of structures important.
4. Intensive Use Areas/Facility Nodes				
Existing concentrations of semi-urban use or recreational visits and sites for intensive facility development including park administration and semi-urban use densities.	High density recreation of all types, interpretation, tourist activities eg curio shops and restaurants. High degree of regulation, social interaction	Day and overnight visitors and holidaymakers, tourists.	All facilities of 'resort' type, concentration of park administrative and visitor facilities. Very visible signposting of regulations plus management personnel to control availability of bait and fish stocks, etc.	Environment is transformed, but basic quality control (water standards, wastes) is high; aesthetic guidelines important to maintain integrity of natural and cultural setting.
5. Prohibited Zones				
Areas under the control of authorities (military), which prohibit public use; areas where primary purpose is commercial exploitation of natural resources, (making them unsuitable for recreational use) including cultivation, mining and industrial, quarrying and military.	Commercial exploitation or extraction, mining, industry, cultivation.	Farmers, military.	None	High impacts; total transformation of environment may ensue, but monitored to ensure prevention of negative impacts on adjacent areas.

* Included here are wetland areas which should fall within the Water Area Zoning Scheme

Table 5.6 (continued): Lagoon (Water Areas) Recreation Opportunity Class Classification Scheme

*	ZONE PURPOSE AND DESCRIPTION	RECREATIONAL CHARACTER AND USE	USER TYPES	MANAGEMENT AND SERVICES	ENVIRONMENTAL QUALITY STANDARDS
1	Nature Trail Area (Zone 3)				
	Protection of critical wader habitat and most productive wetlands; to provide opportunities for low impact activities oriented to nature interpretation.	Interpretation of nature and solitude emphasized; very low use density with limited numbers. Fragility of resource base requires close control of visitor behaviour. Hiking and canoeing confined to defined trails.	Birders, canoeists, hikers, educationists, researchers.	Management of indirect type: education at access points to affect behaviour; or on-site guiding of activities. Presence of officers likely. No structures except bird hides and vehicular access set well back.	Human impacts off trails very minor, annual recovery assumed. No exploitation of intertidal organisms. Monitoring program crucial. No deterioration in water quality; no more than 2% surface area disturbed for amenities.
2	General Sailing Area (Zone 2)				
	Protection of wader feeding and roosting grounds, and fish feeding grounds. 'Traditional' fishing rights observed (recreational fishing prohibited). Provision of tranquill, noiseless sailing and rowing opportunities. Some beaches open for day visitor and residents' use.	Tranquillity assured; sailing dominant activity. Low density and lowkey management presence are features. No competitions or powerboating.	Boardsailors, canoeists, sailing dinghies & keelboats (in deeper channels. NO powerboats. Shoreline walking discouraged.	Low key management, aimed at ensuring safety rather than controlling behaviour. Information at launching points to promote compliance with regulations. No direct beach access or launching sites (access by water), but situation may change.	Monitoring to detect and prevent sustained disturbance of waders - reduction in bird populations not tolerated.
3	Intensive Watersports Area (Zone 1)				
	In the deepest waters provision made for all types of watersports including fishing, in high quality environment. Area zoning to minimize user conflicts may apply.	Hi-tech watersports predominate at relatively high densities, within constraints of safety and resource conservation. Safety regulations enforced.	Sailboards, hobicats, dinghies, yachts, powerboats, canoes, paddleskies, fishermen and bait collectors, waterskiers, divers, beachgoers.	All supporting facilities (launching ramps, moorings, parking, etc.) admissible. Management presence on-site to ensure user safety; constant monitoring of fish stocks and water quality to ensure quality of resource base.	Some shoreline areas subject to total transformation. Water quality remains high; total bait stock constant over 3 year period; Catch per Unit Effort (CPUE) to remain equal to previous 10 year mean, if information available

* Delimitation of zones follows existing division of lagoon into three zones, with north to south gradient of increasing human exclusion and resource conservation.

In general, environmental quality standards become more restrictive from Intensive Use to Primitive Use and Special Areas, as do the uses permitted, while management style moves from regulatory to indirect and subtle.

Land uses other than recreation have had to be included because of existing patterns of ownership and land use. The *Prohibited Zones* are designed to accommodate land uses which are incompatible with recreation either because of the commercial activities conducted there, or because of ownership prescriptions, eg., military areas which are out of bounds to the public.

The Lagoon (Water Areas) Zoning Scheme follows the existing zonation of the lagoon which has been shown to be effective in protecting the lagoon's biotic resources. The Recreation Opportunity Classification (land areas) includes salt marshes but not the intertidal flats. It will be seen that the two classifications complement each other so that the allocation of land units to ROC's dovetails with the zonation of water areas (see Step 7).

Special Areas are described as ecologically critical areas or as areas particularly sensitive to human impacts. These terms are defined in the decision criterion for the first question in the decision tree. They are described as falling within other use zones because they may occupy transitional positions in the landscape, which would make the separation of their management from that of lands around them difficult. Rather, they serve as "red flags" to identify areas which must be managed with special caution.

Primitive Use Areas are extensive areas which contain pristine or near-pristine plant communities, the conservation of which is regarded as a priority. Such extensive areas are also suitable for "wilderness-type" recreation opportunities which will not threaten the maintenance of biotic processes and resources. Hence the specification of an environmental quality standard which demands that there will be no detectable changes in species composition. In practice, of course, changes in localised areas, such as trails and campsites, will occur. The remainder of the standards laid down for this zone refer to user requirements; they are designed to ensure the sense of solitude which is an important component of wilderness experiences. At the same time, the limitation in the number of campsites at one place, for instance, will serve to curtail the extent, hence the impacts, of camping.

Semi-primitive Use Areas are the equivalent of the Bureau of Outdoor Recreation's General Outdoor Recreation Areas. Medium densities of users are tolerable in a robust or extensively degraded environment. They are designed to provide basic facilities for day use, including motorized access, and may be associated with small Intensive Use Areas in the form of *facility nodes*. They serve as a buffer between Primitive Use Areas and Intensive Use Areas.

In *Intensive Use Areas* the emphasis is on satisfying user demands, so long as they do not threaten the conservation values of the park. Such areas conform to the existing situation at the lagoon, particularly Langebaan town. Here environmental quality standards are aimed not so much at the preservation of specific biotic resources, but at ensuring that recreation is conducted in a high quality environment in terms of physical or chemical indicators, such as water quality. Management will tend to be regulatory: this is necessary in situations of high density in order to reduce conflicts between and ensure the safety of recreationists.

CASE STUDY METHODS
STEP 6: DETERMINE SUITABILITY OF LAND UNITS FOR ALLOCATION TO RECREATION OPPORTUNITY CLASSES

6.1 Identify factors which determine suitability of land units for allocation to ROC's.
6.2 Formulate questions and order as a decision-tree.
6.3 Define decision criteria
6.4 Allocate land units to Recreation Opportunity Classes

Since these steps proceeded simultaneously in an iterative interaction, they will be described as one step. It was found that by asking a total of thirteen questions in a hierarchy of six levels, all land units could be allocated to one of the recreation opportunity classes defined in the zoning scheme. The explanation of the questions, decision criteria and question sequence follows (refer to Box 5.2 for criteria definitions discussed in this text).

1. <u>Current land use:</u>

QUESTION 1: Is the area used heavily for recreation or for human habitation at present?

The analysis takes as its starting point existing patterns and traditions of use which there is no need to disrupt, unless there is evidence of significant ecological damage or conflicts related to special conservation values. This view is corroborated by Stankey et al *(1985) and Turner (1988). This first* splitting rule *seeks to discriminate between land units that are currently used for recreation or human habitation (which cannot be moved), on the assumption that such areas may as well be "written off" to continued use, unless there are compelling reasons why this should not be so. Existing use is fundamental to proposals for future recreational use, since, for example, a wilderness, as it is commonly understood, cannot be created from an urban or intensively (cultivated) farmed landscape. A corollary of this question is that it separates extensive areas of the landscape which are not used for recreation and which still retain some or all of their natural character, from those where concentrated use has transformed the features of the land, albeit in a specific locus. The "NO" branch from this question will therefore comprise all those areas not transformed by previous use.* **[Go to pg 198]**

5.7 SUITABILITY OF LAND UNITS FOR ALLOCATION TO RECREATION OPPORTUNITY CLASSES

5.7.1 Decision-tree and Criteria for zone allocations

The decision-tree for zone allocations is shown overleaf in Figure 5.6, while the criteria used for each decision are defined in the accompanying Box 5.2. Criteria definitions in Box 5.2 are listed according the question number in Figure 5.6 to which they are relevant. The decision tree and criteria definitions are discussed fully in Case Study Methods Step 6 (opposite; continued on pages 198, 200-203).

5.7.2 Application of the Decision-tree and Criteria

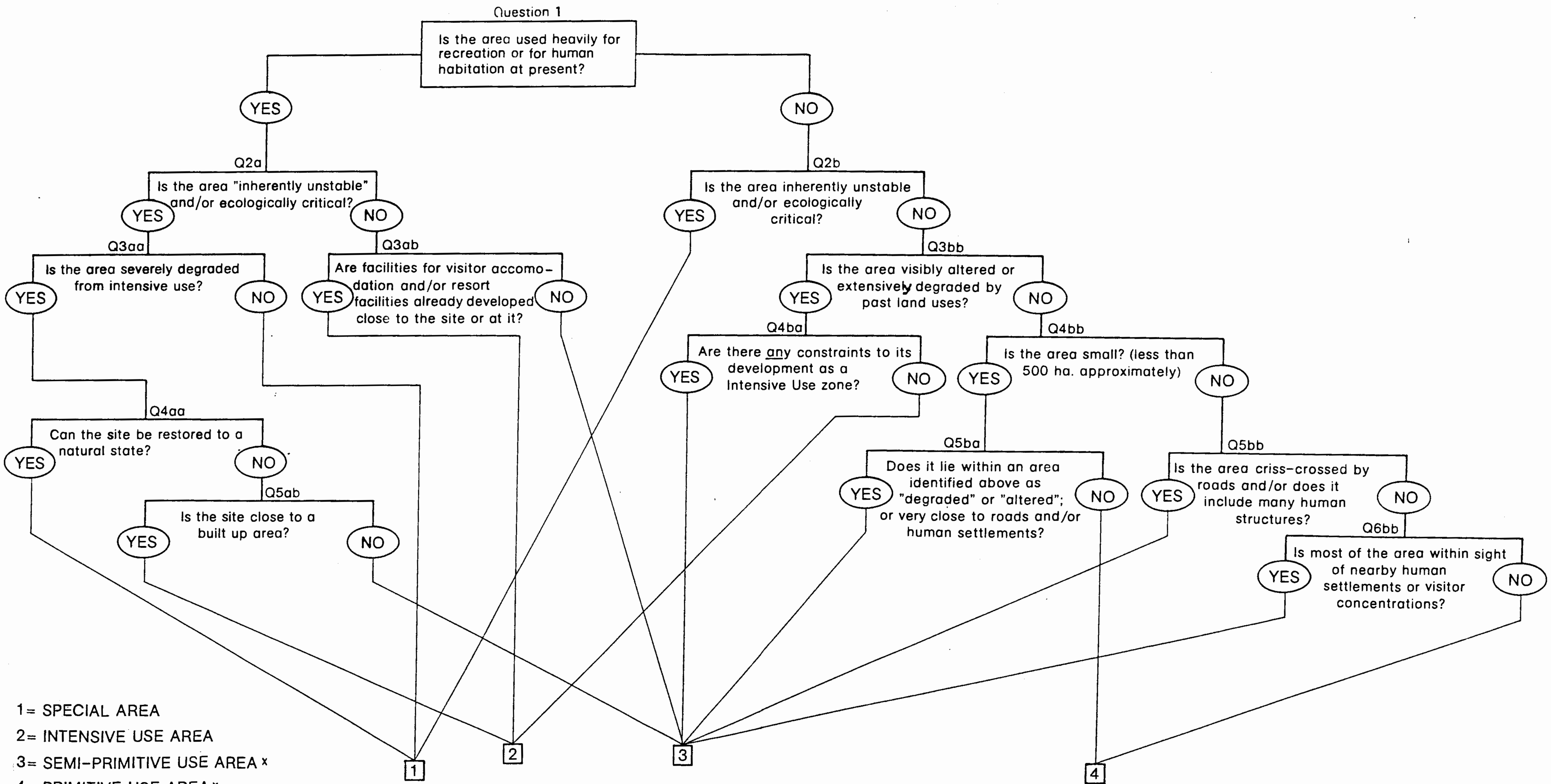
The assignation of land units to ROC's as a result of applying the decision-tree is presented in Table 5.8 (page 199), in which the sequence of questions leading to an ROC assignation is listed. Table 5.7 below shows several examples of the logic of a decision sequence for selected land units.

Land unit	Question	Decision	Reason	Allocation
G2.7---------- (Basement Granite, Granite Outcrop)	1	No---------	not heavily used	
	2b--------	Yes--------	steep slopes unique flora present	Special Area
L2.2 (Surface Limestone, Surface Outcrop)	1----------	Yes--------	heavy use during flower season	
	2a---------	No---------	fulfills no criteria	
	3ab--------	No---------	roads only present	Semi-Primitive Area
C4.1 (Calcareous Dune, Reed Clump)	1----------	No---------	unused, private farm	
	2b---------	No---------	neither critical, nor unstable	
	3bb--------	No---------	not degraded	
	4bb--------	Yes--------	<< 500 ha	
	5ba--------	No---------	>0,5 km from road or village	Primitive Area

Table 5.7: Illustration of application of the ROC allocation decision-tree to individual land units.

Figure 5.6:

Decision-tree for Recreation Opportunity Class allocation



1= SPECIAL AREA
2= INTENSIVE USE AREA
3= SEMI-PRIMITIVE USE AREA x
4= PRIMITIVE USE AREA x
x Totally transformed areas will be separated out later into RESOURCE EXPLOITATION AREAS

BOX 5.2: Decision criteria definitions

Question 1

Heavily used recreation areas = areas which normally attract large numbers (hundreds) of visitors over the Christmas/New Year and Easter weekends, and/or where there is a high probability of meeting 10 or more people on any weekend during the year.

Questions 2a and 2b

Inherently unstable areas = coastal areas defined as such by Heydorn and Tinley (1981) - therefore considered particularly sensitive to disturbance: partially vegetated or bare sand dunes, mobile dune fields; areas of steep slope (>25%) on shallow granitic or limestone soils.

Ecologically critical areas = biologically most productive areas or unique/essential habitats, as identified by biologists and mapped on Overlay 5: Conservation Resources (Appendix F), as "unique" and "important", resources, or areas with greatest density of wader species, greatest number of benthic species/ biomass, seabird colonies.

Question 3aa

Severely degraded areas = areas rendered bare by human and vehicle passage or where plant cover has been reduced by 30% or more from expected cover (estimated on the ground - recent airphotos non-existent); areas where land has been cleared to provide facilities; or due to agricultural practices; areas where infestation by alien tree species is judged on a qualitative scale or "scattered, intermediate, dense" to be "intermediate" or "dense" over most of land unit (as on Overlay 4, Appendix F).

Question 3ab

Facilities for visitor accommodation: presence of towns, villages and clusters of holiday cottages, rest camps, caravan and camping parks.

Resort facilities may include the above, plus hotels, shops, restaurants,sports facilities, launching ramps, etc.

Question 3bb

"Altered" areas = agricultural lands which are presently ploughed or have been cultivated or cut in the past (so that the vegetation is markedly different from the "natural" state; can be easily identified on airphotos by pale tone and smooth texture, or by the regular pattern of strip ploughing and strip cutting.

Extensively degraded areas = areas of "natural" vegetation patchily invaded by alien woody species, and known to have been grazed heavily by stock over a long period, in which there is a widespread network of stock paths and reduced plant cover (visible on airphotos as areas of irregularly stippled texture where bare patches are interspersed with irregularly spaced bush clumps - in contrast with pristine surrounding areas where bushclump spacing is regular and visible bare patches are non-existent. Ground checking revealed an overall reduction in bush clump density and in herbaceous ground cover between bushes, as well as ground disturbance and a network of stock paths.)

Question 4aa

No firm criterion here; hypothetical at Langebaan.

Question 4ba

Constraints include lack of existing road access; steep slopes (>25%); proximity to farm houses; landowner objections; lack of potable water; proximity to acquifers and their recharge areas; continuation of farming activities; falls within a bigger area generally allocated to Primitive Use.

Question 4bb

Small = less than 500 ha.

Question 5ab

Close to a built up area = the central point of the land unit is 0.5 km or less from the nearest town/village.

Question 5ba

Very close to roads = the central point of the area is 0,5 km or less by the shortest distance from the nearest raod (including farm roads but excluding jeep tracks).

Very close to human settlements = the central point of the area is 0.5 km or less by the shortest distance from a human settlement, where "settlement" is a village, town or group of holiday homes, but excludes farm houses.

Question 5bb

The area is *criss-crossed by roads* if there are at least 2 road intersections (including minor and private roads) per square km.

It would be judged to have *numerous human structures* if there were an average over the area of 1 dwelling, windmill, dam, reservoir, or shed per km^2, excluding "human settlements" as defined above.

Question 6bb

"Yes" if settlements and areas of visitor concentration can be clearly seen with the naked eye and form a distinct feature in the landscape thus viewed (subjectively rated); and can be seen from more than 50% of the area.

BOX 5.2:

Decision criteria definitions

The criterion is based on direct observations, counts and user perceptions of existing conditions. Two different descriptions of intensive recreational use are given, because of the pronounced difference between different seasons. In other words, hundreds of people would not always be found in those areas, yet the people using them consider them to be well used.

2. Ecological sensitivity:

QUESTION 2a/2b: *Is the area "inherently unstable" and/or ecologically critical?*

Question 2 seeks to identify those areas which may have special conservation values attached to them in spite of current use, hence the inclusion of the same question in both branches of the decision-tree. The question focuses on identifying land units that are considered, by popular scientific wisdom, to be particularly vulnerable to human impacts (recall the discussion on this topic in 4.2.6.1) for a variety of reasons. By definition these include areas of high biological productivity, species richness, or physical instability - hence the criteria definitions. This is the critical factor approach alluded to earlier, which allows areas of special conservation value to be excluded from further consideration for varying intensities of recreational use. Question 2b identifies highly sensitive areas which have not been transformed by use, so that these could be eliminated from further consideration (the answer Yes to 2b leads directly to a class assignment).

While the estuarine resources of the lagoon have been evaluated by biologists (Overlay 5, appendix F), the same cannot be said for the surrounding terrestrial plant communities. As a guide to identifying sensitive coastal land units, the Earth, Marine and Atmospheric Science and Technology Division of the Council for Scientific and Industrial Research in South Africa is currently engaged in classifying and mapping coastal vegetation in terms of its conservation importance (Raal 1989). The 4-class classification is derived from a formula which includes a rarity factor, species richness, level of endemism, number of threatened species, degree of abuse/disturbance (see below) and alien infestation. This exercise has not been completed for the Langebaan area. In this study, an informal evaluation, based on expert opinion, field observations and the existing literature, has been deemed sufficient for the broad level planning being undertaken. In particular, interpretation of Boucher and Jarman's (1977) detailed vegetation survey and their comments on those types, has been employed in identifying particularly sensitive vegetation types amongst the 20 plant communities they described. Interestingly, Dr Boucher himself was very reluctant to rate these communities in terms of conservation importance and sensitivity: they form a complex, interacting mosaic which should not be dissected. However, at a more detailed level of planning, eg., the routing of a hiking trail, there might be a need for a more refined, detailed analysis of the above type. **[Go to pg 200]**

Table 5.8: Record of decision sequence for ROC assignation of land units

LAND UNIT	QUESTION SEQUENCE	REASON FOR FINAL YES/NO	ROC ALLOCATION
W2,W3,W4	1-2b- Yes-	ecologically critical	Special Area
G2.3, G2.4, G2.5, G2.6, G2.7, G2.8 G2.9, G2.10, G2.11, G2.12	1-2b- Yes	steep slopes, unique biota shallow soils	Special Area
C3.6, C3.7 C3.8	1-2b- Yes	inherently unstable	Special Area
T2, T3, T4, T5, T7, T9, T11, T12 T14, T15	1-2b-3bb-4ba- Yes	national park private land	Semi-primitive
C8*, C5.1	1-2b-3bb-4ba- Yes	adjacent Special Area	Semi-primitive
C5.2	1-2b-3bb-4ba- Yes	adjacent Primitive Area	Semi-primitive
C1.4, C4.1 C7.1, C1.3 C1.2, C2.1	2b-3bb-4bb-5ba- No	most of area does not fit criterion	Primitive Use
L1.1	1-2b- yes	shallow limestone	Special Area
C1.1,C3.3 G1.6, G1.7 G1.8	1-2b-3bb-4bb-5ba- Yes	close to intensive use area or settlement	Semi-primitive
L2.2	1-2b-3bb-4ba	game populations	Semi-primitive
C3.9	1-2a-3aa-4aa-5ab- No	behind Kraalbay	Semi-primitive
C6.1, C6.2	1-2b-3bb-4ba- Yes	landowner objection	Semi-primitive
T10	1-2a-3ab- No	no visitor facilities	Semi-primitive
L2.1, L2.3 G1.1, G1.2, G1.3, G2.2 C3.1, C3.2, T1, W1	Not assigned via decision-tree: Prohibited (military) Zone		

* ERRATUM: 'C'8 should be T8.

<u>3. Presence of severe degradation or permanent structures:</u>

QUESTION 3aa: Is the area severely degraded from intensive use?

This will identify highly sensitive areas (high conservation value) which have been degraded by intensive use. Subsequent decisions must then be made on whether the site or land unit can be rehabilitated cost effectively (Q4aa). If the decision on the latter is No, then the unit's position relative to other units or sites of intensive use are considered (Q5ab) in determining is assignment to an Intensive Use Area or Semi-Primitive Area. In other words a severely degraded site which cannot be rehabilitated cost effectively, is of little actual conservation value. Its further deterioration would, however, be prevented by management intervention.

QUESTION 3ab: Are facilities for visitor accommodation and/or resort facilities already developed on or close to the land unit/site?

This question deals with areas which are not considered sensitive/of high conservation value. It distinguishes areas suitable for Semi-Primitive use from Intensive Use Areas, which have existing visitor accommodation/resort facilities. It is based on the premise that it is desirable not to create new nodes of intensive use or development, but rather to expand existing ones, if need be.

QUESTION 3bb: Is the area visibly altered or extensively degraded by past land uses?

<u>4. Constraints on development or restoration:</u>

QUESTION 4aa: Can the site be restored to a natural state?

There is no firm criterion here, because for Langebaan this remains an hypothetical question. It would in any event be a management decision based on a subjective appraisal of the relative costs and benefits of such an exercise.

QUESTION 4ba: Are there <u>any</u> constraints to its development as an Intensive Use zone?

Question 4ba deals with areas that are not used for recreation or habitation, which are not inherently unstable or ecologically critical, but which have been visibly altered by agricultural practices. Their species diversity and relative abundance is therefore likely to be reduced, so such land units are suitable for medium or high intensity use. However, to conform to the principle of not creating new nodes of development in extensive areas of undeveloped countryside, the criterion is defined in terms of a broad range of constraints on the land unit's potential for development as an intensive use area.

<u>*3. Presence of severe degradation or permanent structures:*</u>

QUESTION 3aa: Is the area severely degraded from intensive use?

This will identify highly sensitive areas (high conservation value) which have been degraded by intensive use. Subsequent decisions must then be made on whether the site or land unit can be rehabilitated cost effectively (Q4aa). If the decision on the latter is No, then the unit's position relative to other units or sites of intensive use are considered (Q5ab) in determining is assignment to an Intensive Use Area or Semi-Primitive Area. In other words a severely degraded site which cannot be rehabilitated cost effectively, is of little actual conservation value. Its further deterioration would, however, be prevented by management intervention.

QUESTION 3ab: Are facilities for visitor accommodation and/or resort facilities already developed on or close to the land unit/site?

This question deals with areas which are not considered sensitive/of high conservation value. It distinguishes areas suitable for Semi-Primitive use from Intensive Use Areas, which have existing visitor accommodation/resort facilities. It is based on the premise that it is desirable not to create new nodes of intensive use or development, but rather to expand existing ones, if need be.

QUESTION 3bb: Is the area visibly altered or extensively degraded by past land uses?

<u>*4. Constraints on development or restoration:*</u>

QUESTION 4aa: Can the site be restored to a natural state?

There is no firm criterion here, because for Langebaan this remains an hypothetical question. It would in any event be a management decision based on a subjective appraisal of the relative costs and benefits of such an exercise.

QUESTION 4ba: Are there <u>any</u> constraints to its development as an Intensive Use zone?

Question 4ba deals with areas that are not used for recreation or habitation, which are not inherently unstable or ecologically critical, but which have been visibly altered by agricultural practices. Their species diversity and relative abundance is therefore likely to be reduced, so such land units are suitable for medium or high intensity use. However, to conform to the principle of not creating new nodes of development in extensive areas of undeveloped countryside, the criterion is defined in terms of a broad range of constraints on the land unit's potential for development as an intensive use area.

5. Resource requirements of different ROC's:

QUESTION 4bb: Is the area small?

Here expanses of unspoilt, but not highly sensitive land are under consideration for inclusion in a Primitive Use Area (which caters for "wilderness type" recreation and conserves representative stands of vegetation). The criterion refers to the necessity for large areas to accommodate this kind of use. The particular limit is related to the characteristics of the particular area; in other localities it may be feasible to have a larger unit.

QUESTION 5ab: Is the unit close to a built up area?

Referring to units which are inherently unstable/ecologically critical, but degraded and not worth rehabilitating: this question establishes such a unit's suitability for inclusion in a Semi-Primitive Use Area (if it is distant from a built up area, that is, part of an open expanse of countryside), or an Intensive Use Area (close to a built up area). Recall the resource conditions associated with the definitions of these zones in Table 5.4.

QUESTION 5ba: Does it lie within an area identified above as "degraded" or "altered", or very close to roads and/or human settlements?

Question 5ba deals with robust land units which are in a relatively non-degraded state, but which are smaller that 500 ha. If such a unit is not surrounded by extensively degraded lands (Q3bb), nor is it close to settlements, it is suitable for inclusion in a Primitive Use Area. The criteria limits are arbitrary, but are related to the topography and dimensions of the Langebaan landscape.

QUESTION 5bb: Is the area criss-crossed by roads and/or does it include many human structures?

More subtle distinctions between areas suitable for wilderness-type use and Semi-Primitive Use are being sought here. Semi-Primitive Use implies medium densities and motorized access, while Primitive use excludes motor vehicles beyond the periphery and seeks landscapes which show few of the scars of human use. A glance at Overlay 4 (Appendix F) will quickly show those areas where the presence of people and their artifacts have disturbed the landscape. This question addresses those areas where the vegetation may be in a natural or semi-natural state, but which have been dissected by infrastructure.

QUESTION 6bb: Is most of the area within sight of nearby human settlements or visitor concentrations?

This final question addresses perceptions regarding wilderness: if the viewer cannot see "civilization", the area may suffice for Primitive Use, but if the constructs of intensive development are always obvious, even if the area is undegraded this will detract from its wilderness character.

STEP 6.4: Allocate land units to Recreation Opportunity Classes

The land units are identified on the overlay on Figure 5.5 by alpha-numeric labels. Each uniquely labelled land unit is then taken through the decision-tree: the planner/analyst "interrogates" the land unit in the sequence laid out in the decision-tree. The decision made on each question, starting at the top of the tree (splitting rule 1), determines the path taken to the next question level, and so on. The characteristics of the land unit (Step 3; descriptions in section 5.4) are compared with the criteria definitions by inspecting Overlays 4 and 5, Appendix F. When a class assignation is reached, the result is recorded in Table 5.8.

CASE STUDY METHODS
STEP 7: ALLOCATE OPPORTUNITY CLASSES IN THE LANDSCAPE AND MAP THE RESULTING ZONING SCHEME

This step is separated from the previous one, 6.4, by the necessity to review each land unit's ROC designation to ensure that they are practical and feasible. It is not always possible to be entirely consistent. For example, a road may make a more practical boundary between Primitive and Semi-Primitive Use Areas than the true land unit boundary.

5.8 CONCLUSION: RECREATIONAL ZONATION OF THE STUDY AREA

The zonation of the Langebaan lagoon environment is presented as a map in Figure 5.7 and is the product of the application of the decision-tree criteria to each land unit identified above.

This process resulted in an overall allocation for each land unit which was then modified on an *ad hoc* basis. This was done in order to separate discrete parts of land units which for special reasons did not fit into the overall zone allocation of that land unit . Where this has occurred the reasons for the final zone allocation are explained in this text. That part of land units C7.1 and L1.1 which runs along the lagoon side of the Churchhaven peninsula, is largely not used for recreation, but has been moderately degraded by past agricultural use, informal camping and walking. It is also immediately adjacent to the road and the fishing villages. The Kraalbay recreation area is visible from most points within it. These factors make it unsuitable for inclusion in a Primitive Area, so that all the land between the road and lagoon on the Churchhaven peninsula has been designated as a Semi-primitive Area. This zone is suitable for medium intensity recreational use and simple, rustic facilities; Facility Nodes are also frequently associated with this zone. Stofbergsfontein, Churchhaven and Kraalbay, as areas which are fairly intensively used at present, are thus identified as being potential Facility Nodes.

Land unit L1.1 has been severely degraded by sheep grazing in the past, so that the bulk of it to the west of the road has been included in the Churchhaven peninsula Primitive Use Area.

All land immediately adjacent to the lagoon and bounded by the gravel road has been zoned for Semi-primitive use, because it is this area in which human settlement and activity at the lagoon are concentrated. Much of the land in this area is degraded and it is either close to or within visible range of intensively used areas. These factors make it unsuitable for designation as Primitive Use Area. The road provides a clear and easily managed boundary.

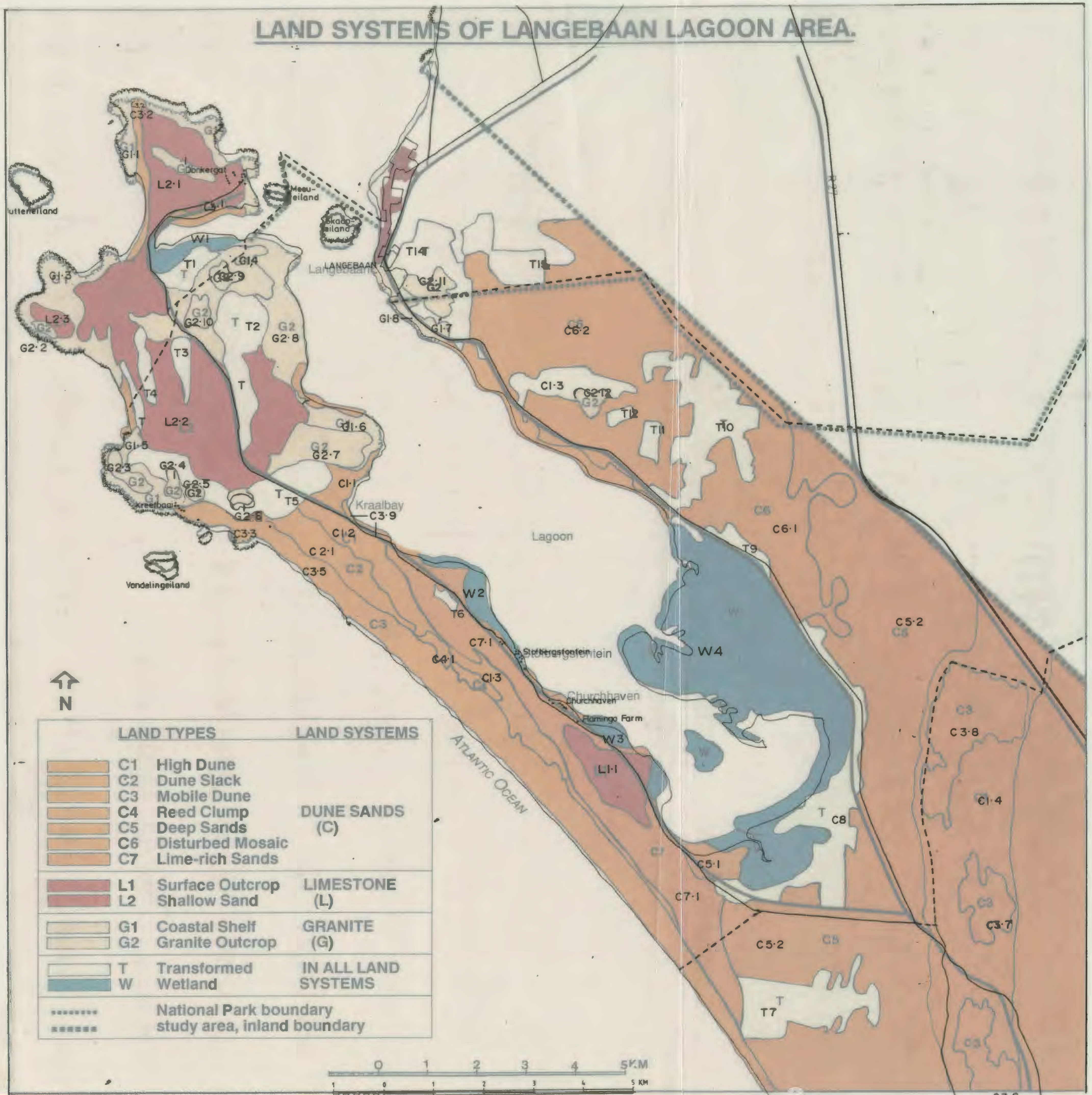
The Postberg Nature Reserve has been zoned for Semi-primitive use for similar reasons: it is criss-crossed by a network of roads and tracks, has large areas of degraded veld and is subject to very intensive use during the flower season. However, during other times of the year, its spectacular scenic beauty may effectively make it suitable for the "wilderness experience" associated with a Primitive Use Area. It may be noted that this area includes extensive tracts of Special Area zoning, for instance, the steep NE-facing slopes of Konstabelkop and Vlaeberg. Such areas would be subject to special use restrictions in order to protect their ecological value.

Almost the entire eastern side of the lagoon has been zoned for Semi-primitive Use, because (a) it is extensively degraded by farming practices (See Map Overlay 4, Appendix F) and (b) it is still actively farmed. These factors again make it unsuitable for providing a wilderness-type of recreation experience.

All the salt marshes in the lagoon are Special Areas because of their ecological importance, as are the most productive intertidal sand- and mudflats. The existing zonation of the lagoon has been kept, since ecological experts are confident that it is sound (Branch, Hockey, Underhill pers comm.). The southernmost zone, which is presently off-limits to the public, could be utilised for interpretive pursuits, such as bird-watching and guided canoe trails, which will afford minimal disturbance to

FIGURE 5.5

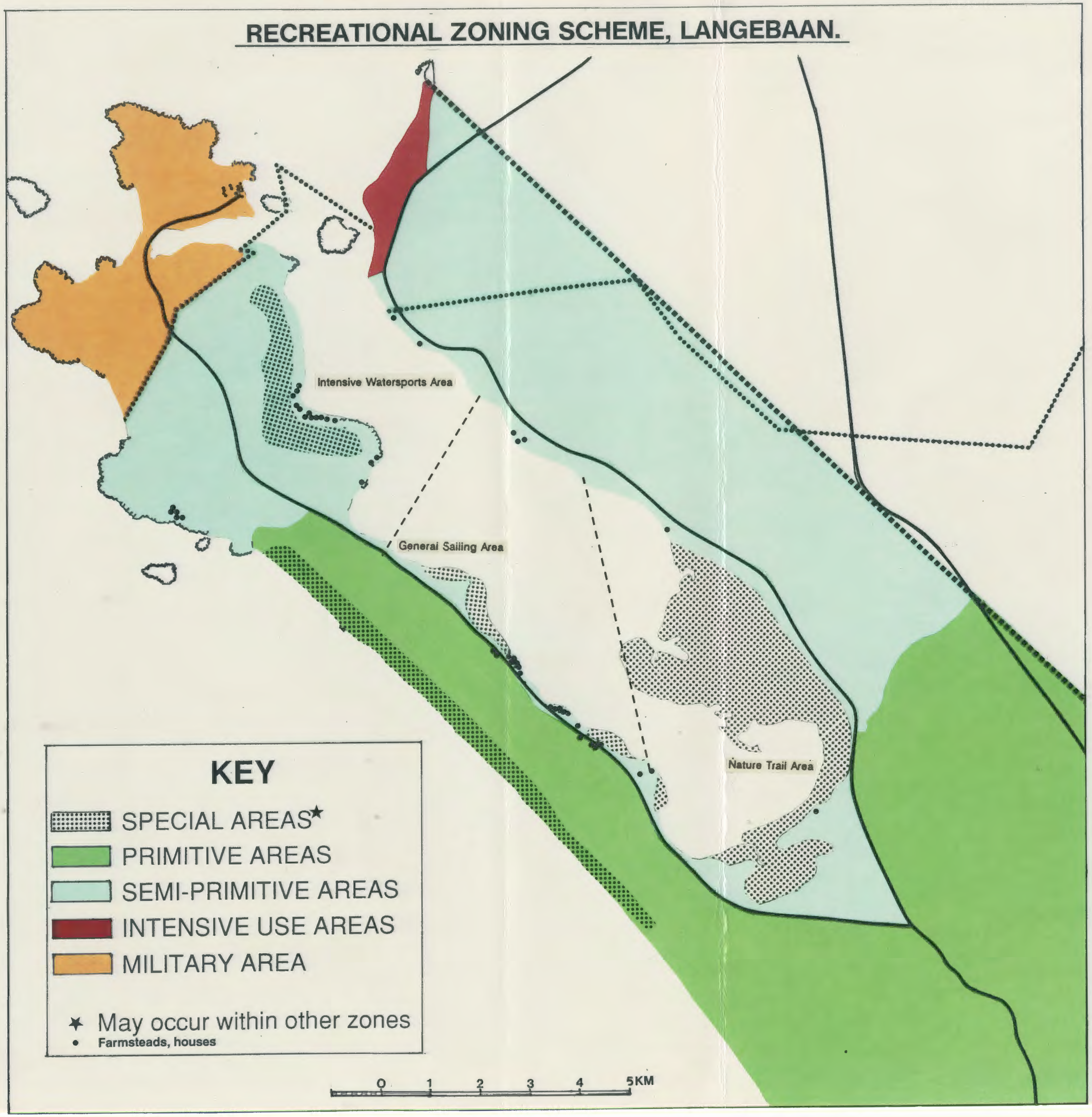
Map of Land Systems and Land Types



LAND SYSTEMS OF LANGEBAAN LAGOON AREA.
LAND TYPES
LAND SYSTEMS
C1 High Dune
C2 Dune Slack
C3 Mobile Dune
C4 Reed Clump
C5 Deep Sands
C6 Disturbed Mosaic
C7 Lime-rich Sands
DUNE SANDS (C)
L1 Surface Outcrop
L2 Shallow Sand
LIMESTONE (L)
G1 Coastal Shelf
G2 Granite Outcrop
GRANITE (G)
T Transformed
W Wetland
IN ALL LAND SYSTEMS
National Park boundary
study area, inland boundary
N
Lagoon
Atlantic Ocean
Langebaan
Kraalbay
Churchhaven
Flamingo Farm
Vondelingeiland
Meeu-eiland
Skaapeiland
Donkergat
Kreefbaai
0 1 2 3 4 5 KM

FIGURE 5.7

Map of recreational zoning plan for the Langebaan lagoon area



RECREATIONAL ZONING SCHEME, LANGEBAAN.
Intensive Watersports Area
General Sailing Area
Nature Trail Area
KEY
SPECIAL AREAS*
PRIMITIVE AREAS
SEMI-PRIMITIVE AREAS
INTENSIVE USE AREAS
MILITARY AREA
* May occur within other zones
• Farmsteads, houses
0 1 2 3 4 5KM

The objectives of the dissertation were:

1) to examine the concept of recreation carrying capacity as a framework for resolving recreation planning problems in natural landscapes;

2) to develop a decision-making procedure for establishing recreational carrying capacity guidelines in natural landscapes;

3) to test the procedure by applying it to the planning of recreation in the Weskus National Park.

In addressing the first objective, the RCC concept was examined in considerable detail. The classic approach to RCC determination which sought to establish the point at which unacceptable or irreversible damage to the environment commenced, was found to be an illusory concept. The concept is bedevilled particularly by widespread findings that most damage follows rapidly on the initiation of even low levels of use, levels which are repeatedly exceeded by today's burgeoning outdoor recreation populations. In addition, human perceptions are a vital aspect of the RCC concept, so that recreational resources comprise a combination of the activities themselves and the setting in which they occur. These activity-environment "packages" constitute recreation *opportunities* which are the unit of analysis in recreation planning. In addition, the manipulative capabilities of management suggest that, as a management objective, the prevention of irreversible damage is malleable and ductile. Investigations of use-environment interactions are therefore insufficient as a basis for establishing the RCC of a landscape.

Furthermore, the diversity of perceptions on what constitutes a quality recreation experience, led RCC researchers to realize that a diversity of needs existed which had to be catered for by providing a diversity of opportunities. [The Recreation Opportunity Spectrum was developed to add a regional perspective to the provision of this diversity, in an attempt to halt the widely observed trend in individual areas from less developed to more developed. (However, recent papers on the state of national parks the world over do not suggest that this has been a particularly effective strategy!)]

The conclusion reached by early proponents of the concept was that the critical tasks of management were to establish carefully formulated objectives for recreation planning and management, to clearly define what is acceptable, to write standards to describe those conditions and to monitor the resource base to see that the standards are maintained. In establishing these norms the inter-relationships of management objectives, recreation user attitudes and the impacts of recreation on the environment should be considered.

So a new type of procedure is required: not one which attempts to predict a threshold of irreversible change, but one which guides the setting of objectives, and determines attributes which will serve as performance criteria for those objectives.

Also, in planning the recreational use of a landscape, the spatial allocation of recreation opportunities must be accomplished.

The corollary of this analysis is that RCC determination procedures comprise a series of decisions about the allocation of recreation resources, these decision sequences sharing many characteristics with general environmental decision-making procedures.

In addressing the second objective, the principles and problems of and approaches to the solution of general decision-making processes were examined. How to improve environmental decision-making, given the complexities of environmental interactions, competing objectives, different rationalities, the uncertainties of prediction, the biases of analysts/ decision-makers, measurement difficulties and the inherent subjectivity of judgmental processes, is a complex subject. There is consequently an enormous range of approaches available to the analyst interested in reducing these difficulties. The range goes from very formal procedures and techniques for the quantification of all values, through a continuum of increasingly informal, qualitative approaches. Considering the widespread evidence of bias on the part of even the most apparently objective scientific analysts, the conclusion is easily reached that the choice of a decision-making approach is also likely to be influenced by preferences and prejudices. In addition, numerous constraints caused by factors external to the decision problem may further affect the choice of approach.

The only counter to this pervasive bias is to open the decision-making process to scrutiny by making it systematic, comprehensive and explicit. By clearly structuring the problem, specifying objectives, formulating decision rules and describing the sequence of decisions taken to reach a conclusion, interested parties can explore and question the logic of the process. The techniques or methods used to solve particular information gathering or analysis problems within the overall process need not be prescribed, provided that they are made explicit.

Other researchers in the field of recreation planning had conceptualised the problem in similar fashion. The re-formulation of the carrying capacity concept as the Recreation Opportunity Spectrum (ROS) and Limits of Acceptable Change planning system was a response to the recognition of the need for planning recreation at different spatial scales, the regional (ROS) and local (LAC). The ROS provides an almost literal framework into which a particular locality/site can be placed to establish the mix of recreation opportunities which should be provided there. The LAC planning system gives form to these opportunities at the local level.

It is clear that the hierarchical framework established by the Recreation Opportunity Spectrum, operating at a regional scale, and the Limits of Acceptable Change planning system, designed to address local problems, in combination provide a powerful decision-making tool for planning recreation and maintaining environmental quality. Since the emphasis in this dissertation is on how to accommodate both recreation and conservation in protected natural landscapes, the focus here is on the LAC as an approach to local area planning and management.

The LAC was designed as a decision-making framework for local area planning and management. The LAC system places the definition of objectives, the specification of standards for their attainment, the evaluation of alternatives and the structuring of data acquisition, at the core of the decision-making process. However, it fails to make explicit a sufficiently rigorous ecological analysis for the planning of protected landscapes. The LAC Area Issues and Concerns calls for the recording of special values to be maintained in the area, but does not require a systematic description of biophysical characteristics as a basis for planning. Neither do the LAC variables which serve as indicators of resource and social conditions (LAC Step 3) constitute an *ecological* analysis; they serve to focus the collection of data, but critical ecological processes may not be reflected in them.

In addition, I submit that a third level of planning is required that the LAC does not distinguish. The LAC operates at the level of allocating recreation *opportunities* in the landscape, and couches the standards for the indicators of the limits of acceptable change in terms of particular activities, eg., extent of bare ground at campsites. I submit that detailed plans for each *activity* included in a recreation opportunity class needs to be planned and spatially located in the landscape. This data intensive process would be the object of a third level of analysis operative at a site scale. It is illustrated by a detailed study of boating at Langebaan lagoon, included as Appendix D. At the level of recreation opportunity class (ROC) allocation, the indicator variables should attempt, at least in respect of ecological indicators, to reflect *ecosystem* processes.

More importantly, the LAC fails to lay bare in any formal way the values and preferences of, and criteria by which, planners and managers allocate recreation opportunity classes in the landscape. The development of the LAC concept is therefore taken further in Chapter 4 with my proposals for a decision-making framework for recreation resource allocation. The proposed procedure is based on the LAC process, but differs from it and makes additions in several crucial details.

The general attributes of an appropriate decision-making framework adopted in Chapter 3 were that the procedure should be:

1. Rational and systematic;

2. Goals and objectives important;

3. Based on substantive knowledge;

4. Process rather than output oriented;

5. Explicit and defensible;

6. *Adaptable*;

7. *Political viability*.

The procedure described in Chapter 4 and tested on the Weskus National Park at Langebaan lagoon comprised the following steps:

STEP 1	Inventory of resource and socio-economic conditions
STEP 2	Identify area issues and concerns
STEP 3	Identify land systems and land types and map them
STEP 4	Define management objectives for recreation and park character
STEP 5	Define and describe Recreation Opportunity Classes
STEP 6	Determine suitability of land units for allocation to recreation opportunity classes
STEP 7	Allocate Opportunity Classes in the landscape and map the resulting zoning scheme

In applying this decision-making process to the Weskus National Park, it was shown to be effective in allocating a spectrum of recreation opportunities in the landscape.

Step 1 establishes a comprehensive information base about the area in question for all the succeeding steps. It is necessary as a precursor to succeeding steps, and has the important function of identifying gaps in the knowledge base. The acquisition of both biophysical data and information about the socio-economic environment, especially regarding attitudes and preferences to recreation, is a central feature of this step. With respect to Langebaan lagoon, this process established that comprehensive information was available on which to base recreation opportunity allocation, but that at the next level of planning, detailed experimental investigations in land areas of use/impact relationships would have to be undertaken before quantitative indicators of resource standards could be set. Step 1 contributes to the fulfilment of general requirement number 3, "based on substantive knowledge". Clearly, with respect to the case study, this requirement is met.

Step 2 interprets information from Step 1, and should clearly identify the preoccupations of the different interest groups in the area. It serves to focus the formulation of objectives and lay the foundations of a definition of park character. It is an important link in the chain of logic.

Step 3 is concerned with analysing the ecological characteristics of the area more formally than in Step 1, to establish the basis for ROC allocation. In a variable landscape it is necessary to have **homogenous** units of land as the basis for analysis, the characteristics of which can be evaluated for their suitability for allocation to ROC's. The integrated approach to land classification has been adopted as the most cost effective technique, but other methods are not precluded. This improves the systematic nature of the planning process.

Step 4 is part of the aproach to ensure that values are made explicit. The objectives are formulated as specifically as possible, so that they provide a real yardstick against which to measure performance. The definition of park character makes an additional contribution to this, in making explicit the management authority's vision of what type of environment they wish to conserve. In the Weskus National Park, this was conceived as being a rural environment in which resident people were an integral element, which provides a very different baseline for subsequent actions from conceiving of it as a wild, pristine, primitive landscape. Values underlying the process were made explicit in the formulation of very focused, specific objectives for the provision of recreational opportunities in the national park. This step establishes the importance of goals and objectives.

Step 5 gives practical expression to the goals and objectives, by defining the range of social and natural resource conditions and managerial characteristics which accompany the range of recreation opportunity classes deemed appropriate to the objectives and park character defined previously. A shortcoming of the dissertation is that quantitative indicators of resource standards, particularly ecological standards operating at the ecosystem process level, were not able to be developed for Langebaan. However, since the procedure is process rather than output oriented, the qualitative standards identified here serve as a starting point for further refinement.

The concern with exposing values and making the planning process explicit is given its most deliberate expression in Step 6. Here the sequence of decisions leading to ROC allocation of land units is structured as a decision-tree and criteria defined for proceeding through the decision-tree. The decision rules are based on factors found generally to affect perceptions of recreation opportunity, the recreation interest variables, and on ecological characteristics, which represent the conservation interest variables. In this way land units are allocated to recreation opportunity classes in such a way that recreational resources are created and protected simultaneously with conservation resources. While the factors embodied in the decision criteria are generally applicable, the precise form of the questions and quantitative limits placed on criteria, where these are applicable, are area specific. The procedure is adaptable however, because decision trees and criteria definitions could be structured for any area under scrutiny.

Step 7 concludes the process, by recognizing that the complexities of these planning procedures cannot be systematized from A to Z, that room needs to be left for anomalies and common sense.

And common sense, really, is the crux of the matter. The procedure is based on observations that despite very sophisticated analyses being done, finally decisions may be made on the basis of a few very simple factors. This procedure makes those factors explicit, but at the same time provides a structured, systematic and logical base for decision-making. By taking account of public opinions, and by selecting a process which does not rely heavily on quantitative, aggregated measures of value, so that the logic is directly and easily discernible by members of the public, the procedure is likely to be politically defensible. It follows a trend in environmental evaluation against an over-reliance on numeric analysis which may obscure bias and sources of possible conflict.

The contribution of this work lies in developing more explicit, systematic procedures for handling the subjective aspects of the LAC decision process. It does **not** attempt to do away with subjective procedures, in fact, it acknowledges the central place these have in environmental decision-making, given the uncertainties and complexities attending the process. The techniques of land evaluation are employed to improve the rational and systematic basis for decisions, while techniques of decision analysis are incorporated to structure the subjective decision process. The case study and its products were undertaken by the author with input from a variety of sources, but without an elaborate data generating methodology. It is held that this is sufficient for recreation planning at the opportunity allocation level where a good information base on the area being planned is available, so long as the way in which this knowledge is used is made explicit.

I submit that this procedure holds real promise for improving defensible recreation planning strategies and managing protected landscapes. But taken as far as it has been in this dissertation, it has several shortcomings. Firstly, the case study plan has not been taken to the public domain, except inasmuch as public opinion surveys identified attitudes and preferences of people recreating at Langebaan lagoon. In a real application, the recreation master plan resulting from the procedure would be part of a public participation campaign, in which the public would be asked to comment on the displayed material which would include the decision-tree. This could not be undertaken for the dissertation because of financial constraints.

More importantly, the same constraint limited the development of quantitative standards of environmental quality for the recreation opportunity classes. However, these could, I believe, be the subject of a disseration in their own right, especially in refining the distinction between standards appropriate at an ecosystem level of analysis and applicable to recreation opportunity classes, and those operating at a site level and applicable to activity planning.

In final conclusion, I submit that the concept of recreation carrying capacity is a dangerous illusion in recreation planning, and should be abandoned. Far more productive is the limits of acceptable change approach, but even here the possibility of defining, on the basis of experimental field work, meaningful quantitative limits to ecological impacts is arguable. Some confidence may be anticipated in the social parameters of limits of acceptable change indicator standards. Regarding ecological standards, I do not believe that generally applicable standards can be obtained, because the complexity of interactions makes quantitative relationships site specific. In addition, the failure to identify thresholds of ecological degradation emanating from recreational use undermines the possibility of an objective basis for definitions of acceptability. Consequently, I submit that more overt, deliberate recognition should be given to management decisions on what are acceptable standards (given public input, etc.), and on manipulation, both physical and social, that is, landscape modification and visitor control, by whatever means deemed appropriate, to maintain those standards.

Finally, I leave the reader with a quotation from Mitchell (1979:199) which, in my opinion, sums up the subject:

> "As most writers testify, the final decision about carrying capacity is always an *arbitrary* one. Someone, somewhere, sometime, must decide what constitutes an undesirable change in vegetation and soils, or an unacceptable level of crowding or congestion".

APPENDICES

APPENDIX A

REVIEW OF METHODS OF LAND EVALUATION (AND THE DETERMINATION OF RECREATION CARRYING CAPACITY)

A.1 THE ROLE OF LAND EVALUATION IN RECREATION PLANNING

What is called land classification or land evaluation is now widely employed as the first step in any land use planning, due to the development of so-called ecological planning in the twentieth century (Steiner, Young and Zube 1988). Where recreation is to be the dominant land use "the evaluation of the land and water resources of the area for their suitability for recreation is a necessary prerequisite for...planning" (Hogg 1977:101). Bastedo and Theberge (1983:317) identify the underlying motivation for resource evaluation as the increasing need to identify opportunities and constraints related to land use and environmental protection; Pigram (1983:42) sees such procedures as answering questions relating to what actually constitute recreation resources and what factors add or detract from the quality of the leisure environment.

These questions are best answered by a systematic assessment of resource potential, beginning with the identification and classification of elements of the recreation resource base (Pigram 1983:42). Such approaches provide a uniform basis for decision-making about land uses, aimed at minimizing the negative environmental impacts (social costs) of such uses and maximizing their social benefits (Pigram 1983; Mitchell 1973; McHarg 1969; Mabbutt 1968).

Classification is fundamental to science, indeed to all conceptual thought, and its primary function is to construct classes about which inductive generalisations can be made (Gilmour 1951). It consists of ordering or arranging objects into groups or sets on the basis of their similarities or relationships (Bailey, Pfister and Henderson 1978:650). Classification reduces the wealth of information available into a manageable number of subsets describing recognizable relationships (Bailey *et al* 1978). Land classification simplifies the task of delineating areas with different land use potential (Mitchell 1973).

An important point for **this** application is Gilmour's (1951) observation that the particular classes created are dependent on the specific purpose, that is, there is "no one ideal and absolute scheme of classification for any set of objects" (Bailey *et al* 1978:651). This becomes all too apparent in the field of land or resources evaluation, in which a vast number of approaches has been developed (Rogers and Steinitz 1969); the products of these approaches are very different, precisely because they are so dependent on the manipulable classification process.

The question of which particular approach is the appropriate one, remains. Since the focus of this study of recreational carrying capacity is the *ecological* capacity of recreational landscapes, the emphasis in choosing a classification system will be on approaches appropriate to ecological analysis. Scientific analysis of ecological systems is notoriously complex because of the apparently endless numbers of interacting variables. Because the recreation resource base is the natural environment, and since a major objective of conservation today is the maintenance of ecological processes, any appropriate classification is complicated by the necessity to accommodate the dynamic nature of ecological interactions. It will become apparent in the succeeding discussion that approaches to land evaluation are not all primarily concerned with ecological relationships (though this is a common theme through the majority), because they have been developed from a wide range of different perspectives for a variety of purposes.

It is clear from the literature that land use planners who have adopted resource or land evaluation approaches do so precisely because they implicitly recognize that there are limits to the land's capability to support different land uses (Mitchell 1979). It is implicit that the specific combination of natural attributes which determines the form of a given landscape, that is, its intrinsic characteristics, also determines its potential for human usage (Pitt and Zube 1989). Following on from this, different parcels of land may be expected to have different capabilities. Techniques of land evaluation have certainly been widely used in recreation planning, but systematic application in a study of recreational carrying capacity is new.

Recreation presents some particular problems to the land evaluator, not least due to the diversity of activities included under this all-embracing term. What then constitutes a recreational resource is almost limitless. The evaluation must thus be broad enough and flexible enough to serve as the basis for assessing the landscape's suitability for a wide variety of purposes and potential impacts. Of course, this process is often simplified by limiting the recreational activities and facilities to be considered. This is one of the reasons for zoning recreational opportunities.

A.2 REVIEW OF APPROACHES TO LAND EVALUATION

Rogers and Steinitz (1969), Bailey *et al* (1978) and Moss (1983) have drawn attention to the bewildering array of land or resource classification or evaluation approaches that have been developed. They identified as a particular problem in this field the confusion regarding terminology, concepts, methods, scale and application (Bailey *et al* 1978:650) and sought to clarify this confusion. They were not the first: comprehensive reviews have been undertaken by, amongst others, Brink and Partridge (1985), Pigram (1983), Brink, Partridge and Williams (1982), Hopkins (1977), Dawson and Doornkamp (1973), Mitchell (1973), Mabbutt (1968), and Belknap and Furtado (1967)[1]. It is not my intention to provide another comprehensive review; rather the most general principles, major developments and trends in the field relevant to this work, are discussed. Terms as they will be used in the dissertation are defined below.

A.2.1 Definition of terms

The terms *land evaluation, land classification, resource analysis* and *evaluation of resource potential*, appear to be used almost randomly in the literature. At the outset, we need to distinguish *resources* from *land*. Resources are attributes or characteristics (usually biophysical) of the environment "appraised by man to be of value over time within constraints imposed by his social, political, economic and institutional framework" (O'Riordan 1971:4).

In Mabbutt's words, land denotes "a complex of surface or near-surface attributes significant to man which may vary individually and in relation to each other to give

1 Unfortunately, reviews of this vast field tend to introduce new sources of confusion by creating classifications of classifications!

local colour" (Mabbutt 1968:11). *Attributes* are the specific bio-physical properties, such as geology, soils and vegetation, which in combination define the morphology of land. Land could therefore be described as the totality of natural resources, or the integrated morphological expression of them.

Secondly, the terms *land evaluation* and *land classification* have different connotations. Longman's English Dictionary defines evaluate as to determine or assess the value of. Land evaluation is the process of estimating the potential of land for one use or several alternative uses (Mitchell 1973:5). Mitchell further introduces a quantitative factor in his definition of land evaluation which is, "the act or result of expressing the numerical value of; judging the worth of". But a necessary start to resource evaluation is resource *classification* (Pigram 1983; Bailey *et al* 1978), which has already been defined as the identification of classes on the basis of similar properties. From this proceeds Mabbutt's (1968:11) widely accepted definition of land classification as

> *the identification and recording of character and establishing its occurrence by categorizing land character into units of determinate extent.* (There is no suggestion of determining the value of the identified classes.)

It is thus clear that land *evaluation* is distinct from land *classification*[2]. Land evaluation goes one step beyond land classification in evaluating the potential of land for specified land uses. Certainly in the literature the distinction is not very clearly drawn, with the two terms being frequently interchanged or even confused (Rogers and Steinitz 1969:300).[3]

In this dissertation, *land evaluation, land appraisal* and *assessment of resource potential*[4] are taken to mean essentially the same thing. The term *terrain* classification is also used (Brink *et al* 1982; Mitchell 1973; Brink and Partridge 1967); again, terrain and land are considered to mean much the same thing, although terrain may be more closely tied to the geomorphological classifications used in engineering appraisals of land.

A.2.2 Methodology of land or resource evaluation

As observed earlier, land evaluation methodology is notable for the sheer variety of approaches. Rogers and Steinitz (1967) observe that the search for one all-embracing methodology may be futile; land evaluation appears to be largely an

---

2 although Mitchell insists that the former is merely one type of the latter!

3 Mitchell (1973) obfuscates the matter further in introducing the term *land appraisal* which he describes as the manipulation, interpretation and assessment of data for practical ends. This, surely, is the purpose of all approaches to land evaluation.

4 *Resource potential* refers to the land's suitability for alternative uses and its capability to support them.

empirical response to a wide variety of practical problems, giving rise to an equally wide range of land classification systems and evaluation schemes. Applications in recreation planning have generally been derived from approaches developed for other purposes. In their excellent review they selected, from some 200 studies, sixteen resource analysis methods for comparison. Rogers and Steinitz did a useful analysis of some of the characteristics of these approaches. Their tabulations are presented at the end of this text as Tables A1 and A2: the tables categorize the approaches by their subject, sources of data and analytical techniques used (Table A1), and frequency of use of resource attributes (Table A2).

The range of applications went from state-wide recreation demand\supply analyses (Michigan RECYS Study 1966; Hills 1960) to evaluations of forest campground sites (Allison and Leighton 1967); from watershed-wide plans for urban development (McHarg 1963) to appraisals of scenic values (Zube 1967). Techniques employed ran the gamut from non-professional evaluations to computer based predictive models. Data sources ranged from existing information to special data collection procedures.

What these approaches have in common is, firstly, they all aim to provide information pertinent to decisions of the kinds and intensities of land use appropriate for a given area and, secondly, they generally conform to the following sequence of steps (which are common to other approaches reviewed as well):

a) **resource survey:** an inventory and classification of existing conditions (Bastedo and Theberge 1983) - a descriptive phase usually presenting the distribution of resources in mapped form (the classification phase proper);

b) **analysis of land use requirements:** the conditions necessary for optimal functioning of the proposed land uses are inventoried\analysed in broad or specific terms; (This step is not always a discrete phase in that the criteria for land use suitability are not made explicit.) Problems here relate to the all-embracing nature of recreation and the establishment of these requirements. They are generally determined by subjective means - state of the art judgement (Stankey *et al* 1985) - and interviews with users (Goodall and Whittow 1975); they are the result of accumulated management experience and user preferences. The intangible social components of such requirements, such as solitude in wilderness recreation, means that the evaluation of suitability for each activity in all parts of the landscape is meaningless. This establishes the need to first evaluate landscapes for their suitability for recreation <u>opportunities</u>, as opposed to single recreation activities.

c) **suitability or capability analysis:** the rating of the surveyed resources in terms of the degree to which they are able to meet the requirements identified in (b) - this is the evaluation phase proper, expressed as resource potential. Procedures adopted to accomplish this task are almost invariably subjective, based as they are, again, on experience, intuition and subjective knowledge. Understanding of natural systems remains too crude to make accurate, objective projections. The opinion of experts is usually relied upon to complete the rating.

Young (1973, in Dawson and Doornkamp 1973) adds a *development* phase to the process: this is the actual physical planning necessary to convert resource *potential* into *production*. At this stage social and economic factors may be brought in.

Many methods described as resource surveys or land classifications in fact include the evaluation phase (c); and the survey and evaluation phases are frequently not described as separate entities. Hopkins (1977) identifies as a sub-class those methods which never actually present raw resource[5] data, such as slope or vegetation, but from the start map derived factors or factor (=attribute) suitability ratings, for example, access, ecological significance or scenic beauty. Rogers and Steinitz (1967) draw attention to the same confusion. Furthermore, many analyses include the artifacts of human intervention, such as transport networks and infrastructure, in "resource" surveys.

This general procedure apart, there is a major conceptual division within the field of land evaluation, which is manifest in two fundamentally distinct approaches to the classification and analysis of land. Firstly, what is alternatively called the *integrated resource survey* (Bastedo and Theberge 1983), *landscape*[6] *approach* (Mabbutt 1968), or *regionalisation* (Bailey *et al* 1978), *gestalt* methods (Hopkins 1977; Mitchell 1973; Rogers and Steinitz 1969), *biophysical land classification* (Hamill 1984; Rowe and Sheard 1981; Rowe 1980; Lacate 1969) and *multifactor ecological classification* (Spies and Barnes 1985; Barnes, Pregitzer, Spies and Spooner 1982). In contrast to this group are *parametric procedures* (Gordon 1978; Speight 1968; Hopkins 1977; Mitchell 1973; Mabbutt 1968)[7].

The two classes of method aim to identify units of land which display internally consistent or homogeneous characteristics, as a prerequisite to the systematic assessment of their suitability for various land uses. The first class of methods (integrated, landscape, gestalt) analyse the land in its entirety as an integrated whole, without first separating it into its component attributes of climate, soils, geology, vegetation. Parametric methods, by contrast, use the distribution of individual attributes, as independent variables, to develop a composite picture of the landscape.

---

5 What is meant by resources in this context, is usually much the same as the term attributes, that is, those biophysical features of landscape which constitute the natural resource base for outdoor recreation, namely, soils, water, vegetation, and so on.

6 One must not be confused by Mabbutt's use of the term *landscape* here: while landscape is colloquially taken to refer to the aesthetic aspects of an area of land, Mabbutt uses it in a strictly physical sense, meaning the composite of qualities and characteristics that give an area its particular bio-geophysical character.

7 A third group of methods which does not fit neatly into this scheme, is less concerned with the concrete properties of land than with its aesthetic or spiritual appeal. To confuse matters, this group is called *landscape evaluation*, which attempts to classify the aesthetic value of landscapes (eg. Pickles 1978; Appleton 1975; Turner 1975; Linton 1968; Zube 1967).

A.3 PARAMETRIC APPROACHES

Parametric methods accomplish the sub-division and classification of land on the basis of selected attribute (or factor) values (Mitchell 1973). They map the distribution of single attributes in the environment, for example, soils, geology, vegetation, surface or ground water, and may then combine them by arithmetic or visual (using overlaid transparencies) addition to give homogeneous *land units*. Sometimes the responsible agency may be interested in one factor only, such as the agricultural productivity of soils.

When the intention is to identify land units, overlaying of single attribute maps will yield a composite mosaic. Areas homogeneous with respect to each attribute may be outlined by using approximately coincident boundaries which require only minor adjustment, or by combining the information from different overlays which appears to be complementary (Hammond and Walker 1984; Ferguson 1981; Mitchell 1973). These procedures have been quantitatively refined by the use of computerised statistical techniques such as cluster analysis. Combinations of attributes constituting land units may be recognized by defining terrain classes in terms of different attribute values applied simultaneously (Brink *et al* 1982:211).

Whereas the landscape approach separates units on the basis of visible changes in the occurrence of recognition features such as vegetation or landform, in parametric procedures it is necessary to fix limiting values for class intervals. Strictly speaking, in the parametric approach the recognition of landscape features plays no part in the delineation of class boundaries; in practice this is, in fact, often the case (Brink *et al* 1982). Limiting values may be derived from some relevant land use criterion, for example, crop soil requirements or the cut-off points in slopes suitable for different land uses, but sometimes totally arbitrary mathematical divisions may be necessary (Mitchell 1973).

Parametric systems require systematic field sampling, often using a grid system, to generate their data base and to ensure that it is fully quantitative. Such sampling yields an array of numerical values related to a grid of sample points. Mapping proceeds by drawing isopleths connecting points at the class cut-off values. One method called *trend-surface* mapping generates a three-dimensional diagram from the two-dimensional grid data (Pigram 1983; Zetter 1974; Mitchell 1973). Sometimes stratified random sampling points related to complex landscape features, may be necessary to supplement grid data (Brink *et al* 1982).

A critical step in the resource survey is the choice of attributes and range of data to be inventoried. The general requirement is for attributes which are relevant to the land use being considered, and which are recognizable and measurable in the field

(Mitchell 1973:34). Among those who advocate *comprehensive* data banks[8] are Wallace-McHarg (undated), the United States Army Corps of Engineers (1968), Hills (1960) and Christian (1958). Classifications based on a small number of *critical* variables are presented by South Africans Hugo (1984), Boddington (1980), A'Bear and Little (1976) and Beaumont, Carter and Gregg (1975), and by Coppock and Duffield (1975) of Scotland.

Comprehensive data banks are supposed to avoid the pitfalls inherent in choosing attributes, but they are not as unbiased as they might appear. They also involve expense, interpretive difficulties and enormous logistical problems in data handling especially where overlays are concerned (the maximum number of transparent overlays is 6 or 7 (Gordon 1978)). As far as objectivity goes, McHarg is a case in point: while compiling apparently exhaustive inventories in all his studies, he never in fact uses precisely the same mix of attributes in each. Thus the resource variables on which he bases his Plan for the Valleys are quite different from the Piedmont Regional Study; so too are the results very different.

This is not surprising considering the sheer magnitude of possible attributes: in the 16 papers they reviewed, Rogers and Steinitz listed a total of 450 distinct variables used in the analyses! Nevertheless, certain attributes are invariably used in one guise or another, for instance, Soil Type, Vegetation. These common variables are shown in capitals in Table A2, included at the end of this appendix (from Rogers and Steinitz 1969); some of their detailed properties are listed below each one, eg. soil stoniness, soil compactability. Only those environmental factors which are commonly identified as being of major importance to recreation are included in the table. The major variables used stem from knowledge of environmental relationships. One does not need a world authority to observe that soil and vegetation type are major players in the interaction of recreation with the biophysical environment!

With respect to the derived attributes favoured by some authors, there are serious problems as regards objectivity, in the collection or derivation of these data. Included in this category are McHarg's suitability ratings of vegetation types for urban development, Coppock and Duffield's (1975) *suitability for water- and land-based recreation*, *scenic quality* and *ecological significance*, and A'Bear and Little's (1976) ratings of agricultural and forestry land. McHarg (1969) skirts this obstacle by talking convincingly of the *intrinsic* suitability of natural attributes for different types of development; Coppock and Duffield (1975) use expert opinion to establish minimum criteria of suitability and habitat diversity as an index of ecological significance; and A'Bear and Little consult experts in establishing their rating scheme. But none of these authors can hide the essentially subjective nature of their procedure[9], nor do they mitigate this problem by making the criteria used in

8 **i.e., the mapping of all attributes with potential relevance**

9 **Although McHarg would have one believe his ratings can be scientifically derived, according to McAllister (1980);**

establishing these ratings explicit, with the possible exception of McHarg's rules of combination (Hopkins 1977). Williams (1967) goes so far as to question the widespread claims of objectivity of numerical classifications, especially computer-based. He advocates caution, noting that such classifications are intended to be hypothesis-generating, not hypothesis-testing. His opinion is confirmed by Gordon (1978), who admits to the impossibility of eliminating subjective judgements from such procedures (see further remarks below).

A.3.1 Advantages of parametric methods

Parametric methods are considered to be more objective because they are able to make use of quantitative data (Hopkins 1977; Mitchell 1973; Mabbutt 1968). This gives them greater potential for providing very precise information (Brink *et al* 1982). Also, as understanding of natural systems and measurement of their characteristics improves, so can parameters be modified or added to increase the accuracy and efficacy of evaluative models (Mitchell 1973). Their potential power is again vastly increased by the advent of computer-based modelling which allows the incorporation of large numbers of attributes (far more than can be handled manually or by overlays) to increase the sophistication of resulting models (Gordon 1978; Coppock and Duffield 1975; Rogers and Steinitz 1969). Numerical analysis has allowed the development of some at least partially predictive models of landform (Gordon 1978). Furthermore, computers make possible the systematic inclusion of invisible and intangible parameters, such as wind or indices of demand, into resource evaluations (Rogers and Steinitz 1969).

A.3.2 Disadvantages

There are a number of problems with parametric methods:

1) The choice of attributes to map can be problematic, since any environment presents an apparently endless array of characteristics to choose from, and the configuration of the resulting land units is at least partially dependent on the attributes mapped (Mitchell 1973). The subjectivity of this process has been discussed, but Gordon (1978) makes the additional point that practitioners often bury their assumptions and criteria in the ranking of attributes. This is in contrast to integrated surveys in which real, visible spatial differences are mapped. The corollary, of course, is that this allows greater flexibility in application, by varying the choice of attributes, although authors such as Mitchell (1973) insist that for true land classification, the criteria used in defining land units should be chosen from the fundamental and permanent features of the landscape and not those more loosely related to it. The latter, in Mitchell's view, include the works of man and "ephemeral" properties such as flora; most other authors, however, would certainly include vegetation amongst the fundamental properties of landscape.

2) Different attributes are recorded in different spatial dimensions, for instance, some derive from point source data, some from line transects and some are diffuse (Mabbutt 1968), making their integration difficult.

3) Related to (2) is the difficulty in recognizing boundaries of classes of some attributes, particularly soils, which are not readily visible on the surface, without a large number of field observations (Brink *et al* 1982).

4) The methods do not indicate cause\effect relationships between attributes (Bastedo and Theberge 1983; Moss 1983; Mitchell 1973; Mabbutt 1968). In fact, they cannot do so because they must implicitly assume that each component acts independently (Gordon 1978). Even less can the descriptive mapping of discrete attributes reflect their functional relationships in terms of biophysical processes[10].

5) Interdependence between attributes can be accommodated only with difficulty (Hopkins 1977; Mabbutt 1968).

6) Mathematical manipulations of essentially ordinal or nominal data are frequently unsound (Hopkins 1977). This is true for overlay techniques such as that pioneered by Ian McHarg in which shaded areas are added to give a composite shading, the tone of which is calibrated to a suitability rating. But in defence of these simple techniques Whitaker (1984:20) argues that unless greater precision and accuracy are required there may not be any need to go for more sophisticated methods (such as non-linear modelling).

7) The methods are only as accurate and useful as the coarsest parts of their data base (Rogers and Steinitz 1969); frequently the elegance of results belies the quality of the data base. Rogers and Steinitz observe that the general principle seems to be to use the best available data, but they criticize authors for accepting unquestioningly the limitations of using data collected for different purposes, and often on varying spatial scales. Nevertheless, this situation is likely to persist in most circumstances because of the expense of data gathering.

8) The large data requirement and increasing necessity for computer handling of complex data make these methods time-consuming and expensive. In short, they may require uneconomic effort to establish a sufficiently comprehensive data base to ensure accuracy in interpolating boundaries (Brink *et al* 1982:213).

9) Whitaker's (1983) and Brink *et al's* reservations are supported to some extent by Gordon (1978). He attempted to quantify ecological relationships between environmental components by performing factor analysis and euclidean distribution classification algorithms, on a 42-variable data set. He was able to collapse this data set into 10 variables which explained 70 percent of the ecological variation

---

10 However, I am not sure that any land classifications to date explicitly do so; at best, it is implicit in integrated surveys.

(pattern) in the landscape. Nevertheless, his conclusions were, that no matter how comprehensive the data set, this would not eliminate the need for numerous subjective judgements. More importantly perhaps, he cautioned that the validity of such correlations was closely tied to the choice of statistical techniques and that this was not a straight-forward process. In short, most practitioners in the field would be unable to perform such analyses. If Gordon is correct, then his conclusions profoundly undermine the validity and usefulness of statistical parametric approaches to the characterisation of landscape pattern.

With respect to procedures for recreation planning in natural areas, the major disadvantage of the parametric approach is the hefty field data requirement. Since most conservation agencies, certainly in South Africa, constantly bemoan their lack of funds and manpower, recommended methodologies must be cost effective. Neither does South Africa have the comprehensive data base enjoyed, for instance, by planners in the United States where excellent soil maps for virtually the entire continent are readily available through government agencies, especially the Army Corps of Engineers.

A.4 THE INTEGRATED APPROACH TO LAND EVALUATION

In the integrated approach the analysis proceeds from the *a priori* identification of land units, usually by aerial photo interpretation, on the basis of visual differences in physiographic characteristics (Mabbutt 1968; Dawson and Doornkamp 1973; Mitchell 1973). The method starts by identifying all obvious discontinuities in the landscape visible on remote sensing products, followed by field checks to confirm or modify the analysis. The classification may proceed either by subdivision of large areas into increasingly smaller units, or by aggregation of individual sites, according to defined criteria, into larger and larger entities (Bailey *et al* 1978). The land units are then described in terms of their biophysical attributes - soil, vegetation, geology.

As indicated above, there are many approaches to integrated land classification, but the concept of landform which underlies land systems mapping (discussed overleaf) is common to them all (in contrast to, for instance, climatic or vegetation classifications). So too are the resulting land units generally labelled in terms of their physiographic attributes, although different groups use very different descriptive terminology. I endorse Rowe's remarks about the confusion in terminology: "Different words do not necessarily refer to different things, and one man's 'land element' may be another one's 'biogeocoenosis' " (Rowe 1980:19). Rowe's response is common sense: the common denominator, he says, is a concern with ecology, that is, environmental **relationships**. Land, or surface form, is assumed to be the integrated expression of its underlying geology, soils, vegetation and climate (Dawson and Doornkamp 1973; Mabbutt 1968; Brink and Partridge

1967). Rowe points out that, while the only way to map is to use visible surface features, namely vegetation and landform (Rowe 1980:20), it is the observed and inferred spatial coincidences, patternings and relationships of soils, landforms, vegetation and climate which the land evaluator must elucidate.

The integrated resource survey (Bastedo and Theberge 1983), otherwise known as biophysical or ecological land classification (Lacate 1969; Rowe 1980) has been used for resource planning in the large undeveloped tracts of Northern Canada. Although the terminology used is very different from that used in other classifications, the procedure remains essentially the same. Thus the Canadian *ecoregions* and *ecodistricts* may be the equivalent of the *land systems* and *land types* of Christian's (1958) landscape approach. The Canadian system produces maps which are elaborately rated at a high level of detail, for a variety of different uses, such as forestry, recreation and wildlife. The basis for the rating of land units is not clear; the procedure and its products are complex and confusing.

A more recent application of the integrated approach is Barnes *et al*'s (1982) *multifactor ecological classification* of northern hardwood forests in the United States. Although the name may suggest a parametric approach, the actual methodology relies on initial classification from aerial photographs followed by field verification of soil type, vegetation type and physiography. The method was in fact developed to test the relative accuracy of an integrated approach versus one based on two attributes only, namely subsets of the soils/vegetation/physiography complex. Statistical analysis demonstrated that all three parameters were necessary for consistent identification of land units which were observable in the field.

The best known example of the integrated approach is called *land systems mapping* or *terrain classification*. It was developed as a method of reconnaissance survey, but it can be used at a range of scales. It is widely used in regional planning by the CSIRO in Australia[11]; by engineers in Britain and South Africa[12]. Its widespread use is probably attributable to its applicability at a variety of mapping scales (Bailey *et al* 1978) and the relatively low costs of the approach.

Landform is classified as a series of hierarchically arranged units, which at each level define areas of homogeneity at different scales. *Land systems* are physiographic entities with characteristic patterns of topography, geology, soils, vegetation and climate identifiable at the scale of geographic regions (Bailey *et al* 1978). The recognition of pattern is a definitive criterion in the delineation of land systems (Speight 1968). Usually each land system is dominated by one major geologic or geomorphic feature, the result of major geomorphic processes. (Brink *et al* 1982). These have also been called *land types* (Hills 1960, cited by Belknap and

---

11 the PUCE classification (Aitchison and Grant 1967);

12 Christian (1958) and Christian and Stewart's (1968) integrated resource survey developed into the land systems\land facet classification of Brink, Mabbutt, Webster and Beckett (1968) at Oxford, and used in South Africa by Brink and Partridge (1967).

Furtado 1967) or *land patterns* (Brink *et al* 1982). [The equivalence of these terms is my interpretation of the literature - they are not critically discussed elsewhere, except to a limited extent by Mabbutt (1968), Speight (1968) and Rowe (1980).

Land systems can then be further sub-divided at a larger scale into *mapping* or *land units* (Cooke and Doornkamp 1974; Rogers & Steinitz 1969; Christian 1958), *land facets* (Brink and Partridge 1967), *physiographic site types* (Hills 1960) or *site units* (Barnes *et al* 1982). These are the smallest physiographic entities that can be reliably identified on aerial photos (Mabbutt 1968). They are distinguished by a simple surface form, a specific soil profile often bearing a particular vegetation type and a characteristic ground water regime. They are repeated in a typical sequence or pattern through the land system (Brink *et al* 1982; Bailey *et al* 1978; Mabbutt 1968; Brink and Partridge 1967). The final criterion for definition of land facets is, according to Beckett & Webster (1967), that their physical properties should be sufficiently uniform for a good arable farmer to manage the whole extent of one facet in one way. Speight (1968:239), however, does not see the facet as a fundamental unit: he calls them a transitional category defined purely on the basis of descriptive convenience.

Speight is in agreement with those authors who claim further divisions which represent an even greater degree of homogeneity (Dawson and Doornkamp 1973; Mitchell 1973; Lawrence *et al*'s (1977) land *elements*, or Christian's (1958) *site types*). But Mabbutt (1968) and others draw attention to the difficulties even at the facet level, in identifying the precise point at which values are sufficiently different to justify their separation into a new unit. Some practisioners circumvent this difficulty by talking of **patterned** facets (Lawrence *et al* 1977), especially in landscapes of high topographic heterogeneity and geological complexity. Here the identification of units of homogeneous character may be almost impossible.

Different components of the landscape may be used to differentiate units at successive levels of the hierarchy: land systems may be identified primarily by climate and geology; the next level by vegetation and soils and the third by relief and aspect. Criteria at the upper levels are broad and general, while lower down they are more specific (Rowe 1980; Bailey *et al* 1978). Mitchell (1973:11) makes the point that the characteristics whereby land types are recognized, for example, vegetation type or photo tone, are not necessarily the same as its definitive criteria, which are usually given in terms of forms and materials. The significance of these points will become apparent in the application of these methods as described in Chapter 5.

A.4.1 Land Systems Mapping and Ecology

There are differing opinions on the extent to which land systems mapping (or integrated resource surveys or biophysical land classification), based as it is primarily on the analysis of landform, is the appropriate vehicle for ecological analysis and classification (which is what we are, ideally, aiming for here). While there is much discussion of this problem in the literature, there are curiously few attempts to provide a working definition of an ecosystem; it is apparently assumed that everyone agrees on what they are talking about. Odum's (1971:8) early definition still stands as a classic:

> Any unit that includes all of the organisms (i.e., the community) in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles within the system is an ecological system or ecosystem.

A somewhat simpler definition, provided by Siegfried and Davies (1982), is "an ecological community and its abiotic environment", in which an ecological community is a set of local interacting populations of organisms.

In either case, the definition emphasizes the coupling of components to form **functional units** (Odum 1969). The litmus test of any ecological classification ought then to be whether or not it establishes this functional coupling. In practice, this is almost impossible to accomplish; it is assumed rather than explained, as Moss (1983) maintains. Plant ecologists, according to Mueller-Dombois and Ellenberg (1974), are in any case divided over the degree to which the repeating groups of associated species which comprise *plant communities* influence each other and are interdependent. The extreme school, of which Whitaker (1970, cited by Mueller-Dombois 1974) was a prominent adherent, holds that communities are hardly discrete units; they represent hardly more than the chance meeting of a number of species whose environmental tolerance ranges overlap. The whole is less than the sum of its parts (Mueller-Dombois and Ellenberg 1974:4).

What the vagueness regarding functional relations does mean, however, is that ecosystem boundaries are difficult to draw. Even where boundaries may be sharp (land/water interfaces, for instance), adjacent systems are not independent; they interact via flows of material and energy, so that boundaries are variable and imprecise (Siegfried and Davies 1982). In addition, there should be no limitation on size and kind: anything from a leaf or a drop of water, to the entire planet, can be regarded as an ecosystem (Mueller-Dombois and Ellenberg 1974). There is therefore a scaled hierarchy of ecosystems, and the delineation of boundaries is to some extent artificial. As noted before, *ecosystem* is thus a conceptual, rather than an actual, entity (Scholes 1989; Mueller-Dombois and Ellenberg 1974).

Land systems mapping, as Bailey *et al* point out, always deals with geographically associated objects, each land unit constituting a concrete and unique piece of terrain (Bailey *et àl* 1978:653). Several authors hold that the land systems approach is valuable because it separates the landscape into natural units based on origin, process and form (Brink and Partridge 1984; Mitchell 1973; Mabbutt 1968). It thus generates units which represent the product of the interaction of all genetic factors in giving a single ecosystem (Mitchell 1973:27). What we are dealing with is natural areas of interplay of land-forming agents (Mabbutt 1968). Landform thus provides the best means for identifying functionally similar and dissimilar ecosystems (Rowe and Sheard 1981). Mabbutt notes that this approach aims to discover *causes* of differentiation in landscape, no matter how superficial the criteria which are chosen to define or identify land units. He maintains that the land systems approach does define land at the ecosystem level, citing the example of the catchment basin which is a fundamental unit in integrated land classification.

Furthermore, as Bailey *et al* (1978:652) write:

> It is widely recognized that components of the landscape occur in patterns and complexes that affect physical and biological processes such as erosion and plant succession....Process is controlled by structure and cannot be observed, much less inferred, from system components alone. It emerges only at the integrated system level which shows not only composition, but structure and interactions.

In other words, a map of rock types cannot tell the observer where landslides will occur; only when integrated with information on climate and topography may this become apparent.

However, many researchers are agreed on the integrative nature of vegetation - the distribution of plant communities integrates climate, edaphic and topographic factors - hence it is used as the basis for much ecological mapping (Bailey *et al* 1978; Mabbutt 1968; Hills 1966). Mapping the vegetation is "the only effective method to present the ecological order of our living space", says Kuchler (1984:3). On the other hand, in confirmation of the integrated approach, Spies and Barnes (1985) have demonstrated that vegetation alone is insufficient for mapping ecosystem boundaries. Moss (1983:14) warns against fundamental problems in defining vegetation units for land mapping purposes. He questions whether it is possible to recognize discrete, bounded vegetation units on the ground.

One cannot ignore, however, the long tradition of vegetation mapping within the botanical sciences. There are many approaches to vegetation classification, all of which differ subtly in their orientation[13]. For instance, the European school of physiognomic or phytosociological classification, led by the Braun-Blanquet school since shortly after the turn of the century, emphasizes ecological relationships in its interpretation of vegetation distribution (Kuchler 1984; Werger 1974). The method rests on the prior recognition in the field or from remote sensing products, of phytocenoses or stands of vegetation[14], characteristic examples of which are sampled. In this respect it is very similar to the integrated approaches, which use field checking to confirm patterns already observed on remote sensing products.

13 For an excellent, full treatment of the subject, refer to Mueller-Dombois and Ellenberg (1974). These authors maintain, however, that all these orientations are synthesized in the "ecosystem" concept.

14 the basic unit of vegetation classification, the equivalent of the *land facet*, is the vegetation *association* which, sensu Mueller-Dombois and Ellenberg (1974), has a definite floristic composition, uniform physiognomy and uniform habitat conditions, and is named after the dominant/distinctive species of the association.

While the objectives of phytosociological classifications are quite different from those of land classifications, the end results are remarkably similar. In combination with detailed botanical characteristics of the sample stand, information on physical parameters of the stand are also recorded (Werger 1974). Phytosociological classifications thus produce maps of floristically and environmentally characterized natural entities; it is empirically determined that patterns in floristic composition correspond to patterns in the environment (Werger 1974:317). Kuchler (1984:3) argues that a phytocenose is the only tangible, integrated expression of the entire ecosystem; it is the basic unit to be mapped.

The difference in approaches is related to emphasis and level of detail. In vegetation classifications, obviously vegetation takes precedence as an indicator of environmental pattern and in sampling effort (habitat parameters are defined loosely, recorded less rigorously and described vaguely; they serve merely as an adjunct to floristic parameters, unless the investigators are statistical ecologists with a particular interest in plant-habitat interactions (Werger 1974)). In the land systems approach, vegetation would be characterized probably in less detail and sampling effort divided more evenly over the range of parameters. Interestingly, there appears to have been little contact between the botanical mappers and the land evaluation school, though there would appear to be much mutual benefit to be gained from such interaction.

In the integrated school, Rowe (1980) gives perhaps the most coherent account of the relationship between environmental attributes and ecology. He describes three kinds of attributes used to capture ecological units of land:

(1) **key factors**, especially climate, are factors which exert a very strong influence on the physical and biological properties of land;

(2) **controlling features** are physical components of land, geological structures and surface forms, which control the intensity of key factors such as radiation and moisture;

(3) **environmental indicators**: soils, vegetation, fauna and land uses are the biological indicators of the land environment; changes in them may indicate significant changes in key factors and controlling features.

Rowe, like Spies and Barnes (1985), holds that maps of any individual factor in any of the three categories are not ecological maps: they become ecological only when their interconnectedness is demonstrated. However, identifying the spatial coincidence of factors (which is what most land classifications do) does not constitute an understanding of their ecological interactions. In other words , describing a land unit in which vegetation community *x* is to be found on soil type *y* with a slope range *z*, does not explain why this is so. At Langebaan, for instance, the same vegetation community type appears to occupy areas with two soil types: what then is the key factor controlling its distribution?

In fact, in South Africa little research has been done to elucidate relationships between macro-biotic components and physical factors. Our understanding of environmental controls remains in the realm of broad generalisations. A recent revision of Acock's (1975) vegetation classification of South Africa has, however, attempted to quantify the relationship between vegetation type at a biome level with physical determinants. Statistical analysis confirmed a strong correlation between vegetation and a combination of an index of summer aridity and rainfall seasonality (Rutherford & Westfall 1986). But this would be of little value in planning at the local and site level.

Latterly, new developments in the integrated approach have stressed the dynamics of biophysical systems. Moss (1985, 1983) argues that land classification procedures should identify the *key dynamics* of the landscape, because biophysical processes are the critical properties of the environment which are impacted by land uses. Most existing classifications, while recognizing the interactions of components, fail to reflect these in their static descriptions of land units. The prescriptive value for land use planning of such classifications, therefore, is limited to assumptions only (Moss 1983:145).

While Moss' approach solves many of the conceptual problems of either the traditional integrated or parametric procedures, the dynamic nature of processes makes the mapping of their spatial distribution extremely complex. His solution is somewhat disappointing . He uses energy and moisture, as critical determinants of biotic distribution, as his processes, but has not yet come up with a satisfactory method for mapping processes.

Other analyses based on ecological principles take *habitat* as their unit of analysis (Margules and Usher 1984; Tubbs and Blackwood 1971). There are two problems with habitat:

(1) as with the concept of ecosystem, the hierarchical nature of the concept and the interaction of adjacent habitats makes boundaries difficult to establish;

(2) habitats are most often described in terms of vegetation, for example, *woodland* or *savannah*, and few classifications of habitats for plants exist. Where physical habitats are described, they usually apply to large vegetation units such as biomes, and are characterised in terms of broad physical parameters, particularly macro-climatic variables, e.g., Rutherford and Westfall (1986).

A.4.2 Advantages of land systems mapping

The integrated view of land is particularly appropriate to the assessment of overall land potential. Development involves consideration of the whole resource complex in a framework of land areas (Mabbutt 1968; Belknap and Furtado 1967). Land systems mapping by its integrative, comprehensive nature, provides a general framework within which more detailed data can be gathered.

This is appropriate to recreation studies for two reasons: firstly, because recreation impacts a spectrum of environmental attributes and, secondly, information on the variety of variables with significance to recreation requirements can be rapidly obtained within a meaningful framework.

The advantages of land systems mapping include a limited need for field verification, simplicity, low budgetary requirements, potential for rapid transfer of material to planners and environmental managers (Cooke and Doornkamp 1974; Mabbutt 1968). Cooke and Doornkamp believe the method is not suitable for site selection, but Brink and Partridge's (1967) use of it in evaluating alignments for roads demonstrates that it is capable of resolution to fine detail. However, these authors also make it clear that the quality of the method relies heavily on expertise and experience in geomorphological analysis and aerial photo interpretation.

A.4.3 Problems in integrated surveys

Integrated resource surveys in general have been criticized on a number of points (Mabbutt 1968):

1) The subjectivity of boundary definition in landscapes characterised by environmental gradients. However, this applies to all land classification and description.

2) The methods are not quantitative; Speight (1968) however, has continued earlier work by Savigear (1956) and Troeh (1965) in delineating facets and elements using equations expressing mathematical relationships between physical parameters related to slope. There may be some argument though as to whether Speight's approach falls into the integrated or into the parametric camp.

3) Differences in some attributes, such as soils, are not always detectable on remote sensing products; or differences in one component, soils for instance, may obscure patterns in another, such as vegetation: this may be true in arid environments where vegetation cover is sparse (Lane 1980).

4) For practical purposes, knowledge of specific attributes may be vital and small differences may go undetected; data may effectively be lost by presentation of data by integrated methods (Bastedo and Theberge 1983);

5) Different criteria or attributes are used to distinguish units at each level in the hierarchy ie. lack of systematic application of criteria (Moss 1983). Moss claims that the significance of changes in one level of the hierarchy cannot then be evaluated at another level of the system. At the same time, however, he recognizes

that different factors control vegetation units at different scales (Moss 1983:147). The answer to Moss' misgivings is perhaps given by Werger (1974:315) who, quoting Hull (1964/65) on the subject of taxonomic classification procedures, states that "usually no one particular property or set of properties is necessary and any one of numerous sets is sufficient" for grouping taxonomic units.

Moreover, insisting on the rigid rules of hierarchy theory may well impose artificial constraints on complex natural order. At different scales, different forces and processes operate (Scholes 1989). Climate at the continental scale operates as high and low pressure cells, trade winds and so on. At a land facet level it is expressed as diurnal temperature fluctuations, orographic rainfall, soil temperature and local moisture gradients. It would be nonsensical to distinguish land facets on the basis of global circulation, yet they may be distinguishable on the basis of other parameters falling under the general heading Climate. The use of apparently different criteria at successive levels of the hierarchy may thus simply reflect the complexity of natural processes. And as Mabbutt suggests it is, if the purpose of land classification is to uncover the causes of land differentiation, then units mapped on the basis of the same criteria at every scale, might well be entirely artificial.

6) Classification procedures fail to distinguish between what Moss (1983) calls the "active" and "relatively inactive" components of land. Active components respond rapidly to environmental change, particularly human-induced change. They tend to be the biotic fractions of land - vegetation and the upper soil horizons - and can be measured on a timescale of human activities. Moss maintains that only these components are relevant to land use planning, because they can be modified by land use. The inactive components - geology and macroclimate - will not be modified[15]. This would mean the omission of climate in land classification procedures, but this contradicts Moss' own pre-occupation with processes, since it is climate which drives many of those processes.

7) Moss (1983) objects to the assumed dominance in many classification procedures, of one component of the land system, be it landform, vegetation or soils. No single component controls all processes, says he. But again, he misses the point: landform, for example, may be a more accessible, observable indicator of the presence of different land facets and land systems, than the controlling climatic factors. Finally, one must not forget that landform, in integrated mapping, is only a mapping tool and that land classification maps represent nothing more than an approximation of the land complex.

---

15 **He was writing before the Greenhouse Effect swept world headlines!**

A.5 CONCLUSIONS

Recreation planning requires methods for the classification of land and the evaluation of recreation potential. The general steps in this process are an inventory of attributes and resources, both biophysical and socio-economic, an analysis of recreation requirements and an understanding of the land area's vulnerability to recreation impacts. A wide variety of methods for accomplishing these tasks is available which make varying claims to objectivity. However, numerous problems exist in the analysis and evaluation of land for planning purposes.

These problems comprise: the objective, quantitative identification of natural land units; the choice of attributes to define or characterise them; the delimitation of land unit boundaries; the identification of recreation requirements; and the definition and characterisation of criteria - both ecological (relating to ecological vulnerability) and social (relating to user preferences) - for determining suitability for different recreational types.

Subjectivity is inherent in the presentation of apparently the most simple, objective data. Rogers and Steinitz (1969)) again hit the nail on the head in observing that "one has the curious feeling that the several investigators are looking at the same objectively measurable data and idiosyncratically interpreting them". Thus Angus Hill's interpretation of the Ontario landscape becomes a patchwork of *landscape units* and *physiographic site types*, while Philip Lewis' vision of the Wisconsin landscape comprises resource *corridors* within which lie concentrated resource *nodes*.

Such semantic or conceptual differences aside, value judgements must always be made in identifying the cut-off points for boundary definition in land classification. There is no objective guide to this task (Mabbutt 1968). Rogers and Steinitz (1969) note that the cut-off point for good versus bad slopes for urbanisation (a criterion on which many slope maps are based) ranges from 9 to 45 degrees! While it is unlikely that the value-free inventory stage for which they call will ever be realised, something could be achieved in explicitly stating the criteria whereby boundaries are drawn, be they related to some land use criterion or totally arbitrary mathematical subdivisions (Mitchell 1973).

Nevertheless, reliance will continue to be placed on intuition, experience and consensus amongst knowledgeable people. Although data collection biases could be reduced by the use of techniques like Delphi panels, A'Bear and Little (1976) point out the expense and time-consuming nature of such exercises. In any event, the invaluable contribution to land evaluation made by the profound understanding of natural systems and the inspired interpretation of landscape by people such as McHarg (1969; Wallace-McHarg, undated) and Lewis (1964; also Lewis 1963, 1965, 1966 cited in Belknap and Furtado 1967), cannot be dismissed. One suspects that artistry will remain the close partner of scientific method in producing good land use planning.

In conclusion, any method that is comprehensive and rigorous and which takes a systematically explicit approach to the problem of subjectivity, is as valid as the next (Rogers and Steinitz 1969).

Land systems classification in an assessment of recreational carrying capacity/limits of acceptable change process, provides a systematic basis for the delineation of recreation opportunity zones. It is also valuable as a data storage system for baseline data, giving a rapidly perused picture of existing conditions (Briggs and Hansom 1982:293). This is important in the limits of acceptable change system, in which monitoring environmental standards is crucial to detecting unacceptable changes in resources.

TABLE A1 : ANALYTICAL METHOD AND DATA SOURCES (Rogers and Steinitz 1969)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Urban		X	X			X			X	X			X		X	X	X	
Agric.		X	X		X	X				X			X			X		
Forest		X	X		X	X				X			X			X		
Recreation	X			X	X	X	X		X	X	X	X	X	X	X		X	
Conservation					X	X	X		X	X			X		X		X	X
Visual				X		X	X	X	X	X								X
Resourse Based	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Political Based			X	X							X	X			X	X	X	X
Other incl. Grid	X							X			X							
Avail. Pub. Data	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spec Data Col.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Air photo			X		X								X			X		
Field Survey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Descript Classif	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Supply Attract.	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X
Suppl Constraint	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X
Non-Prof. Eval.						X	X						X	X			X	
Expert Eval.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Numer.Point Rat.	X			X		X	X					X		X			X	
Analytic Der.Eval.				X								X						
Consumer Survey				X								X						
Demand Analysis	X		X	X						X	X	X					X	
Analytic Model											X	X						
Predict. Model						X				X	X	X			X			
Simul. Model				X								X						
Planned Proposal			X	X	X		X		X	X			X		X		X	X
Implement Strategy										X							X	
Computer Use				X							X	X					X	

AUTHOR
CODE

A = ALLI-LEI
B = CHESTER CO.
C = CHRISTIAN
D = DEARINGER
E = HILLS
F = LEWIS
H = LITTON
I = McHARG
J = PARIS
K = RECYS
L = SCS-1
M = SCS-2
N = TOTH
O = CORP ENG.
P = WILLIAMS
Q = ZUBE
R = STEINITZ-ROGERS

SUBJECT

ZONES AND SOURCES OF DATA

ANALYTIC METHOD

TABLE A2: FREQUENCY OF USE OF VARIABLES IN RESOURCE EVALUATIONS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
NATURAL RESOURCES																
CLIMATE, General		X	X	X	X	X		X		X	X	X	X	X		X
Rain		X		X				X			X			X		X
Snow		X						X			X			X		X
Temperature		X		X	X					X	X			X		X
Fog				X				X								
Wind		X		X						X				X		
Storms		X	X	X						X						X
GEOLOGY, General			X	X	X			X		X		X	X	X		X
Bedrock Outcrops				X		X	X	X					X			
Bedrock Type	X		X	X	X			X		X	X		X			
Unique Formations	X		X	X		X	X	X					X		X	
Stable Formations				X				X			X					
Depth to Bedrock	X		X	X	X			X			X		X			
Building Materials						X					X		X			
Structure Type		X	X			X		X			X					
Structural Age			X								X					
Economic Minerals									X				X		X	
LANDFORMS, General				X			X	X		X	X	X	X	X	X	
Unique Features				X			X	X				X	X	X		
SOILS, General			X	X	X	X		X	X	X	X	X	X	X	X	
Soil Type		X	X	X	X			X				X		X		X
Soil Texture		X	X	X	X			X			X		X			
Soil Depth	X	X	X	X	X			X			X		X			
Drainage	X	X		X	X			X			X		X			
Erodability		X						X			X		X			
Bearing Capacity		X		X				X			X		X			
Permeability		X		X	X			X			X		X			
Instability																
Stoniness	X	X			X						X		X			
Soil Productivity					X	X		X			X		X			
TOPOGRAPHY, General	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Elevation				X	X	X	X	X		X	X				X	X
Excessive to Utilities	X	X				X		X			X					
Relief Variation					x	x		x		x	x				x	x
ORIENTATION, General		x				x	x	x			x		x			
WATER, General		X		x		X	X	X		X		X	X	X	X	X
Watersheds		X		X				X					X			
Drainage Patterns		X	X	X	X	X		X		X	X		X	X		
Ground Water			X	X		X		X			X		X	X	X	X
Aquifers		X				X		X			X		X			
Surface WAter	X	X		X		X		X					X	X	X	
Lakes	X		X	X	X	X	X	X		X		X	X	X	X	X
Rivers and Streams	X	X		X		X		X		X	X	X	X	X	X	
Wetlands				X		X		X			X		X		X	
Springs				X		X							X			
Floods					X	X		X			X		X		X	
Quantity				X							X		X			
Quality	X			X		X		X		X	X		X			
Temperature				X	X			X		X						
Dis. and Sus. Solids				X	X			X		X						
Biological Productivity				X	X			X		X						
Shoreline Type	X				X	X				X						
Shoreline Quality	X				X	X				X						
VEGETATION, General	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Quality		X		X	X	X		X			X					
Specimen Stands	X	X		X	X	X		X							X	X
Shore and Bank Commun.						X					X					
Fields				X							X					
Forest Areas		X		X	X	X		X			X		X	X	X	
Natural Associations		X			X	X		X			X		X		X	
Understory	X			X	X			X								

AUTHOR CODE

A = ALLISON–LEIGHTON
B = CHESTER CO.
C = CHRISTIAN
D = DEARINGER
E = HILLS
F = LEWIS
H = LITTON
I = McHARG
J = PARIS
K = RECYS
L = SCS–1
M = SCS–2
N = TOTH
O = CORPS OF ENGINEERS
P = WILLIAMS
Q = ZUBE
R = STEINITZ–ROGERS

Overstory	X				X			X								
WILDLIFE, General	X		X	X	X	X		X			X	X	XX		X	X
Quantity	X					X						X				
Prime Habitat				X	X	X						X	X			X
Major Ecotones				X	X			X					X		X	
Uniqueness			X	X	X	X										
Quality and Production				X	X	X									X	
Wilderness					X											
LAND USE																
AGRICULTURAL. General		X	X	X	X	X		X			X	X	X		X	X
REC.& OPEN SPACE, General	X			X		X		X	X	X		X	X		X	X
Recreation Facilities	X		X	X	X	X			X	X			X		X	X
Tourist Facilities	X		X			X				X				X		
Facility Standards								X	X	X					X	
Demnd Factors	X			X					X	X					X	
Water Rec. Facilities	X			X	X	X		X	X	X			X		X	
URBANISATION, General		X		X		X		X	X	X		X	X	X	X	X
RESIDENTIAL, General		X						X					X			X
Quality								X								X
Growth						X		X								
COMMERCE, General	X							X		X						X
INDUSTRY, General								X						X		X
INSTITUTIONS & SERVICES								X						X		
UTILITIES						X		X	X					X		
AIR TRANSPORTATION														X		
RAIL TRANSPORTATION														X		
WATER TRANSPORTATION								X						X		
ROAD TRANSPORTATION	X	X		X		X	X	X	X	X		X	X	X	X	X
Road Type	X			X		X	X	X		X			X		X	X
Scenic Highways						X	X						X			
Proposed Highways						X	X	X					X			
ACCESSIBILITY	X		X	X				X	X	X		X	X		X	X
ENVIRONMENTAL HAZARDS	X		X			X		X								
HISTORICAL & CULTURAL				X	X	X		X				X	X		X	X
VISUAL CHARACTER	X		X	X	X	X	X	X		X			X		X	X
LAND COSTS	X							X							X	
POPULATION CHACTERISTICS				X				X		X		X		X	X	X
Population Projections						X		X	X	X					X	
SOCIO-ECONOMIC CHARACTER	X			X		X		X	X	X		X			X	X

APPENDIX B1

MATRICES OF RECREATION ACTIVITY COMPATIBILITY
(SOURCE: TIVY 1980)

APPENDIX B1

MATRICES OF COMPATIBILITY BETWEEN RECREATION ACTIVITIES AT SCOTTISH LOCHS (TIVY 1980)

	CAMPING FORMAL	INFORMAL	CARAVANNING FORMAL	INFORMAL	BANK-FISHING	NATURE TRAIL	NATURE STUDY	ORIENTEERING	FORMAL PICNICKING	INFORMAL	PONY TREKKING	SIGHTSEEING	WALKING	WILDFOWLING	BOAT-LAUNCHING MOORING	CANOEING COMPET	INFORMAL	BOAT-FISHING	POWER-BOATING	ROWING COMPET	INFORMAL	SAILING COMPET.	INFORMAL	SUB-AQUA	SWIMMING	WATER-SKIING COMPET	INFORMAL
CAMPING FORMAL																											
INFORMAL	O																										
CARAVANNING FORMAL	O	O																									
INFORMAL	O	O	O																								
BANK-FISHING	O	O	O	O																							
NATURE TRAIL	X	X	X	X	O																						
NATURE STUDY	O	O	O	O	O	O																					
ORIENTEERING	X	O	X	O	O	X	O																				
FORMAL PICNICKING	O	X	X	X	O	X	O	X																			
INFORMAL	O	O	O	O	O	O	O	O	O																		
PONY TREKKING	X	O	X	O	O	X	O	O	X	O																	
SIGHTSEEING	O	O	O	O	O	O	O	O	O	O	O																
WALKING	O	O	O	O	O	O	O	O	O	O	O	O															
WILDFOWLING	O	O	O	O	O	O	O	O	O	O	O	O	O														
BOAT-LAUNCHING/MOORING	O	O	O	O	O	O	O	O	O	O	O	O	O	O													
CANOEING COMPET.																											
INFORMAL																O											
BOAT-FISHING																O	O										
BOATING				D	O	E	S		N	O	T					O	O	O									
ROWING COMPET.																O	O	O	O								
INFORMAL				A	P	P	L	Y		T	O					O	O	O	O	O							
SAILING COMPET.																O	O	O	O	O	O						
INFORMAL				S	A	M	E		A	R	E	A				O	O	O	O	O	O	O					
SUB-AQUA																O	O	O	O	O	O	O	O				
SWIMMING																O	O	O	O	O	O	O	O	O			
WATER SKIING COMPET.																O	O	O	O	O	O	O	O	O	O		
INFORMAL																O	O	O	O	O	O	O	O	O	O	O	

MATRIX 1

- O COMPATIBLE in same area at the same time
- X INCOMPATIBLE – ie. no zoning required

MATRIX 2

- O COMPATIBLE in adjacent areas at the same time
- X INCOMPATIBLE – ie. space zoning required

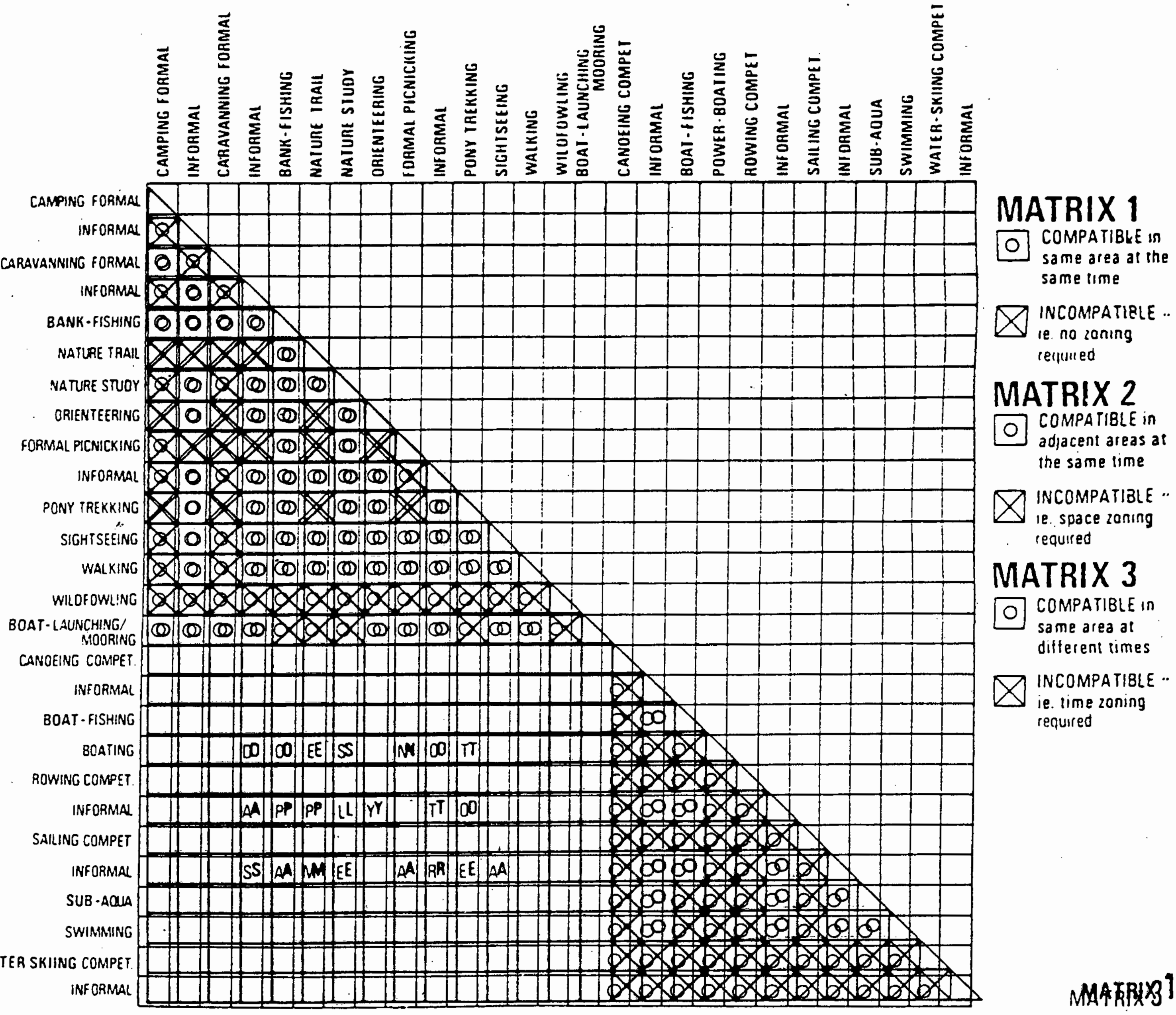
MATRIX 3

- O COMPATIBLE in same area at different times
- X INCOMPATIBLE – ie. time zoning required

MATRIX 3

APPENDIX B1

MATRICES OF COMPATIBILITY BETWEEN RECREATION ACTIVITIES AT SCOTTISH LOCHS (TIVY 1980)



APPENDIX B2

SYNOPSIS OF THE LIMITS OF ACCEPTABLE CHANGE SYSTEM

Assembled from: *Stankey, Cole, Lucas, Petersen & Frissell 1985*

STEP 1 : IDENTIFY AREA ISSUES AND CONCERNS

Purpose

- To identify special features or values of the area to be maintained.
- To identify particular sites of concern
- To supply basis of management objectives
- To guide allocation of land to different opportunity classes.

Process

- Identify issues raised by public involvement
- Consult with managers, planners, etc. on areas of concern.
- Review policy
- Analyse regional context and opportunities in area from a regional and national perspective.

Product

- Written report on unique values and special opportunities to be featured in area's management and problems needing special attention.

STEP 2 : DEFINE AND DESCRIBE OPPORTUNITY CLASSES

- To define management objectives for thearea.
- To establish recreation opportunities in area which reflect those objectives.
- To ensure the provision of diversity.

- Review information collated in Step 1.
- Select appropriate range and names of recreation opportunity classes.

- Description of resource, social and managerial conditions defined as appropriate and acceptable to each opportunity class.

STEP 3 : SELECT INDICATORS OF RESOURCE AND SOCIAL CONDITIONS

. To identify specific variables to guide inventory (Step 4) which reflect desired conditions (Step 2). To provide basis for where and what management actions are needed.	. Review Step 2 Review Step 1 issues and concerns to select variables which reflect these.	. List of measureable (quantifiable) resource and social indicators e.g. campsite condition in terms of % ground-cover loss, number of inter-party contacts per day.

STEP 4 : INVENTORY EXISTING RESOURCE AND SOCIAL CONDITIONS

. To provide information on range of conditions existing for variables specified in Step 3. . To aid in the establishment of meaningful indicator standards. . To aid allocation of land to different opportunity classes. . To identify locality and types of necessary management action.	. Field measurements of conditions of resource and social variables (e.g. questionnaire surveys, physical measurements) . Map information	. Map of existing conditions of each indicator variable.

STEP 5 : SPECIFIC STANDARDS FOR RESOURCE AND SOCIAL INDICATORS FOR EACH OPPORTUNITY CLASS.

. To provide the means for comparison between desired conditions and existing conditions for each opportunity class.	. Review Step 2 classes . Analyse inventory data.	. A table of specific (quantified where possible) measures of acceptable conditions for each indicator in each opportunity class.

STEP 6 : IDENTIFY ALTERNATIVE OPPORTUNITY CLASS ALLOCATIONS REFLECTING AREA CONCERNS AND EXISTING CONDITIONS.

• To give several alternatives, for public review and comment, of the provision of different opportunities in the area.	• Review all previous steps. • Make alternative allocations of OP's in the landscape reflecting different management phases.	• Maps and tables of alternative distributions of opportunity classes.

STEP 7 : IDENTIFY MANAGEMENT ACTIONS FOR EACH ALTERNATIVE

• To evaluate the costs of implementing each alternative. • Step towards selecting a specific management program.	• Review <u>management</u> conditions specified for each opportunity class. • Analyse differences between existing and acceptable conditions. • Analyse management actions needed to bring existing conditions into line with desired conditions.	• List or map of all areas where conditions require management action and what action needed.

STEP 8 : EVALUATION AND SELECTION OF A PROFERRED ALTERNATIVE

- To fix allocation of opportunity classes and specify a management program needed to achieve this allocation.

- Analyse costs resource, social, managerial - who pays - what alternative.
- Analyse benefits - resource and social : who receives them.

- Map of final allocation and report detailing appropriate management program.

STEP 9 : IMPLEMENT ACTIONS AND MONITOR CONDITIONS

- To implement program to achieve objectives.
- To provide periodic, systematic feedback on performance.

- Periodic re-survey of resource and social indicators.
- Comparative analysis of conditions and objectives.

- Summary of relationship between existing conditions and standards for all indicators.
- Recommendations for and implementation of corrective management actions.

APPENDIX C1

SOURCES FOR BIOPHYSICAL DATA COLLECTION

General	Proceedings of a Symposium on Research in the Natural Sciences at Saldanha Bay and Langebaan Lagoon (Royal Society, 1977).
Geology	Formations mapped directly from 1:125 000 Geological Survey map of SW Cape.
Soils	Copied from 1:50 000 map of soils forms produced by soil scientists of Department of Agriculture, Winter Rainfall Region, Elsenburg, Cape. Additional information from Mr Bennie Schlomms and staff.
Hydrology	Information given by Mr L Timmermans of the Directorate of Geohydrology of the Department of Water Affairs, Cape Town. Also Timmerman (1985) report.
Vegetation	Original 1:50 000 map of plant communities at Langebaan produced by Boucher and Jarman (1977) copied. Species lists for quarter degree grid squares 3318, 3317.... obtained from the Flora program of the Botanical Research Institute, Pretoria.
Land Uses	Distribution of "cultivated" lands as shown on 1:50 000 topocadastral maps checked against orthophotos (1983) and ground checked. "Cultivated" includes bush cut, strip cut or old, fallow lands where the appearance of the vegetation is distinctly different. Areas altered by human settlement or intensive use treated likewise.
Birds	Analyses of wader counts by Western Cape Wader Study Group supplied by Prof Les Underhill, University of Cape Town. Discussion with Dr Phillip Hockey of the Percy Fitspatrick Institute for Ornithology. Species list printed by the Wader Study Group.
Reptiles	Species list supplied by Mr L Mouton of the Department of Zoology, University of Stellenbosch.
Mammals	"Mammals of the South Western Cape lowlands", by Mr Jeremy David of the Marine Development Branch, Cape Town. Postberg Nature Reserve Information pamphlet.
Marine resources	A number of sources, including published papers and discussions with the following: Dr George Branch of the Zoology Department, University of Cape Town; Mr Bruce Bennett, of same department; Mr G Visser, Sea Fisheries inspector stationed at Langebaan; Mr V Ferreira, commercial fisherman, Langebaan.

APPENDIX C1 (CONT.)

SOCIO-ECONOMIC DATA SOURCES

General	Existing popular literature; interviews with local people; Town clerk, Langebaan, interviewed; Brink and Marais (1985) report; residents and homeowners of Churchhaven peninsula villages interviewed.
Social profiles of users	Questionnaire surveys at Kraalbay, Easter 1985 and at Langebaan, Christmas/New Year, 1986.
Regional issues	Unpublished report on tourism in Region 3 (Southwest Cape); Draft Report on resorts and recreation facilities on the Cape coast (Division of Physical Planning, Department of Local Government, 1986).

APPENDIX C2

LANGEBAAN '86 AND KRAALBAY '85 QUESTIONNAIRES

Raad van Kuratore vir Nasionale Parke
National Parks Board of Trustees

In Collaboration with the Department of Environmental and Geographical S··ences, University of Cape Town.
In samewerking met die Departement van Omgewings- en Aardrykskunde, Universiteit van Kaapstad.

Dear Langebaan Recreationist,

Your help is needed to ensure that the planning of the longterm conservation management and recreation for the Langebaan National Park will meet your, the people who use and enjoy the lagoon's, needs.

As you know, the lagoon and some surrounding land was recently proclaimed a National Park. By filling in this questionnaire you will provide the National Parks Board with invaluable information on your preferences and needs.

The success of this unique park will largely depend on public input and interest.

Your answers will be treated in strictest confidence and there are no "right" or "wrong" answers. Please put the completed questionnaires in the red boxes which are situated at convenient places on or near the beaches.

Geagte Langebaan Vakansieganger,

U hulp word benodig om te verseker dat die lang-termyn bewaring-bestuur en ontspanning beplanning vir die Langebaan Nasionale Park aan u, diegene wat die strandmeer benut en geniet, vereistes sal voldoen.

Soos u weet, is die strandmeer en sekere omliggende grond onlangs as Nasionale Park geproklameer. Deur die voltooiing van hierdie vraelys sal u dus belangrike inligting aan die Nasionale Parkeraad oor u voorkeure en behoeftes beskikbaar stel.

Die sukses van hierdie unieke park sal grootliks afhang van insette deur en die belangstelling van die breë publiek.

U antwoorde sal as streng vertroulik beskou word en daar is geen antwoorde wat as "reg" of "verkeerd" beskou word nie. Plaas asseblief voltooide vraelyste in die rooi kaste wat vir u gerief op strategiese punte op of naby die strand aangebring is.

Yours sincerely,
Die uwe,

Caroline Henderson.

Coordinator, Questionnaire Survey
(021) 698531 Ext. 186.

1. How long are you spending in the Langebaan lagoon area ? [ ] day/s

OR Are you a permanent resident - of Langebaan
- of Saldanha-Vredenburg

Hoe lank vertoef u in die Langebaan strandmeer gebied ? [ ] *dag/e*

OF *Is u permanent woonagtig - in Langebaan* [ ]
- in Saldanha-Vredenburg area [ ]

2. (i) Approximately how many times per year do you visit the coast (anywhere)?
Hoeveel keer per jaar besoek u die kus (enige plek)? [ ]

(ii) How many times do you come here per year during:
Hoeveel keer per jaar besoek u Langebaan strandmeer:

spring lente	summer somer	autumn herfs	winter winter

(iii) When was your first visit to Langebaan lagoon? [ ] (year)

Wanneer was u eerste besoek aan Langebaan ? [ ] (jaar)

(iv) If you could not come to Langebaan because of limits placed on the number of visitors allowed here, where on the Cape coast would you go instead?
Indien u nie Langebaan kon besoek nie as gevolg van beperkings wat op die aantal besoekers geplaas word, waar sou u as alternatief gaan?

____

____

3. In order of importance indicate 4 factors from the list below which will be the most important for your choice of a resort or spot to spend a day or a weekend.
Toon 4 faktore uit onderstaande lys aan (in volgorde van belangrikheid) wat die grootste rol speel in u keuse van waar u 'n dag-/naweekuitstappie deurbring.

[ ]	Low admission fee or lack of such fees *Lae toegangsgeld*
[ ]	Distance from home *Afstand vanaf tuis*
[ ]	Water surfaces available (dams, rivers, lakes) for water sports *Wateroppervlakke (damme, riviere, mere) vir watersporte.*
[ ]	Scenic beauty *Natuurskoon*
[ ]	Silence, peaceful atmosphere *Stilte, rustigheid*
[ ]	Suitability for children *Gerieflik vir kinders*
[ ]	Popularity of resort *Populariteit van die oord*
[ ]	Contrast from normal environment *Verandering van normale omgewing*

4. (i) Now please list, in order of importance, the reasons why you come to Langebaan lagoon rather than go somewhere else on the Cape coast.

Maak nou asseblief 'n lys, in volgorde van belangrikheid, die redes waarom u Langebaan strandmeer besoek in plaas van enige ander plek op die Kaapse kus.

1.) ______
2.) ______
3.) ______
4.) ______
5.) ______
6.) ______

(You may consult the list of possible reasons attached at the back of the questionnaire, if you wish)

(ii) What do you like especially about Langebaan/Kraalbay/Kreeftebay? (This applies only to the site where you received the questionaire).

Waarvan hou u in besonder van Langebaan/Kraalbaai/Kreeftebaai? (Hierdie aspek het slegs betrekking op die plek waar die vraelys aan u gegee is). ______

______

______

(iii) Is there anything you dislike about Langebaan, etc?

Is daar enigiets waarvan u nie hou nie vir Langebaan, etc?

______

______

5. Please fill in on the list below the activities you take part in while at Langebaan lagoon. Number them from 1 onwards, where 1 = the most time spent doing it.

Vul asseblief die aktiviteite waaraan u deelneem terwyl u by Langebaan is, in op onderstaande lys. Nommer hulle in volgorde van 1, waar 1= "die meeste tyd gespandeer daarop":

☐	swimming *swem*	☐	snorkeling *snorkel duik*
☐	paddleskiing *branderroei*	☐	scuba diving *skuba duik*
☐	canoeing *kanovaat*	☐	fishing *hengel*
☐	windsurfing *seilplak*	☐	collecting white mussels *versamel van wit mossels*
☐	dinghy sailing *kleinboot seil*	☐	bait collecting *aas versamel*
☐	waterskiing *waterski*	☐	walking along beaches *stap op strande*
☐	powerboating *kragboot*	☐	walking along mudflats *stap op moddervlaktes*
☐	sunbathing *sonbaai*	☐	bird watching *voëlwaarneming*
☐	braaing *braai*	☐	sight seeing *kyk na besienswaardighede*
☐	picnicking *pieknik*	☐	nature study *natuur studie*
☐	relaxing *ontspanning*	☐	other (describe) *ander (beskryf)*
		☐	
		☐	

6. (i) Do you regard the situation today
Hoe bekou u die situasie vandag

	crowded *oor vol*	acceptable *aanvaarbaar*	under populated *onder vol*	
on the water as *op die water*				?
at launching sites as *by die lanseerbane*				?
on the beach as *op die strand*				?

(ii) Please tick any problems you might have experienced here today (add any not on the list)
Merk asseblief probleme wat u vandag hier ondervind het (voeg by enige wat nie op die lys is nie)

shortage of parking	☐	*parkeer plekke te min*	☐
queues at launching sites	☐	*tou-staan by lanseerbaan*	☐
near-collision in the water	☐	*na-botsings op water*	☐
rip currents	☐	*tye te sterk*	☐
dirty toilets	☐	*vuil toilette*	☐
noise from kids	☐	*rasende kinders*	☐
noise from radios	☐	*geraas van radios*	☐
noise from motorboats	☐	*geraas van motorbot*	☐
noise from off-road vehicles (ORV's)	☐	*geraas van duinebesies*	☐
danger from ORV's	☐	*gevaar van duinebesies*	☐
theft	☐	*diefstal*	☐
litter/broken glass	☐	*rommel/stukkende glas*	☐
danger to swimmers	☐	*gevaar vir swemmers*	☐
other (describe)	☐	*ander (beskryf)*	☐

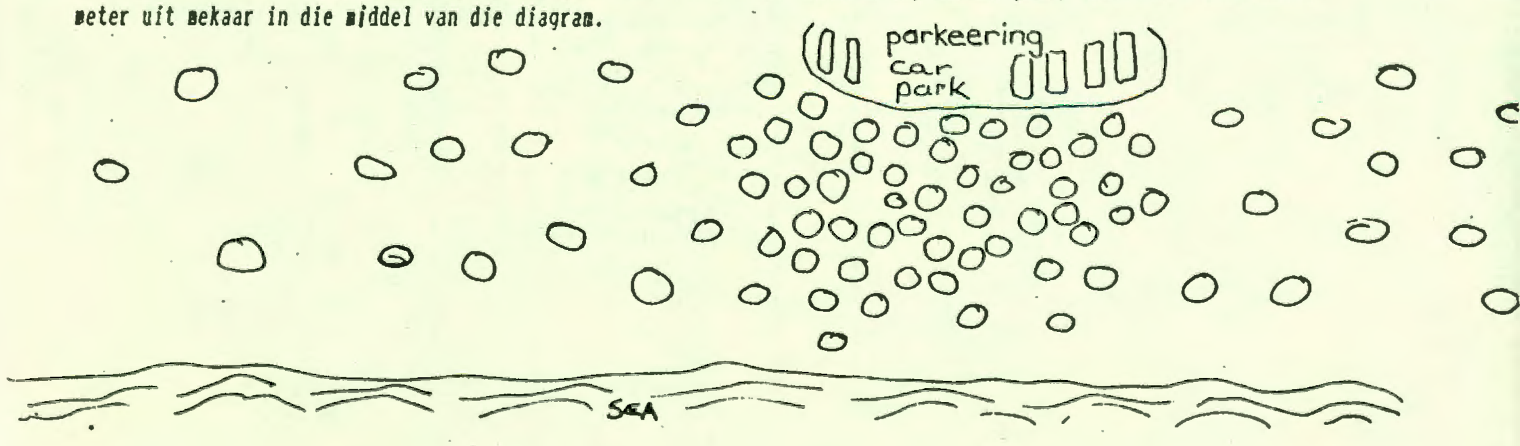
7. Do you believe zoning the lagoon for different uses is necessary? YES/NO
Glo u in die sonering van die strandmeer vir alternatiewe gebruike? JA/NIE

Please comment/ *Kommentaar:* ______________________________

____

____

8. If you arrived at a beach where groups of people were distributed as shown in the diagram below, where would you set up for the day? (Please mark the spot with a large cross). Each circle represents a group of 4-6 people spaced about 2 meters apart, in the middle part of the diagram.
Indien u op a strand arriveer met baaiers versprei soos op onderstaande diagram, waar sal u vir die dag plasing inneem? Merk asseblief die plek met n groot kruis. Elke kring stel n groep voor van 4-6 mense, 2 meter uit mekaar in die middel van die diagram.



9. (i) What facilities do you think are absolutely necessary at this site? (that is, Kraalbay or Langebaan beach, etc).

Watter fasiliteite dink u is heeltemaal noodsaaklik op hierdie plek? (Dit is te se, Kraalbaai of Langebaan, etc).

(ii) What improvements and/or developments would you like to see here in the future?

Watter verbeteringe en/of ontwikkelinge sou u graag hier wil sien in die toekomis?

10. If a fee were to be charged for using the launching sites and beaches what would you be willing to pay to continue coming to Langebaan lagoon?

Indien 'n fooi gehef word vir die gebruik van die lanseerbane en strande, wat sou u bereid wees om te betaal om voortaan nog die Langebaan strandmeer te benut?

Tick whichever you like best in the left hand column
Tiek die fooi wat u sou betaal links op

	per vehicle *per voertuig*	per person *per persoon*	per boat/trailor *per boot-sleep*
	R2.00	+ 50c	No charge (N/C)
	R4.50	N/C	N/C
	R4.50		+ R2.50/trailor *sleep*
	R10.00 (heavy vehicle/ *swaar voertuig*)	N/C	N/C
	N/C	R1.00	N/C
	N/C	R2.00	N/C
	R1.00	N/C	+ R5.00/boat daily permit *daaglikse permit.*

11. (i) Please rate your experience here today by circling one of the adjectives below:

Valueer u ondervinding hier vandaq deur een van die onderstaande te omring:

excellent	good	average	could-be-better	awful
baie goed	goed	gemiddeld	kan better wees	vreeslik

(ii) What are the 2 main reasons for your answer above?

Wat is die 2 hoof redes vir begenoemde antwoord?

12. (i) How did you travel here today? (eg. by car/bus/minibus; by boat or on foot).

Met watse vervoermiddel het u vandaq heir gekom? (bvd, motorkar/bus; per boot, te voet, etc).

(ii) Where did you come from today? (eg, Cape Town, Langebaan, house in Langebaan, Postberg, etc)?

Waarvandaan het u vandag gekom? (bvd; Kaapstad, Langegaan, huis op Langebaan, Postberg, etc)?

____

(iii) Who are you here with? (eg, a large group, group of friends, family, alone, etc)

Met wie bring u die dag deur? (bvd, groot groep, groep vriende, familie, alleen, etc)

____

(iv) If you are a visitor staying in the area, what kind of accommodation do you have?

Indien u 'n besoeker is wat in die gebied oornag bly, watter tipe akkommadasie maak u van gebruik?

rented house	________	*gehuurde huis*
rented municipal bungalow	________	*gehuurde munisipale strandhuis*
"boere" bungalow	________	*"boere" strandhuis*
plettenberg unit	________	*plettenberg eenheid*
caravan	________	*karavaan*
camping	________	*kampeer*
hotel	________	*hotel*
friends' house	________	*vriende se huis*
family holiday house	________	*familie se vakansie huis*
on a yacht/houseboat	________	*op 'n seilboot/huisboot*
other (describe)	________	*ander (beskryf)*

____

____

____

(v) Do you have any boats or sailing craft with you here?
Het u enige bote of seilbote?

type / *tipe*	________	length / *lengte*	________	horse power / *HP*	________
	________		________		________

13. PERSONAL DETAILS
PERSOONLIKE BESONDERHEDE

Age / *Ouderdom* ________ Sex / *Sex* ________ Occupation / *Beroep* ________

Home language / *Huis taal* ________ Highest education / *Hoogste opvoedkunde* ________

APPENDIX: Some reasons why you might come to Langebaan (refer to question 4)

Sommige redes vir 'n besoek op Langebaan (met betrekking op vraag 4)

unspoilt natural beauty	*ongerepte natuurskoon*
"getting away from it all"	*"om weg te kom van alles"*
interest in natural history	*belangstelling in natuurlike geskiedenis*
within easy distance from home	*maklik bereikbare afstand vanaf die huis*
not enough beaches closer to home	*strande nabeider die huis is te min*
lack of tourist facilities in the area (Kraalbay)	*tekort aan toeriste fasiliteite in die gebied (Kraalbaai)*
opportunity to meet people	*geleentheid om mense to ontmoet*
presence of tourist facilities (Langebaan)	*teenwoordigheid van toeriste fasiliteite (Langebaan)*
friends/family were coming	*saam met vriende/familie gekom*
friends/family have a house here	*vriende/familie het 'n huis hier*
safe mooring for yachts	*veilige ankerplekke vir seilbote*
safe swimming for children	*veilige swemplek vir kinders*
facilities for watersports	*watersport fasiliteite*
good fishing	*goeie hengel*
nice place to picnic	*gerieflike piekniekplek*
interesting places to walk	*interesante plekke om te wandel*
good wind	*goeie wind*
opportunity for solitude	*geleentheid om alleen te wees.*

UNIVERSITY OF CAPE TOWN

DEPARTMENT OF ENVIRONMENTAL AND GEOGRAPHICAL SCIENCE

KRAALBAY VISITORS QUESTIONNAIRE

FOR OFFICE USE

The information obtained from this questionnaire will be used in a research program at the University of Cape Town which is looking at problems of development at Langebaan lagoon.

All information given will be treated as strictly confidential. The questionnaire will be given to the "head" of the family, but he/she is free to consult with other members of the family on all questions (in fact, this is preferable).

Since much of the information required is about what you are doing today, it would be best if you could fill it in immediately. Just complete by ticking the appropriate boxes or giving a number where asked to do so. Please read the instructions carefully and answer ALL QUESTIONS , unless otherwise instructed.

I shall be collecting questionnaires later today, but if I do not get back to you before you leave, please leave it is the box placed at the entrance to the car park at Kraalbay.

1. Please insert a number in the boxes below.

Number of children (0 - 18 years)	
Number of adults (19 - 40 years)	
Number of adults (41 - 60 years)	
Number of adults (over 60 years)	
Number of families	in your party*

* where "family" is a married couple with or without children or a single representative of a family.

* where "party" means the group of people with whom you are spending the day at the beach.

2. Where have you come from today?

Town of origin*: ____________________

* or yacht, if appropriate

FOR OFFICE USE

3. Where is your home town (that is, where are you living at present)?
Please give town and suburb) ______________________________

4. Please list the number of vehicles of the following types used to bring your family to the beach today:

cars		motorbikes	
minibuses		boats/yachts	
trucks/bakkies			
buses			

(If you came by boat, please

(If you came by boat, please also complete the Boatowners Questionnaire)

5. Is your visit here just a day-trip? YES/NO
If "yes", go to Questio n 7.

6. Is your visit here part of a longer holiday? YES/NO
If "yes", please answer the following questions:

(a) Are you staying in the Langebaan area for your entire holiday? YES/NO

(b) How many days are you spending here? ______________

(c) Where do youstay while you are in this area (e.g. Churchaven, Langebaan, Kraalbay, etc)? ______________________

(d) What type of accommodation is it (e.g. rented house, yacht, camping, family house, friend's house)?

____

(e) Do you come to this part of the lagoon during your holiday?

every day	
once a week	
only during weekends	
irregularly	
during the week	
other (please specify)	

FOR OFFICE USE

ALL RESPONDENTS TO ANSWER:

7. (a) Please state how many times since April 1984, you have visited

	during summer*	during winter*
(i) Langebaan town		
(ii) Kraalbay/Preekstoel		

* "Summer" means 1 November to 30 April.
* "Winter" means 1 May to 30 September.

(b) Do you visit long weekends only (Easter/Christmas/New Year) ☐
any weekends ☐
weekdays & weekends ☐
in season ☐
out of season ☐

8. Please tick the average amount of time you spend at this beach per visit.

all day ☐
half a day ☐
less than half a day ☐

9. Do you visit other parts of the lagoon when you come to Kraalbay? YES/NO

Please tick which areas:

Stofbergsfontein ☐
Churchaven ☐
Postberg ☐
Kreeftebaai ☐
Langebaan ☐
Donkergat ☐

FOR OFFICE USE

10. If "No", would you like to if you were able to? YES/NO

11. What is your favourite place at Langebaan lagoon?

____

12. Please list the NUMBER of each of the following types of sporting equipment your family brought with you to the beach today:

	NUMBER
windsurfers	
paddleskis	
canoes	
dinghies	
hobicats	
rowing boats	
motorboats	
skis	
other ______	
______	
______	

(Motorboat owners must also please fill in the Boatowners Questionnaire)

13. Please list the number of members of your family who take part in any of the following activities while at the beach today (space has been left for you to include activities not on the list):

	NUMBER		NUMBER
swimming		snorkeling	
paddleskiing		spearfishing	
canoeing		fishing	
windsurfing		collecting white mussels	
boating			
yachting		bait collecting	
waterskiing			
powerboating		walking along beaches	
sunbathing			
braaing		walking along mudflats	
picnicking		bird-watching	
other		sight-seeing	
relaxing			

FOR OFFICE USE

14. Now please list, in order of importance, the four activities your group spends most of its time doing:

1. ______
2. ______
3. ______
4. ______

15. Do anybody else's activities interfere with your activities? Please describe: ______

______

______

16. If you fish, please answer these questions:

(a) How many members of your group fish? ______

(b) Whereabouts in the Langebaan lagoon/Saldanha Bay system do you fish most often?

in Kraalbay	
in the channels off Langebaan	
off Skapeneiland	
in Saldanha Bay	
no one place	

(c) Where do you collect bait? ______

______

(d) What type of craft do you use for fishing?

Type ______ Length ____ metres

Engine power ______

(e) Please list the four types of fish most often caught:

1. ______
2. ______
3. ______
4. ______

(f) List other species you sometimes catch: ______

______

______

FOR OFFICE USE

(g) Please indicate by ticking the box below what you think of the following statement:
"It is more difficult to catch fish at Langebaan now than it was ten years ago."

Didn't come herè then	
Don't know	

Strongly agree	
Strongly disagree	

Please explain your attitude briefly: ______________________

____

____

17. Facilities (things such as toilets, rubbish bins, cafés, picnic places) are provided at these beaches. Please show your opinion of them by ticking the relevant box:

	enough/adequate	not enough/inadequate
car parks		
pit toilets		
rubbish bins		
braai places		

18. If certain developments were made, which of the following facilities would you like to see at Kraalbay/Preekstoel?

	would like	neutral	would not like
more rubbish bins			
braai places on the beach			
braai places behing the beach			
a restaurant			
shops/cafés			
a waterslide			
a hotel			
flush toilets			
a rest camp			
houses to rent			

...../continued

FOR OFFICE USE

	would like	neutral	would not like
water taps			
a putt-putt course			
a golf club			
simple ablution blocks (toilets and showers)			
tarred roads			
other (please say what) ______________			
______________			
______________			

19. Here are some reasons why you might come to these beaches. Please show how important these might be to you by circling a number on the 5-point scale given next to each reason. Space is provided for you to add any not on the list.

On the scale, 5 means "very important" and 1 means "very unimportant".

	Very Important		Neutral		Very Unimportant
unspoilt nature beauty	5	4	3	2	1
"getting away from it all"	5	4	3	2	1
relatively uncrowded	5	4	3	2	1
peace and quiet	5	4	3	2	1
"there's no one telling us what to do and not to do"	5	4	3	2	1
safe mooring for yachts	5	4	3	2	1
lack of tourist facilities in the area	5	4	3	2	1
safe swimming for children	5	4	3	2	1
water for watersports	5	4	3	2	1
access to beaches closer to home is limited	5	4	3	2	1
nice place to picnic	5	4	3	2	1
deep water close inshore for watersports	5	4	3	2	1
only beach along here where public can go	5	4	3	2	1
presence of lots of people on the beach	5	4	3	2	1
interesting places to walk	5	4	3	2	1
good wind	5	4	3	2	1
other ______________	5	4	3	2	1
______________	5	4	3	2	1

FOR OFFICE USE

20. The following is a list of things which might spoil your enjoyment of your visit here. Please rate these like you have done in Question 19 above:

	Very Important		Neutral		Very Unimportant
overcrowding at peak holiday times	5	4	3	2	1
noisy people	5	4	3	2	1
noise of motorboats disturb the peace	5	4	3	2	1
litter on the beach	5	4	3	2	1
not enough parking	5	4	3	2	1
not enough toilets	5	4	3	2	1
toilets are dirty	5	4	3	2	1
sight of houses along the shores	5	4	3	2	1
nowhere to stay overnight on Langebaan peninsula	5	4	3	2	1
no access to other parts of the lagoon shores	5	4	3	2	1
dust from cars on the road	5	4	3	2	1
bad roads to get here	5	4	3	2	1
slimy seaweed along shore	5	4	3	2	1
too much wind	5	4	3	2	1
other ______________________	5	4	3	2	1
______________________	5	4	3	2	1

21. Some suggestions about the character of the area and its future are given below. Please show if you agree, don't agree, etc, with these statements by ringing the relevant number on the 5-point scale given next to each statement.

	Strongly agree		Neutral		Strongly disagree
Langebaan lagoon has a "special atmosphere"	5	4	3	2	1
Langebaan peninsula should be conserved as it is	5	4	3	2	1
development on the peninsula is desirable	5	4	3	2	1
the public should be allowed more access to the lagoon along the peninsula	5	4	3	2	1
there should be more accommodation for the public on the peninsula	5	4	3	2	1

...../continued

FOR OFFICE USE

	Strongly agree		Neutral		Strongly disagree
only minimal facilities should be provided on the peninsula (that is, toilets, parking, rubbish bins, water taps)	5	4	3	2	1
the public is destroying the lagoon	5	4	3	2	1
houseboats should be removed from Kraalbay	5	4	3	2	1
yachts should be removed from Kraalbay	5	4	3	2	1
motorboats should not be allowed into Kraalbay	5	4	3	2	1
the water area should be zoned for different uses	5	4	3	2	1

DATE COMPLETED ______________________

NAME ______________________

SEX ______________________

ADDRESS ______________________

____

____

OCCUPATION ______________________

EDUCATION (please tick relevant one)

primary school completed	
some high school	
high school completed	
education after high school	

THANK YOU FOR YOUR CO-OPERATION!

APPENDIX D

THE RECREATIONAL CARRYING CAPACITY OF KRAALBAY AND LANGEBAAN LAGOON (ZONE 1)

A report prepared for the National Parks Board

by C M Henderson

Environmental Evaluation Unit

Cape Town

April 1986

TABLE OF CONTENTS

3. THE PHYSICAL CARRYING CAPACITY OF ZONE 1 FOR BOATING

3.1 Discussion

3.1.1 Proposals for Zoning at Langebaan Town

4. THE CARRYING CAPACITY OF KRAALBAY

4.1 Beach Capacity

4.1.1 Beach Visitor Capacity

4.1.2 Ablutions

4.1.3 Vehicle Parking

4.2 The Carrying Capacity for Boating

4.2.1 Scenario A: Spatial Separation of Activities

4.2.2 Scenario B: Time-zoning

4.2.3 Scenario C: No Powerboats

4.2.4 Conclusions

Map 1

Map Overlay 1.1

Map 2

Map 3

Map Overlay 3.1

[Reduced copies of maps reproduced here]

REFERENCES

[Included in dissertation reference list]

EXECUTIVE SUMMARY

1. This study proceeds from a series of premises, the first of which is that the conservation of Langebaan lagoon's ecosystems is the paramount objective of the Langebaan National Park. Equally important is the preservation of the area's archaeological, historical and cultural heritage.

2. However, the importance of the area as a recreational playground for both rural and urban, especially Greater Cape Town, dwellers is recognised and provision must be made to accommodate this group.

3. Where conservation and recreation meet, the "golden mean" between preservation and development can be realised, at least theoretically, in the concept of recreational carrying capacity. This has social, ecological and physical components.

4. Physical carrying capacity is held to be the key to the manipulation of social and ecological capacity. There are major problems with estimating these last two, i.e. with being able to quantify and predict the thresholds beyond which they have been or will be exceeded. However, one can identify physical, social and ecological constraints on recreational development.

5. Assessment of physical capacity involves the application of "space standards". An integral element in assessing the recreation carrying capacity then is to propose a zoning scheme in which different densities and mixes of activities are permitted in different areas. Such a scheme is proposed here for Zone 1 of the lagoon, that is, that area in which all forms of boating are presently unrestricted.

6. In assessing the lagoon's recreational carrying capacity I consider it to be desirable that existing *patterns* of use be disrupted as little as possible, in respect for the traditions of the area. Only where clear evidence of ecological damage or of safety or social problems has been found, have these patterns been altered.

7. Available information suggests that serious impact to the lagoon's ecosystems has not yet occurred. Only at very localised sites has serious damage occurred, mostly at Kraalbay where trampling has resulted in a loss of vegetation cover, sand slips, blow-outs and some erosion. The evidence for organic pollution of the bay from wastes disposed there by yachts and houseboats is not conclusive. The effects of sport angling at the lagoon requires further research.

8. However, the *social* carrying capacity of Kraalbay appears to have been exceeded at peak holiday periods, so that peak numbers have diminished over the past 3 years (although other factors eg economic, could be involved).

9. The proposed zonation of Zone 1 is as follows:

(i) The eastern channel in the vicinity of Langebaan town will remain a high density recreation area.

(ii) However, a "no wake" zone for powerboats, extending 200m from the high tide level, is proposed. Additionally, the entire area occupied by Yacht Club moorings should be a "no wake" zone. It is recommended that waterskiing be stopped in the vicinity of Langebaan, at least over the peak season period of December 15 to January 20 and Easter weekend.

(iii) Waterskiing should then be encouraged in the western channel in the lee of Constable Hill. This constitutes a large area of very calm water.

A 200m "no wake" zone along the shore should protect the tranquillity of riparian owners along this stretch of shore.

(iv) Kraalbay should be designated a "semi-primitive" area with only minimum facilities - parking, garbage disposal, ablutions, water - being provided.

(v) In Kraalbay powerboat cruising should be eliminated, but waterskiing permitted in a designated area, namely the southern half of the bay. Powerboats entering or leaving the area will be required to go at speeds which do not produce a "wake".

(vi) Sailing activities should then be confined to the northern half of the bay which abutts on Postberg Reserve land.

(vii) The number of yacht moorings should be reduced to clear more space for waterskiing.

(viii) A 30m "no wake" zone to protect swimmers along the entire shore should be introduced.

(ix) This zoning may be necessary only during peak season.

(x) The continuous presence of a law enforcement officer will be necessary to ensure the success of any zoning scheme.

10. The carrying capacity of Zone 1 as a whole for all forms of boating has not been exceeded, but the capacity for keelboats is being approached.

11. With respect to Kraalbay, current peak levels of use closely approach or may occasionally exceed the recommended physical carrying capacity.

12. In keeping with Kraalbay's "semi-primitive" designation, a low density beach carrying capacity of 1 153 persons has been calculated. This has been greatly exceeded at times.

13. Existing parking facilities, including roadside parking, is probably sufficient for this number of visitors. Ablution facilities must be greatly expanded.

14. Access to the beach down the dune at Preekstoel must be closed. Elsewhere boardwalks are recommended to prevent erosion and path proliferation.

15. The capacity for waterskiing in the designated area is 9 boat-skier combinations active simultaneously. This level of use has already been reached at Kraalbay, but further rises will be socially intolerable.

16. No facility for powerboat launching should be provided at Kraalbay. All powerboats should be controlled from Langebaan, perhaps by a permit system.

17. Windsurfing, hobicat and dinghy sailing are below capacity in Kraalbay and do not constitute a problem.

1. INTRODUCTION

1.1 PHYSICAL CARRYING CAPACITY

Recreational carrying capacity embraces three concepts, ecological, social and physical carrying capacity. Physical carrying capacity will be used because it provides a definite standard to go by. Yapp and Barrow (1979) suggest that the key to the control of conflicts is the manipulation of physical capacity. Sowman (pers comm.) agrees that physical capacity should be used as a baseline against which the more nebulous social and ecological capacities can be compared.

Physical capacity is based on a number of "space standards", developed mostly in the United States, which supposedly have taken social and safety factors for each activity into account (Lime and Stankey, 1971), though how the standards have been derived is not explicit. Jaakson (1970) for some of his standards says they were derived from "personal observations". Essentially they are practical management tools which have developed by trial-and-error.

1.2 MANAGEMENT CONSIDERATIONS

Zoning and recreational carrying capacity go hand in hand. Zoning implies some separation, either spatial or temporal, of activities; this is frequently the best way to reduce conflicts between incompatible uses. However, it also requires enforcement and implies regulation and restriction. Lime and Stankey (1971) have recommended that management be effected with a minimum of overt control, because control is widely perceived to have a negative influence on the quality of the recreational experience. Comments made by Langebaan residents and visitors and the results of questionnaire surveys suggest that a significant proportion of users of the lagoon feel their quality of life there is threatened by the prospect of further regulations.

At Kraalbay, the busloads of people that arrive on peak holidays are widely perceived to be a major social and ecological problem (Boer, Engelbrecht, pers comm.). They physically crowd out those wanting a quiet, uncrowded experience and, while the ecological impacts are uncertain, they do contribute in a major way to the litter problem. This agrees well with Lime and Stankey's (1971) finding that large groups invariably have a disproportionately severe negative social impact; they maintain that controlling group size is an important component of social carrying capacity. Although this issue is likely to be misconstrued as political, since most of the buses bring Coloured people to Kraalbay, there is every reason to support discontinuing access to Kraalbay for big buses. However, considering the general paucity of facilities for Coloured recreation in the Western Cape, this must be accompanied by applying pressure on the relevant planning authorities to provide facilities elsewhere. There is already some action on this issue at Provincial level, with a comprehensive plan for the Cape West Coast being developed (Theunissen, pers comm.).

A basic assumption here is that in a National Park conservation comes first, recreation second. Proceeding from this, the kind of recreational experience catered for must be different from that at, for instance, a metropolitan lake. In large measure the difference is going to be one of the numbers of people seen to be using the same facility, and the quality of the natural environment. Management must then establish the recreational "context" for the area within which carrying capacity is to be manipulated.

At Kraalbay, an as yet undeveloped, "semi-primitive" area, the question must also be asked: what kind of activities are appropriate to such an area? It could be argued that both keelboat sailing and power-boating are excessively obtrusive in this environment. However, the keelboats in Kraalbay are very passive elements since they are mostly only moored there, but they do occupy space. There does not appear to be any public feeling in support of removing them completely from the bay. Power-boating, on the other hand, has elicited complaints on two fronts: disruption by noise and danger to other users in the water. But if powerboats, therefore, were to be prohibited from using Kraalbay, there would be an outcry from power-boat owners who represent a considerable lobby (there are possibly 500 - 600 power-boats which use the lagoon).

Nevertheless, some power-boat activities in Kraalbay need to be curtailed; just how this is to be done only the Parks Board can decide. The capacities given below will indicate some of the limitations to the variety of recreational activities currently pursued in Kraalbay.

1.3 PRELIMINARY PROPOSALS

1. Kraalbay should be maintained as a "semi-primitive natural area" in the context of the entire lagoon as a "semi-natural" area.
2. Accordingly, the space standards applied for the lagoon and Kraalbay will be the lowest densities suitable for "country resorts" (Baud-Bovy and Lawson, 1977; Cape Coastal Survey, 1973) so that the ecological and social carrying capacity will not be exceeded as they appear to have been in the past.
3. Zoning regulations should be enforced only when absolutely necessary, that is, over the peak December/January holiday season and at Easter

weekend. Nevertheless, when it comes to maintaining the integrity of local ecosystems at the expense of public freedom, this must, of course, be done. Otherwise, present traditions of use at the lagoon should be allowed to continue as far as is possible.

2. RECREATION PRESSURE AT LANGEBAAN LAGOON

This concerns estimates of recreation pressure in terms of people, numbers of recreational craft and associated activities, to which the lagoon is currently subject and might in the future have to sustain. The only points of public access onto the lagoon are at Kraalbay (and Tweede Stop adjacent to it) and at Langebaan town, so statistics are for these two areas. **We are concerned with whether the system can sustain current <u>peak</u> levels and future peak levels of use.**

(Statistics derived from counts at Kraalbay at Christmas/New Year and New Year 1984; aerial surveys of the lagoon on 26/12/85 and 11/1/86, data from the Langebaan Municipality and Cape Provincial Administration and ad hoc observations at Langebaan by Parks Board and Sea Fisheries personnel).

2.1 POTENTIAL RECREATIONAL POPULATION OF LANGEBAAN LAGOON

2.1.1 Langebaan Town

A variety of statistics were used to derive the probable present and future recreational populations which are presented in Tables 1 and 2 below.

These estimates are, I believe, likely to be low since they do not take into account the rapid increase in Coloured participation in outdoor recreation in recent years, nor the tremendous growth in Langebaan's day visitor population, simply because no figures are available for these subjects. The figure of 20% of day visitors among respondents to a questionnaire survey done at Langebaan on New Years Day, 1986, is surprisingly low. It is felt that numbers might have been down on previous peak periods, but if this is a low estimate, then all the other projections must rise, with yet greater impacts on the lagoon.

Table 1. Current Potential Recreation Population of Langebaan town

White Population (1985/86)

	No. of people
506 developed erven at peak average of 6,9 people per dwelling (Sowman 1984; 1986) (of which approximately 450 are permanent residents)	3491
Caravan parks (104 sites, 100% occupancy @ *5 people/site)	520
120 new sites, 40% occupied, @ 5/site*	240
Plettenberg bungalows - 50 @ 5/unit	250
Rented bungalows	180
'Boere bungalows', 15 @ 6.9 people/unit	104
Hotel (number of beds)	90
Assume *20% day visitors* (beach survey, 1985/86)	975
Total	5 850

*Group numbers very variable (Sowman, 1984) so this is my guesstimate; new park 40% occupied by aerial photo observation.

Coloured population

Resident (Brand, pers. comm.)	1 100
Caravan park (built 1979), 80 units @ 8/unit*	640
Grand Total	7 590

*(This value certainly low, because aerial survey showed park densely packed with tents, caravans.)

Table 2. Projected Future Population of Langebaan town

Low Projected Estimate	*High Projected Estimates*
(a) Additional erven (150 municipal + 121 Wiggins) developed; caravan park full (ignores increases in Coloured population and visitation and day visitor increases)	(a) = Low Projected Estimate + full development of proposed Myburgh Park (1021 units @ 6.9 people/unit) in 20 years time.
9 820	16 969
(b) As above, but assume 5% annual increase in residential development (CPA statistics) and the same for visitor and Coloured population increase for the next 20 years (the rapid recent development of Langebaan as a holiday town suggests this would be a very conservative estimate of annual increase; CPA stats show a 105% increase in camping/caravan sites and 430% increase in "holiday" (rented) accommodation for Whites between 1982 and 1985!) and there is almost 100% occupancy over peak periods.	(b) As above, but assumes Myburgh Park will absorb White residential growth rate; then 5% growth in only holiday accommodation, Coloured and day visitor numbers is added for 20 years. 21 116 of which 12 406 will be associated with private properties.
19 640	(21 116)

2.1.2 Kraalbay

Table 3. <u>Current Peak Visitor Levels at Kraalbay</u>

New Years Day 1984 observations by Mr P Haumann, Postberg Syndicate) 778 cars & bakkies @ 4 people/ vehicle + 1 bus @ 40 people	3 144
+ approx. 1000 in houseboats, yachts, 'boats' I consider this a gross over-estimate therefore suggest	250
	3 394
New Years Day 1985 (Brink & Marais, 1985) (=maximum number at one time)	2 640
New Years Day 1986 (i) counted from aerial photos - excluding yachts, houseboats	1 356
(ii)calculated from number of cars @ 4/car + no. mini-buses @ 8/mini-bus + no. buses (12) @ 40 (a more accurate figure I suspect)	1 668

Projections of future peak visitor levels at Kraalbay

Since numbers at peak times appear to have been dropping over these 3 years, future projections are difficult to make. Also, no statistics on visitor rates to Kraalbay prior to 1984 exist. The declining trend might indicate that the social carrying capacity has been exceeded and people have not come back at peak times because of the unpleasantness of such crowds.

2.2 BOATING PRESSURE AT LANGEBAAN LAGOON

2.2.1 Current numbers of recreational craft

This is all craft which use the water : canoes, paddleskis, windsurfers, dinghies/small sailboats, Hobicats, powerboats and keelboats (yachts).

2.2.1.1 Langebaan

This is the critical area in terms of supply of craft to the lagoon. No total counts have been done at Langebaan. 1986 aerial survey was not maximum.

Use Sowman's (1986) statistic of 3,3 "recreational craft" per household for Kromme River township to estimate number of "resident" craft (assuming Coloured contribution is insignificant = and ignoring day visitor contribution)	1 670
Actual Counts	
Yachts (Keelboats) : Yacht Club	60
01/01/1986 Kraalbay	44
Aerial photos 01/01/1986 Oudepos	3
Total	107
Motorboats(analysis of Sowman's 1984 and 1986 statistics both indicate 1,03 powerboats/household) 506 erven	521
(a figure of about 300 has been mentioned by several people, including Engelbrecht (National Parks Board) and Visser (Sea Fisheries) and this does not include boats out of water, or at homes, so this estimate is probably realistic).	
Aerial photograph count 01/01/1986	
Powerboats moored in shallows or on beach	122
Powerboats active (intermediate tide)	24
16.4% of visible powerboats active or 4.6% of all craft. (521)	
Engelbrecht reports seeing approx. 60 active simultaneously, Langebaan, Easter 1986. Therefore % active = 60/521 =	11.5%

which agrees well with Jaakson's (1970) findings, while the lower figure (4.6%) agrees with Sowman's (1986:25) findings for powerboats.	
Therefore suggested probable peak levels on water near Langebaan =	60
(though Visser claims to have seen "100")	
<u>Hobicats</u>	
01/01/1986 aerial photographs : active	3
on shore	21
Likely total several times this	100
<u>Sailboards</u>	
1/1/86 aerial survey : active	11
on shore	55
Also, several times greater, guess	400
<u>Dinghies</u>	
1/1/86 : active	0
on shore	6
Suggest probable numbers	100
<u>Paddleskis/Canoes/Rowing Boats</u>	
Unknown, but suggest similar numbers to dinghies	100
	----
	1 328

2.2.1.2 Kraalbay

Highest peak levels recorded probably between Christmas and New Year, 1985, by Brink and Marais. On 85/86 aerial survey numbers of craft in Kraalbay were very low, possibly because the busiest day recorded, 1/1/86, was also a day on which many Whites kept away. Brink and Marais' (1985) results, however, are not presented as a <u>daily</u> count, but are summed for the three week period of their observations. These figures are given below as activities pursued, but they indicate the number of craft present in Kraalbay. The number of moored yachts at the time was 44.

Table 4. <u>Afternoon Activities at Kraalbay, Preekstoel and 2de Stop (Brink and Marais, 1985)</u>

		Kraalbay	2de Stop	Preekstoel	Total
1.	Waterskiing	39	12	41	92
2.	Powerboat-other	26	4	32	62
3.	Rowing	57	19	23	99
4.	Sailboards	70	45	58	173
5.	Hobicats	16	3	11	30
6.	Yachts-sailing	5			5
7.	Yachts-moored	44			44

The number of craft in Kraalbay cannot be added to those for Langebaan because a significant proportion of them originate in Langebaan, particularly powerboats. Interestingly, at New Year 1986 there were 29 powerboats attached to yachts in Kraalbay.

At Kraalbay the crucial variables are the numbers of powerboats present and the numbers of those active on the water (yachts represent a fairly static number; hobicats are never numerous (Brink reports seeing no more than 10 on the bay), as well as the number of sailboards present and active.

At Easter 1985 the maximum numbers of powerboats recorded in Kraalbay were 10 active (including 4 waterskiers) and 22 pulled up along the beach. On 1/1/86, aerial survey showed only 10 pulled up along the beach (including 4 at a private cove on Postberg property) and 3 active, plus 29 attached to yachts. Brink (pers comm.) reports seeing a maximum of about 15 pulled up and 11 active on the water. So a peak total of 30 - 35 powerboats is likely. Brink also recorded approximately 80 sailboards present at once: at a 15% active rate, this amounts to 12 on the water at once.

2.2.2 Projected Future Numbers of Recreational Craft

Projected estimates derived by proportional calculation based on human population projections for Langebaan assumes constant ratio of recreational craft to human population, though this might be rising for certain craft, e.g.powerboats

TABLE 5 : Estimated Numbers of Recreational Craft at Langebaan *SEE TABLE 2.

	Present estimate	'Low' projected estimate*	'High'projected estimate*
All craft (estimated)	1670	(a) 2161 (Population 9820)	(a) 2730 Population 12 406
	1670	(b) 4322 Pop^n : 19 640	(b) 4646 Pop^n : 21 116
'Actual' no. craft	1328	1718 Pop$_n$: 9820	2171 (Pop^n : 12 406)
	1328	3341 Pop^n : 19 640	3694 Pop^n : 21 116
Yachts	107	(a) 139 (b) 277	(a) 175 (b) 298
Powerboats	521	(a) 674 (b) 1 348	(a) 852 (b) 1 449
Sailboards	400	(a) 518 (b) 1 035	(a) 654 (b) 1 113
Hobicats & dinghies	200	(a) 259 (b) 518	(a) 327 (b) 557
Canoes/ paddleskis	100	(a) 130 (b) 259	(a) 164 (b) 278
TOTALS		(a) 1 720 (b) 3 437	(a) 2 172 (b) 3 695

sailboards and powerboats due to increasing popularity of these sports in South Africa (Sowman, 1984).

2.3 SUPPORTING FACILITIES

Boating capacity cannot be looked at in isolation. Jaakson (1970) has pointed out that in planning for recreation on water bodies the capacity of the shore and associated facilities must match with the capacity of the water to support recreational activities.

Here we will consider the adequacy of existing launching facilities and parking facilities at Langebaan and Kraalbay to support present recreational pressure. Using Sowman's (1984) figure of an average of 10 minutes for boat launching and 12 minutes for taking-out we can calculate the daily capacity for launching of slipways at Langebaan.

2.3.1. Langebaan

2.3.1.1 Launching

At Langebaan many 'boats' are left anchored along the shore. We shall assume a 12 hour day for launching and bringing in over the summer peak season.

The daily capacity for one slipway is then 33 boats, but since many boats are left anchored along the shore at Langebaan, this is probably an underestimate. Besides, launching tends to occur most during the morning, so that 30 boats could be launched in 5 hours.

Since there are at least 6 put-in points at Langebaan, there does not appear to be a problem with respect to boat launching.

The launching points are (refer Map Overlay 1.1) :

1. Yacht Club : concrete slipway for large skiboats, motor launches and yachts.

2. Alabama Street : double slipway, suitable for smaller powerboats.

3. Sandy Bay : 2 access points from streets across beach, suitable for smaller powerboats, dinghies, etc..

4. Langebaan beach : access across beach from car park for Hobicat and dinghy launching.

2.3.1.2 Associated Parking

The Florida Recreation and Parks Association (1975) recommend 60 car-trailer parking spaces for every 2000 population. With a White population of 5850 (which is the effective boating population), there should be 176 car-trailer parking spaces associated with launching facilities. At Alabama Street, there are 24 spaces, at Bree Street about 10, at the Yacht Club space for 30 (personal estimate).

The Langebaan beach parking area has a large available area, but this is distant from the major launching sites. Clearly then, more car-trailer parking needs to be provided (shortage of parking was a frequent complaint of respondents in the 1985/86 survey conducted at Langebaan beach).

2.3.2 Kraalbay

2.3.2.1 Launching

With respect to launching facilities, there are no proper facilities at Kraalbay. A track down to the shore has been cleared and is used by a few houseboat and yacht owners who do not launch their powerboats from Langebaan town. For purposes of better control it is recommended that no further facilities be provided here and that houseboat and yacht owners who use it be given special permits to do so.

2.3.2.2 Parking

Parking here is associated with bringing day visitors to the beach.

A widely held average for number of people per car in recreation areas is 4 (Fogg, 1981; Baud-Bovy and Lawson, 1977); a standard for parking is 350 cars/ha ()Baud-Bovy and Lawson, 1977), therefore the present officially allowed parking space available at Kraalbay is 165 cars and at 2de Stop 86, with space for perhaps 100 more along the road inbetween.

At the present maximum population of 2 640 which brought 378 vehicles into the area on one day (Brink and Marais, 1985), including buses, the available area for parking is already "giving at the seams". It will be demonstrated later, however, that the capacity of the beach for beach-goers has also been exceeded.

3. THE PHYSICAL CARRYING CAPACITY OF ZONE 1 FOR BOATING

Zone 1 is the area of the lagoon and National Park presently accessible to all recreational craft and where skiboat fishing is unrestricted (see Map 1). The Southern line demarcating it has been taken to be the new alignment from Oostewal to the spit of land immediately south of 2de Stop (Map 1) (Robinson, pers comm.).

The high tide area of Zone 1 will be taken as the baseline At low tide, activities are extremely restricted by the large expanses of sandflats exposed or too shallow to allow navigation by most craft and the available area is less than 50% of the high tide area **(see Map** 2)

The space standard for general boating which will be adopted is that recommended by Tanner (1973), and Jaakson (1970), namely 4,04 ha per boat. Jaakson is considered particularly reliable because he has had considerable experience in estimating capacities for boating. The capacities shown below for each activity assume that that is the only activity being pursued at one instant, therefore the composite capacity is different.

Table 6 : Carrying Capacity for Boating in Zone 1

	Site	Area	Space Standard	Carrying Capacity
General boating	Zone 1, high tide	1544,2 ha	4,04 ha/ "boat"	382 on water 1910 total, assuming 20% active
				3820 total, assuming 10% active (Jaakson, 1970)
Yachting	Zone 1, channels (= only area safe for keelboats)	657,1 ha	4,04 ha/ boat	163 on water = total, because moored in channels too ie no yacht 'basin'.
Powerboat cruising	Zone 1	1544,2 ha	8,08 ha/ boat	191 on water 955 total, assuming 20% active
Waterskiing	Zone 1		8,08 ha/ boat = absolute minimum	191 on water
			16,16 ha/ boat	96 on water
Paddling/ rowing/ canoeing	Zone 1	1544,2 ha	0,8 ha/ boat	1930 on water
			3,2 ha/ boat	483 on water

3.1 DISCUSSION

A comparison of Tables 5 and 6 shows that :

1. The present boating pressure on the lagoon is below its hypothetical capacity. Assuming a 20% 'active' proportion, 1910 'recreational craft' can be supported by Zone 1, while the 'estimated' total is 1670 and the 'counted' total is 1328. However, it must be noted that the numbers of craft observed to be active simultaneously on the lagoon in Zone 1 have never approached the 20% level of 265, so that the actual numbers of craft might be lower or the percentage active might be lower (which would imply a higher permissible total capacity - see Table 4).

2. The capacity for keelboats is near capacity, since moorings themselves take up space in navigable waters. In this respect the Yacht Club moorings take up almost the entire east channel along one side of the town's shoreline. Without significantly encroaching on space popular with other users, there is little room for expansion of this facility without building fixed moorings which can accommodate a greater density of boats.

3. Both powerboat cruising and waterskiing are presently below capacity. No accurate figures for peak levels of waterskiing on the lagoon are available, but they have certainly never reached 91. Nevertheless, questionnaire responses indicate that powerboat cruising and waterskiing are widely perceived to be problems in the immediate vicinity of Langebaan town, largely because of the simultaneous concentration of other on-water activities in this area. Furthermore, much of the lagoon is at most times unsuitable for waterskiing because of a combination of tidal levels and wind speeds. Langebaan, with its high frequency of wind (and conditions become unfavourable for waterskiing

at 15 knots and above (Sowman, (1984)) is often too exposed for waterskiing. The best venue for the sport is Kraalbay, especially on its south-east side under the lee of the dune. An equally suitable but little used area is in the lee of Constable Hill off Oudepos beach. Waterskiing is nevertheless concentrated in the east channel off Langebaan town and at Kraalbay. Since waterskiing is the most 'space-consuming' of watersports and generates the greater disturbance (Jaakson, 1970; Tivy, 1981), the capacity for conflict in these areas is great. The capacities of these specific areas is examined next.

4. No assessment of the ecological carrying capacity for fishing of the lagoon can yet be made and the nature of the game precludes zoning of the sport. Standards for fishing off boats vary enormously, from 1 boat per 4 ha to 2 boats per ha (Jaakson *et al* 1976; Jaakson (1970) concludes that fishing, because of the wide range of standards used, is one of the most crowding tolerant of on-water activities, yet he suggests 4,04 ha (10 acres) per boat is optimum. The absolute minimum is a radius around each boat sufficient for casting, a length of 30 m (75 ft) according to Jaakson (1970). Sowman (1984) says it is well known that fishermen are very jealous of their fishing spots and dislike being crowded. In any event, the application of such standards in a marine environment like the lagoon and Saldanha Bay may well be inappropriate, because fishing distribution and density is determined by fish behaviour and distribution - and fish distribution is usually patchy. There are definite "fishing spots" but these move, so that a fixed fishing density cannot be instituted. Besides which, fishermen are likely to set their own capacity : when a site becomes too crowded, they will move off.

Unfortunately the most favoured fishing area in the lagoon is off Schapen Island in the East channel opposite the town, which is also the favoured area for windsurfing, small boat, sailing and powerboating and is the main access channel from Saldanha Bay into Langebaan for yachts and bigger boats. Since fishing is one of the most popular activities at Langebaan (more than 50% of Whites at Langebaan fish, constituting a potential fishing population, therefore, of 2984 people) its requirements must be met as far as possible without ecological constraints. It is therefore envisaged that no restrictions be placed on skiboat fishing - as a relatively static pastime, it does not have a severe impact on other on-water activities, so it can be pursued simultaneously with them.

The impact of recreational fishing at Langebaan requires further research. Mr G. Visser, Sea Fisheries officer at Langebaan, reported having seen 100 fishing boats on the lagoon at once. This might be an exaggeration, but whether or not the lagoon can sustain this level of fishing, albeit on a seasonal basis, cannot be assessed with any confidence at this stage.

5. Small boat sailing on the lagoon is very much lower than capacity, but this is misleading in that windsurfing, in particular, tends to occur in one or two relatively confined areas. Most hobicats and windsurfers on the lagoon operate from Langebaan beach and sail in the east channel. The prevailing south wind comes almost straight down the channel so that windsurfers sail across the channel to and from Schapen Island. This puts them in direct conflict with powerboats moving up and down the long axis of the channel. The channel at its narrowest point is only 405 m wide, of which 333 m is suitable for fast-moving craft. Zoning of this area for separate uses might thus be difficult, but some suggestions are given below :

3.1.1 Proposals for Zoning at Langebaan town

Referring to Map 1: the line *map* demarcates the northern end of the Yacht Club moorings. The area north of this in the east channel, to the end of the large sand spit at the northern end of Langebaan beach, that is, the area of water between Schapen Island and Langebaan's main beach, is 111,6 ha.

Since this channel carries boat traffic entering the lagoon from Saldanha Bay, a fixed capacity would be impossible to enforce. Rather than limiting numbers in this area then, it is proposed that the type of permissible activities be curtailed.

Complaints of powerboats 'roaring up and down' close inshore have been registered by beach users, both the noise and danger to swimmers being perceived problems. But many powerboats are kept moored along the shoreline (106 counted on New Years Day, 1986, plus approximately 50 'bakkies' pulled up on the beaches), so they cannot be refused access to the shore.

I therefore propose that a zone 200m wide from the high water mark along the entire length of Langebaan's shoreline to the end of the Yacht Club area be proclaimed a "no-wake" zone for powerboats.

This would require powerboats to go so slowly as not to create a 'wake' behind them and would protect both swimmers and windsurfers to a large extent. It is a very common practice on American lakes, where the peace and quiet of lakeside cottage owners is at issue. The entire area occupied by Yacht Club moorings should also be a "no-wake" zone.

(iv) Ultimately, it might become necessary to build jetties for motorboat moorings, because at peak holiday times almost the entire beachfront is occupied by anchored motorboats, hobicats, dinghies and windsurfers. Several remarks have also been made about the danger presented by anchors, especially homemade ones, to the feet of swimmers, sailors, windsurfers, etc.. Since SAS Flamingo is leaving Langebaan, would this not be a suitable area in which to concentrate motorboat moorings? In the meantime, however, many people feel it would spoil the town's atmosphere if the old practice of anchoring along the beach were to be forbidden (Ferreira, pers comm.).

With a 200m "no wake" zone there would be an approximately 200m - 300m wide channel left which would be suitable for only very limited waterskiing.

It is therefore proposed that waterskiing be stopped, at least at peak periods (15 December to 20 January and Easter weekend) in the channel off Langebaan town.

Since only 10 - 20% of the lagoon's users waterski, it is felt that other activities should take precedence. In any event, there is ample space to accommodate this activity in the central and Western channels and in Kraalbay. The area in the Western channel which lies in the lee of Constable Hill and is therefore protected from the southern wind is an excellent area for waterskiing. With a surface area of approximately 170 ha (area defined by a line AB on Map Overlay ...), which excludes an inshore zone 200m wide, and a desirable 16,16 ha/boat for waterskiing (Jaakson, 1970), this area can accommodate 11 boat-waterskier combinations simultaneously. At the minimum requirement for waterskiing of 8,08 ha/boat (Baud-Bovy and Lawson, 1977), this number would be doubled.

The problem here lies in the ownership of the shore by members of the Postberg Syndicate who like their privacy. They are reported to be unhappy with public use of this area, which is close to their holiday cottages, for waterskiing. This raises the question of equity : this is a national park, the water body is publically owned and the public has every right to use all sections of it (providing there are no compelling ecological reasons why they should not do so).

It is therefore recommended that this area be promoted as a waterskiing area, with a 200 m "no-wake" zone inshore to protect the privacy and tranquillity of riparian owners.

4. THE CARRYING CAPACITY OF KRAALBAY

Assessment of the recreational carrying capacity of Kraalbay proceeds from the premise presented earlier that it must be maintained in a "semi-primitive" state, where the emphasis will be on a relatively low density of "use-units" (be they people or activities), and on protecting the sense of tranquillity of users. The standard to be applied to Kraalbay beach is that of 23,23 square metres per person recommended by the Cape Coastal Survey (1973) for country resorts. This agrees well with planning principles adopted for the Transkei coast where 30 square metres/person has been recommended "to project an image of solitude" in remote areas (Sowman, 1984, citing Mr M. Kerr, Development Officer, Transkei Development Corporation).

In order to minimize conflicts on the water (yacht owners complain of powerboats and waterskiers which tear around at high speed between the yachts; swimmers likewise fear high speed powerboats and beach-goers complain of the noise), a separation of activities in Kraalbay has been envisaged.

4.1. BEACH CAPACITY

4.1.1 Beach Visitor Capacity

Jaakson (1970) has correctly observed that beach capacity must be matched with the capability of the adjacent water body to sustain boating, but at Kraalbay the influx of day visitors changes the appropriate ratios. These visitors may bring windsurfers or paddleskis and canoes, but not powerboats and rarely sailing boats, so the relation of numbers of people on the beach to numbers of craft on the water is not so critical.

Using the Cape Coastal Survey's (1973) recommended beach capacity for "country resorts" of $23m^2$ per person, we derive a total carrying capacity for Kraalbay beach, from the northern, Postberg end to the end of the sandy beach beyond 2^de^ Stop (see Map Overlay 3.1)of 1 530 persons. The 3,52 ha of available beach space consists of a very long but very narrow beach (17m wide at low tide at the jetty). At spring high tides the beach area is covered by water to within 1 m from the base of the dune; this determines length of stay at the beach for most day visitors.

Personal observations suggest that this beach capacity would constitute a sufficiently low density, assuming more or less even spacing and the use of the "Postberg half" of Kraalbay beach. Up until now, members of the public have been discouraged from using this section by the presence of the Postberg Reserve fence which extends below the high water mark. This beach capacity is the equivalent of 2,6 m of shoreline per person (there are approximately 3 kms of usable shoreline in the study area).

The beach beyond 2^de^ Stop is not prime beach area because the broad sandflats which abutt it put swimmable water some distance away (and encourage trampling across the sandflats) and vehicular access is remote. The land across which access has been gained in the past is private land (Stofbergsfontein farm) whose owners object to public abuse of their property. It might well be in the best interests of all to excise this last spit of sand from the publically accessible Kraalbay beach area, in which case the total carrying capacity drops to 1 153 persons (see Map Overlay 3.1). Data on visitor numbers to Kraalbay over the past 3 years show clearly that this capacity has already been exceeded : on New Years Day, 1985 there were 2 640 people on these beaches (Brink and Marais, 1985).

4.1.2 Ablution Facilities

The next question is whether or not existing supporting facilities are sufficient for present or estimated capacity levels of use.

Ablution facilities quite clearly are not. The eight pit toilets erected by the Malmesbury Divisional Council 3 years ago are in such a revolting condition that they are hardly used by visitors (personal observation). Fogg (1981) recommends the following basic ablution facilities:

	Toilets	Urinals	Showers	Change rooms
Per 1 001 - 1 500 males :	4	5	6	10
Per 751 - 1 000 females :	7	-	5	9

Leaving aside the question of showers and change rooms, toilet facilities alone are inadequate. Should flush toilets be put in, there should be no problems with septic tanks and soakaways in the sandy soils in the area (Schlomms, pers. comm.)

4.1.3 Vehicle parking

With respect to parking, we can work on an average of 4 people per car (Baud-Bovary and Lawson, 1977 and Fogg, 1981) and 350 cars per ha in parking areas (California State Guidelines). At present the parking area behind the Kraalbay jetty can accommodate 165 cars, that at 2de Stop can take 86 cars (P. Haumann counted 92 in 1984). Parking along the road inbetween makes provision for about another 100 cars, making a total of "legal" parking for 336 cars, the equivalent of approximately 1 410 people. Even including the larger numbers accommodated by buses and mini-buses, existing parking is inadequate for existing levels of use.

For the capacity of 1 153, approximately 290 car parking spaces would be required. Existing parking is thus sufficient, provided roadside parking is included. The problem with this is beach access, since access paths down the steep dune face near Preekstoel are considered undesirable. At Kraalbay behind the jetty there is about 0,75 ha available for expansion of the car parks. This would satisfy parking requirements, but it would make the entire back beach area into an enormous car park.

Ultimately, if numbers into Kraalbay are to be controlled a single, controlled access point will have to be developed. I submit that the present configuration of the road relative to the bay would make this difficult and that eventually the main access road will have to be moved back behind the first dune/hill with a gate to control movement into the Kraalbay area. Parking should then be no problem.

4.2. THE CARRYING CAPACITY FOR BOATING :

Kraalbay has been treated as a separate entity by demarcating the approximate boundaries of the bay, here called Greater Kraalbay.This has been done by drawing a line between the two points which protrude most into the lagoon on the north and south sides of the bay i.e. from Constable Hill to the spit of land east of 2de Stop (see Map Overlay

3.1). This area of water is assumed to be relatively sheltered by the high land to the north and south of it.

The total area of Greater Kraalbay is 152,5 ha, while "Kraalbay proper", (see May Overlay 3.1) where activity is concentrated, comprises 49,4 ha, of which approximately 12 - 13 ha is at peak periods occupied by yachts and houseboats (Area A on Map Overlay ...). This area is 1 279 m across at the widest and 580 m deep. The area within these very sheltered waters suitable then for all watersports is very limited at about 37 ha. It is thus not surprising that there has been conflict.

Let us examine two scenarios in which waterskiing is permitted and one in which it is not.

4.2.1 Scenario A : Spatial Separation of Activities

In order to minimize conflicts between powerboats and sailing craft, a separation of activities has initially been assumed to be desirable. To achieve an equitable division of space for these two groups I divided the bay into two more or less equal portions with the point where the Postberg fence meets the high water mark as the dividing line (see Map Overlay , line BW). This gives 2 areas, the northern one on the Postberg Reserve side comprising 22,2 ha and the southern, Preekstoel section being 27,2 ha of Kraalbay 'proper'. The extension of these areas to 'Greater Kraalbay' makes the northern area 73,8 ha and the southern wedge 82,8 ha. The area occupied by moored yachts and houseboats falls almost entirely into the larger, southern zone.

The southern zone has been assigned to waterskiing for two reasons: (i) it is the area where most powerboaters from Langebaan anchor and picnic on the beach because (ii) lying in the lee of a steep, high dune it is the most sheltered, therefore most suitable for waterskiing, area on the entire lagoon.

Since windsurfing and dinghy/hobicat sailing require wind, it has been assumed that the more exposed northern side of the bay will be suitable for these sports, although some beginner board sailors might protest the loss of the more sheltered waters. The wind direction should pose no problem here, since this is merely the 'mirror image' of the other side of the bay.

It is also assumed that motorboats may not cruise inbetween the yachts at high speed : this will be a "no wake" area, as will be a 30 m zone along the entire shoreline, to safeguard the interests of swimmers (Kraalbay is a very popular swimming area, being calm, shallow, warm and without strong currents).

This zonation then gives a capacity of 148 (at 0,5 ha/boat) windsurfers/hobicats/dinghies in northern Greater Kraalbay and 9 waterskier-boat combinations (at the minimum requirement of 8,08 ha/boat) in the Preekstoel section. (The capacity of the entire Greater Kraalbay for waterskiing would be 17 boats simultaneously on the water.) This level of powerboat activity has already been reached at Kraalbay and is perceived by some people to constitute crowding of the area.

Allowing access to paddleskis and canoes throughout Kraalbay would give a capacity in Kraalbay "proper" of 62 and 101 in Greater Kraalbay at the minimum space requirement of 0,8 ha/boat. (The figure for Greater Kraalbay is not really meaningful, because although paddling is a popular pastime in Kraalbay, these craft rarely move out beyond the confines of the bay "proper".)

Combining the capacities for the different types of activity then - sailing, waterskiing and paddling - we arrive at a "general boating" capacity of 220 (using '62' above) in Greater Kraalbay: This is much greater than the capacity of 38 which would be achieved using the standard recommended for general boating in a "country resort", namely 4,04 ha/boat. However, since much of the activity in Kraalbay is taken up in windsurfing and paddleskiing it is felt that a greater density of these activities can be tolerated. As yet the capacity of 148 calculated for "small boat" sailing has not even been approached at Kraalbay. With full use being made of the northern side of the bay it is felt that current levels of activity and more can easily be accommodated. In any event, the limitation of access to the beach will limit the number of windsurfers, etc. on the bay.

Because of this limited capacity and because the yachts and houseboats moored take up so much space, I propose that the number of yachts allowed in Kraalbay at peak times be reduced by approximately 50 percent to 20 (no private moorings to be allowed; moorings will be 'booked' like hotel accommodation). In so doing, those moorings on the southern perimeter should be removed to create more space for waterskiing. However, since 32 'legal' moorings apparently exist (O'Riley quoted by Brink and Marais (1985)), a compromise might be necessary to allay public opinion : 32 then would be the maximum number allowed at peak periods.

The overall picture would then be:

(1) "small boat" sailing on the northern side of the bay. Access by powerboats in this area to be at "no-wake" speeds only.

(2) waterskiing along the southern side of the bay. Because of the confined area a direction would be fixed so that all skiers followed the same course. The problem here is that in the vicinity of the jetty there would be insufficient area in which to turn, given the position of the yacht moorings. Two schemes could overcome this:

(a) the waterskiing circuit could circumnavigate the mooring area (thereby encroaching a little into the sailing area, but this would not be serious); or

(b) a reduced number of moorings be moved to the north to create more skiing area close to the southwestern shore of the bay.

(3) No high-speed powerboat cruising in "Kraalbay proper" other than waterskiing. There is simply insufficient space. "Kraalbay proper" would then be a 'no-wake' zone except for waterskiers. The 30 m shoreline zone would be 'no-wake' for all powerboats.

(4) Assuming an "active" rate of 35 percent (which was the case at Easter, 1985, when, at high tide, 18 powerboats were pulled up along the shore while 10 were active on the water), the total number of powerboats allowed into Kraalbay from sources other than yachts on one day should be about 30. Powerboats attached to yachts are mostly inflatable dinghies or are small craft; they appear to be used mostly for moving to and from the shore rather than cruising or waterskiing.

(5) Yacht and houseboat owners would have seasonal permits to bring powered craft into the bay. Other powerboaters would have to be controlled from Langebaan, where daily permits for Kraalbay could be purchased on a first-come-first-serve basis. The actyal capacity could be set slightly higher than that quoted above to cater for daily turnover of visitors from Langebaan.

(6) Most essential of all, a law enforcement officer would have to be in continuous attendance in the bay to regulate users behaviour and to ensure that the zonation is not disregarded or abused.

4.2.2 Scenario B : Time-zoning

However, such a complex zoning scheme could be both difficult to enforce and to demarcate, but it would protect the quality of recreational experiences of all users.

A second scenario might then allow waterskiing and powerboat cruising, but confine them to certain hours of the day. These activities are in any event severely curtailed in Kraalbay by the low water levels at low tide. Accordingly, it is proposed that waterskiing and powerboat cruising be allowed only for 2 hours per day, that is, the 2 hours straddling high tide. At all other times of the day Kraalbay "proper" would be a "no-wake" zone; during those 2 hours sailing would be prohibited, at least along the southern margins of the bay. The mooring area would remain off-limits at all times to high-speed cruising, as would a 30m swimming zone along the shore.

This may well be an equitable solution, but it would again require constant 'policing'. In addition, the permissible hours of activity would have to be "posted" where prospective users could observe them. It is still recommended that the total number of powerboats in Kraalbay be limited to 30 or 40 : this appears to be presently acceptable to most users, but higher numbers are likely to impair recreational experiences.

4.2.3 Scenario C : No Powerboats

A third scenario bans all powerboating from Kraalbay. This would be totally unacceptable to many people in Langebaan (although it might please the yachting fraternity, some of whom were in favour of banning powerboating from Kraalbay when questioned on this issue at Easter, 1985). This "radical" solution would certainly ensure the tranquillity of the bay, but it does discriminate against holiday-makers in Langebaan who have traditionally enjoyed Kraalbay. The regulation could be softened though by allowing access to Kraalbay by powerboat, but banning any powerboating within the bay which requires speeds greater than 8 kmph (i.e. speeds which create a wake).

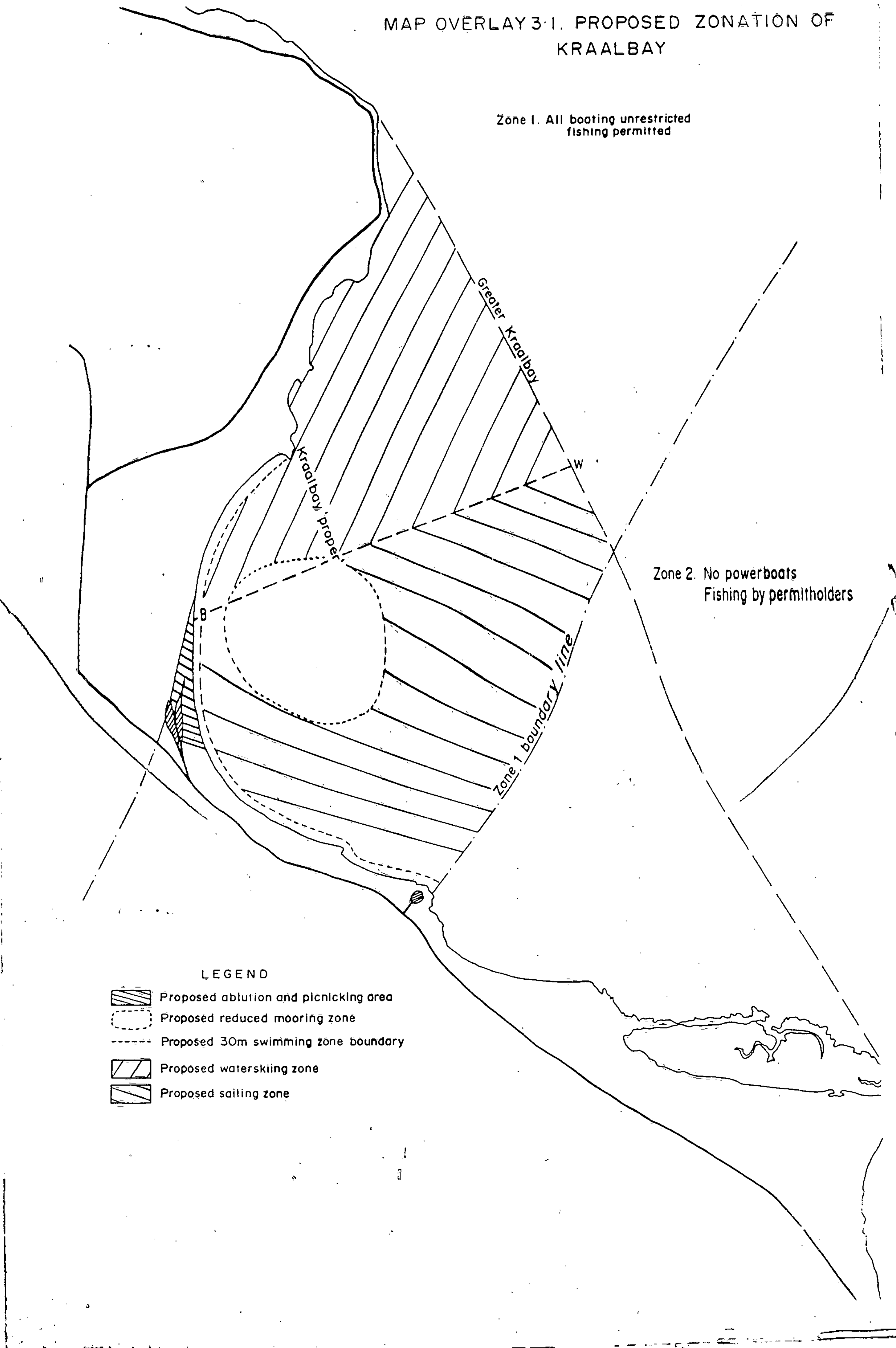
Alternatively, powerboating within the bay could be curtailed over peak periods, but this would discriminate against those holiday-makers whose one annual holiday this is (i.e. Christmas/New Year).

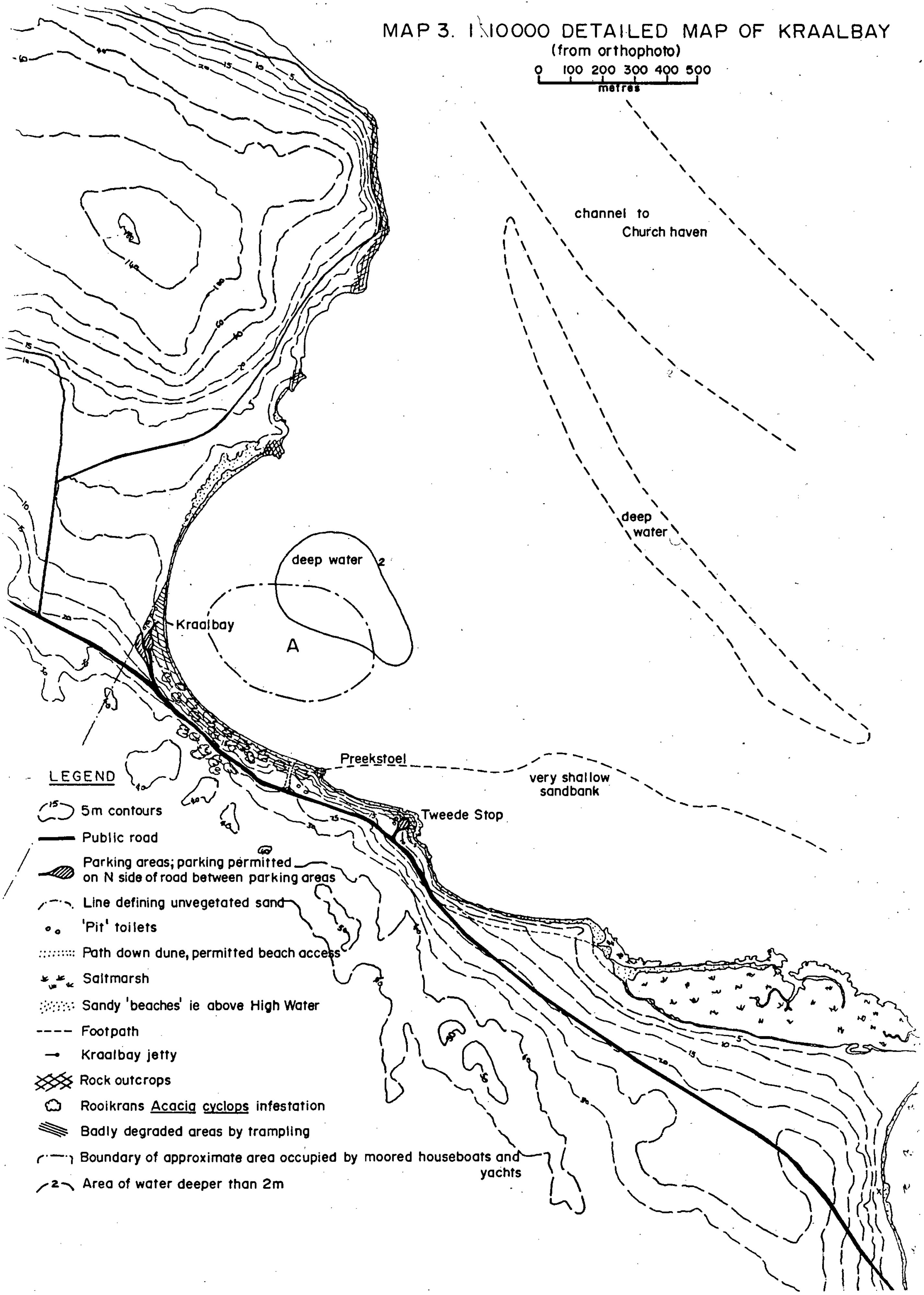
4.2.4 Conclusions

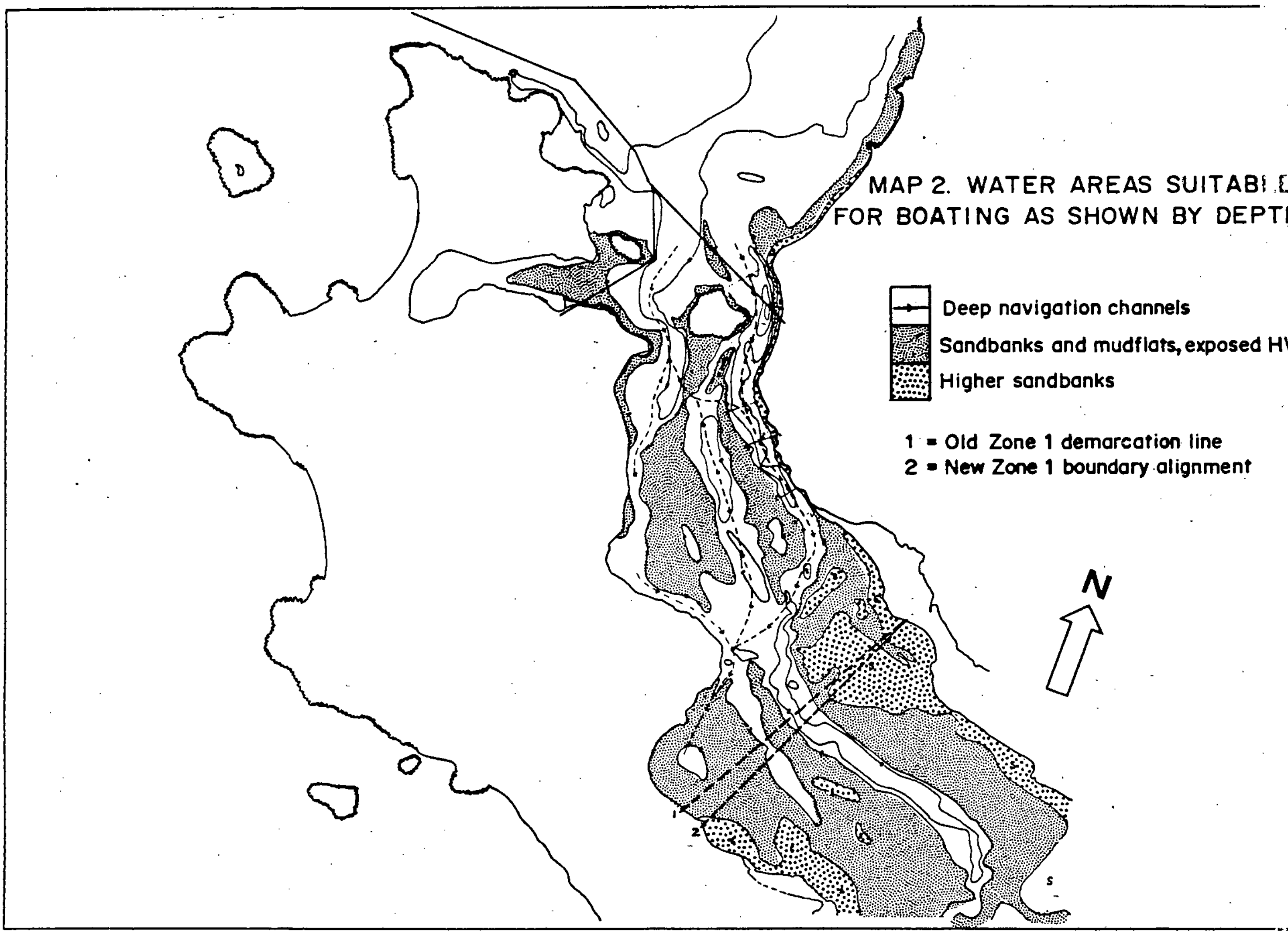
In the final analysis, the decision to enforce very severe restrictions in order to protect one kind of experience (the 'wilderness'/'semi-primitive' experience) as opposed to a more *laissez-faire* attitude which aligns itself more with traditions of usage on the lagoon, can only be made by the National Parks Board.

In the light of existing data and evidence I conclude that the latter is the appropriate route to take. This implies the adoption of a scheme which might include some elements of scenarios A and B. Finally, I am aware that the discussion does not cover all the complications of instituting such schemes, but these should not be insurmountable.

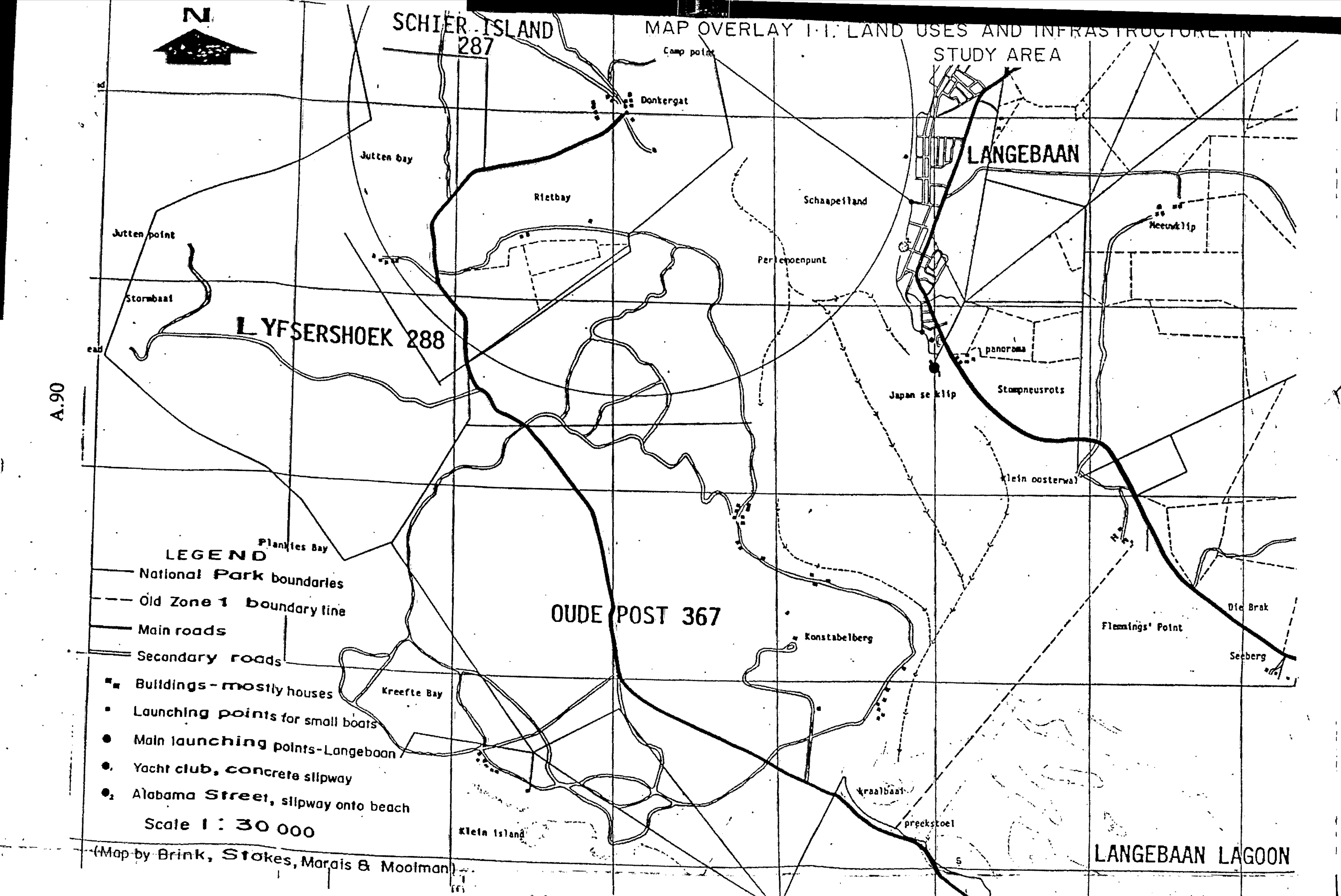
MAP OVERLAY 3·1. PROPOSED ZONATION OF KRAALBAY

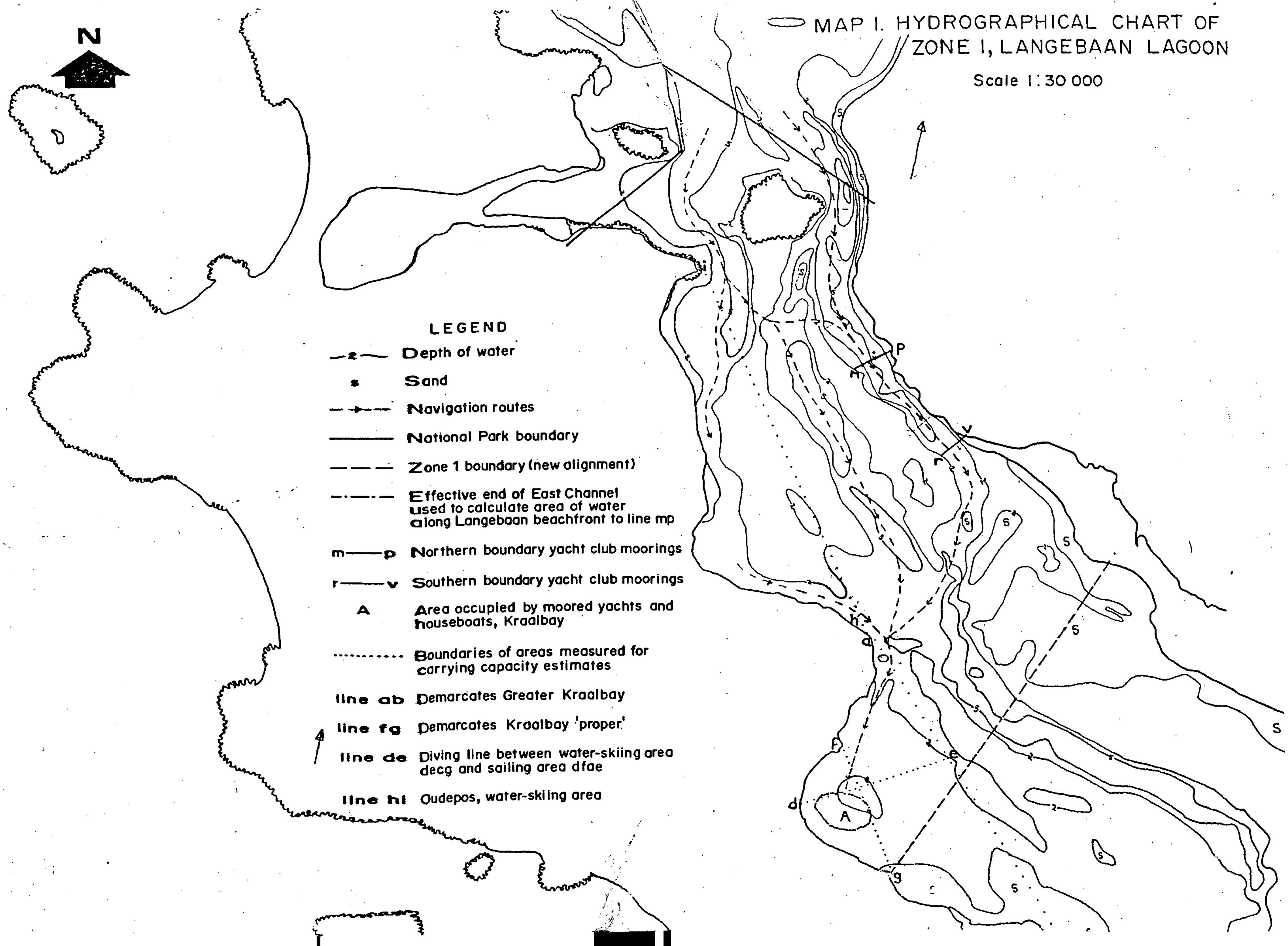



MAP 3. 1:10000 DETAILED MAP OF KRAALBAY
(from orthophoto)
0 100 200 300 400 500
metres
channel to
Church haven
deep
water
deep water
Kraalbay
A
Preekstoel
very shallow
sandbank
Tweede Stop
LEGEND
5m contours
Public road
Parking areas; parking permitted on N side of road between parking areas
Line defining unvegetated sand
'Pit' toilets
Path down dune, permitted beach access
Saltmarsh
Sandy 'beaches' ie above High Water
Footpath
Kraalbay jetty
Rock outcrops
Rooikrans Acacia cyclops infestation
Badly degraded areas by trampling
Boundary of approximate area occupied by moored houseboats and yachts
Area of water deeper than 2m



MAP 2. WATER AREAS SUITABLE
FOR BOATING AS SHOWN BY DEPT
Deep navigation channels
Sandbanks and mudflats, exposed H
Higher sandbanks
1 = Old Zone 1 demarcation line
2 = New Zone 1 boundary alignment
N
1
2


MAP OVERLAY 1·1. LAND USES AND INFRASTRUCTURE IN STUDY AREA
N
SCHIER ISLAND
287
Camp point
Donkergat
LANGEBAAN
Jutten bay
Rietbay
Schaapeiland
Meeuwklip
Jutten point
Perlemoenpunt
Stormbaai
LYFSERSHOEK 288
panorama
Japan se klip
Stompneusrots
A.90
Klein oosterwal
Plankies Bay
LEGEND
National Park boundaries
Old Zone 1 boundary line
Main roads
Secondary roads
Buildings - mostly houses
Launching points for small boats
Main launching points-Langebaan
Yacht club, concrete slipway
Alabama Street, slipway onto beach
Scale 1 : 30 000
(Map by Brink, Stokes, Marais & Moolman)
OUDE POST 367
Die Brak
Flemmings' Point
Konstabelberg
Seeberg
Kreefte Bay
kraalbaai
preekstoel
Klein Island
LANGEBAAN LAGOON



MAP I. HYDROGRAPHICAL CHART OF ZONE I, LANGEBAAN LAGOON

A.89

APPENDIX E1

WATERBIRDS AT LANGEBAAN LAGOON
(Source: Underhill 1987)

Palaearctic waders

Common Name	Species Name
Turnstone	*Arenaria interpres*
Ringed Plover	*Charadrius hiaticula*
Sand Plover	*Charadrius leschenaultii*
Grey Plover	*Pluvialis squatarola*
Curlew Sandpiper	*Calidris ferruginea*
Little Stint	*Calidris minuta*
Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Ruff	*Philomachus pugnax*
Terek Sandpiper	*Xenus cinereus*
Marsh Sandpiper	*Tringa stagnatalis*
Greenshank	*Tringa nebularia*
Bartailed Godwit	*Limosa lapponica*
Curlew	*Numenius arquata*
Whimbrel	*Numenius phaeopus*

"Resident waders"

African Black Oyster-catcher	*Haematopus moquini*
Whitefronted Plover	*Charadrius marginatus*
Chestnutbanded Plover	*Charadrius pallidus*
Kittlitz's Plover	*Charadrius pecuarius*
Threebanded Plover	*Charadrius tricollaris*
Blacksmith Plover	*Vanellus armatus*
Ethiopian Snipe	*Gallinago nigripennis*
Avocet	*Recurvirostra avosetta*
Blackwinged Stilt	*Himantopus himantopus*

Non-waders

White Pelican	*Pelecanus onocrotalus*
Grey Heron	*Ardea cinerea*
Purple Heron	*Ardea purpurea*
Blackheaded Heron	*Ardea melanocephala*
Little Egret	*Egretta garzetta*

Black Stork	*Ciconia nigra*
Sacred Ibis	*Theskiornis aethiopicus*
African Spoonbill	*Platalea alba*
Greater Flamingo	*Phoenicopterus ruber*
Lesser Flamingo	*Phoenicopterus minor*
Egyptian Goose	*Alopochen aegyptiacus*
South African Shelduck	*Tadorna cana*
Cape Shoveller	*Anas smithii*
Yellowbilled Duck	*Anas undulata*
Cape Teal	*Anas capensis*
African Marsh Harrier	*Circus ranivorus*
Kelp Gull	*Larus dominicanus*
Hartlaub's Gull	*Larus hartlaubii*
Caspian Tern	*Sterna caspia*
Common/Artic Tern	*Sterna hirundo/paradisea*
Antartic Tern	*Sterna vittata*
Sandwich Tern	*Sterna sandvicenis*
Swift Tern	*Sterna bergii*
Little Tern	*Sterna albifrons*
Pied Kingfisher	*Ceryle rudis*

APPENDIX E2

REPTILES OF THE LANGEBAAN PENINSULA
(Source: Mr L Mouton, University of Stellenbosch)

SAURIA (Lizards)

Species Name	Common Name
Family Geckonidae	
Phyllodactylus lineatus lineatus	Striped gecko
Phyllodactylus porphyreus	Marbled gecko
Pachydactylus austeni	Austen's gecko
Pachydactylus geitjie	Ocellate gecko
Family Agamidae (Koggelmanders)	
Agama hispida hispida	Green spiny agama
Family Chamaeleontidae (Chameleons)	
Bradypodion occidentale	Namaqua dwarf chameleon
Family Lacertidae (Sand Lizards)	
Meroles knoxii	Knox's sand lizard
Nucras tessellata tessellata	Striped sand lizard
Family Scincidae (Skinks)	
Typhlosaurus caecus	Cuviers' legless lizard
Acontias meleagris meleagris	Spotted slow skink
Scelotes gronovii	Gronovi's monodactyle skink
Mabuya capensis	Cape three-striped skink
Mabuya variegata variegata	Variegated skink
Family Cordylidae (Girdled lizards)	
Cordylus cordylus niger	Black rough-scaled girdled lizard
Cordylus polyzonus polyzonus	Karoo girdled lizard
Cordylus macropholis	Large-scaled girdled lizard
Tetradactylus seps	Plated lizard

OPHIDIA (Snakes)

Family Typhlopidae	
Typhlops lalandei	Delalande's blind snake
Family Colubridae	

Lamprophis inornatus	Olive house snake
Lamptophis guttatus	Spotted housesnake
Pseudaspis cana	Mole snake
Lamprophis fuliginosus fuliginosus	Brown house snake
Duberria lutrix lutrix	Common slug eater
Dasypeltis scabra scabra	Common egg eater or Rhombic egg eater
Crotaphopeltis hotamboeia hotamboeia	Red-lipped/Herald snake
Dispholidus typus	Boomslang
Psammophylax rhombeatus	Spotted skaapsteker
Psammophis notostictus	Karoo sand snake/Whip snake
Psammophis leightoni leightoni	Cape sand snake
Psammophis crucifer	Montane/Cross-marked grass snake

Family Elapidae

Naja nivea	Cape cobra
Aspidelaps lubricus lubricus	Coral snake
[Elaps lacteus]	

Family Viperidae

Causus rhombeatus	Rhombic/Common night adder
Bitis arietans arietans	Puff adder

CHELONIA (TORTOISES)

Chersina angulata	Angulate tortoise
Homopus signatus	Rock tortoise

REFERENCES

A'BEAR DR & AM LITTLE (1976) Techniques in evaluating natural resources for recreation. **In:** *First Conference on Recreation Research,* Presented by the Dept of Nature Conservation, Faculty of Forestry, University of Stellenbosch, 29 September - 1 October, 1976: 119-136.

ABEL B & P BLAIKIE (1986) Elephants, People, Parks and Development: the Case of the Luangwa Valley, Zambia. *Environ. Manage.* **10(6):** 735-751.

ACOCKS JPH (1975) Veld Types of South Africa. *Mem. Bot. Surv. S. Africa.* **No. 40.**

AITCHISON GD & K GRANT (1967) The P.U.C.E. programme of terrain description, evaluation and interpretation for engineering purposes. *Proc. of the Fourth Reg. Conf. for Africa on Soil Mechanics and Foundation Engineering,* Cape Town.

ALLISON R & R LEIGHTON (1967) Evaluating Forest Campground Sites. **In:** Rogers P & C Steinitz (1969) *A Comparative Evaluation of Resource Analysis Methods (Sections III and IV).* Graduate School of Design, Department of Landscape Architecture, Harvard University, Massachusetts: 82-382.

ANSELIN A & PM MEIRE (1989) Multicriteria Techniques in Ecological Evaluation: an Example Using the Analytic Hierarchy Process. *Biol. Conserv.* **49:** 215-229.

APPLETON J (1975) Landscape evaluation: the theoretical vacuum. *Trans. Inst. Brit. Geographers* **66:** 120-123.

ASHOR JL, SF McCOOL & GL STOKES (1985) Improving wilderness planning efforts: application of the transactive planning approach. Paper presented at National Wilderness Res. Conf., Fort Collins, CO, July 23-26 1985: 7p. (In: McCool 1988)

ASHTON PG & M CHUBB (1972) A preliminary study for evaluating the capacity of waters for recreational boating. *Water Resources Bull.* **8(3):** 571-577.

AXELSON E (1977) A summary of the history of human settlement at Saldanha Bay. *Trans. R. Soc. S. Afr.* **42(3 & 4):** 215-222.

BAILEY KD (1978) *Methods of Social Survey* Freedom Press, New York.

BABBIE ER (1973) *Survey Research Methods* Wadsworth Publ. Co. Inc., Belmont, California.

BAILEY RG, RD PHISTER & JA HENDERSON (1978): Nature of Land and Resource Classification - A Review. *J. For.*, October 1978: 650-655.

BARKHAM JP (1972) Recreational Carrying Capacity: a problem of perception. *Area* **5(3):** 218-222.

BARNES BV, KS PREGITZER, TA SPIES & VH SPOONER (1982) Ecological Forest Site Classification. *J. For.* **80 (8):** 493-498.

BASTEDO JD & JB THEBERGE (1983) An Appraisal of Inter-disciplinary Resource Surveys (Ecological Land Classification). *Landscape Planning* **10:** 317-334.

BATE GC & SD CRAFFORD (1985) Inhibition of Phytoplankton Photosynthesis by the WSF of Used Lubricating Oil. *Mar. Poll. Bull.* **16(10)**: 401-404.

BATTEN LA (1977) Sailing on reservoirs and its effects on water birds. *Biol. Conserv.* **11**: 49-58.

BAUD-BOVY M & F LAWSON (1977) *Tourism and Recreation Development* Architectural Press, London: 210p.

BEANLANDS GE & PN DUINKER (1983) *An Ecological Framework for Environmental Impact Assessment in Canada.* Inst. for Resource & Environ. Studies, Dalhousie University, Halifax: 132p.

BEAUMONT RD, NG CARTER & JS GREGG (1975) A system for land use evaluation. *Proc. Third Symp. on Terrain Eval. and Data Storage, Div. Soil Mech. & Foundation Eng.*, S.A. Inst. of Civ. Eng., 5-7 Feb, Kyalami: 23-30.

BEGG G (1978) The estuaries of Natal. *Natal Town and Regional Planning Commission Report 41.*

BEGG G (1984) The estuaries of Natal: Part Two. *Natal Town and Regional Planning Commission Report 55.*

BELKNAP RK & JG FURTADO (1967) *Three approaches to environmental resource analysis.* The Conservation Foundation, Washington D.C.

BELKNAP RK & JG FURTADO (1968) The Natural Land Unit as a Planning Base *Landscape Archit.*, January 1968: 145-147.

BELL DE, H RAIFFA & A TVERSKY (eds) (1988a) Preface to: *Decision making: Descriptive, normative and prescriptive interactions* Cambridge University Press, Cambridge/London (623p).

BELL DE, H RAIFFA & A TVERSKY (1988b) Descriptive, Normative, and Prescriptive Interactions in Decision Making. **In:** Bell DE, H Raiffa & A Tversky (eds) *Decision making: Descriptive, normative and prescriptive interactions* (Chapter 1) Cambridge University Press, Cambridge/London: 9-30.

BELL KL & LC BLISS (1973) Alpine disturbance studies: Olympic National Park, U.S.A. *Biol. Conserv.* **5**: 25-32.

BETTMAN JR (1971) The structure of consumer choice processes. *J. Mark. Res.* **8**: 465-471.

BISSET R (1978) Quantification, decision-making and environmental impact assessment. *J. Environ. Manage.* **7**: 43-59.

BISSET R (1980) Methods for environmental impact analysis: Recent trends and future prospects. *J. Environ. Manage.* **11(1)**: 27-43.

BISSET R (1988) Developments in EIA Methods (Chapter 3) **In:** P Wathern (ed.) *Environmental Impact Assessment: Theory and Practice* Unwin Hyman, London: 47-61.

BODDINGTON G (1980) Hiking Trail Corridors in the Cape Peninsula Mountain Chain. *Research Report No. 21*, (Unpublished M.Sc. Thesis), School of Environmental Studies, University of Cape Town, Cape Town.

BODEN R (1977) Ecological Aspects of Outdoor Recreational Planning. **In:** Mercer D (ed.) *Leisure and Recreation in Australia* Sorrell, Melbourne: 222-232.

BOTKIN DB (1982) (convenor) Ecological characteristics of ecosystems. In: WR Siegfried & BR Davies (eds) Conservation of Ecosystems: Theory and Practice. *SA Nat Sci Programme Report No. 61:* 17-27.

BOUCHER C (1983) Floristic and structural features of the coastal foreland vegetation South of the Berg River, Western Cape Province, South Africa. *Bothalia* **14(3 & 4):** 669-674.

BOUCHER C & ML JARMAN (1977) The vegetation of the Langebaan area, South Africa. *Trans. R. Soc. S. Afr.* **42(3 & 4):** 241-272.

BOWLES JM & M ANWAR MAUN (1982) A Study of the Effects of Trampling on the Vegetation of Lake Huron Sand Dunes at Pinery Provincial Park. *Biol. Conserv.* **24:** 273-283.

BRAMER M (1986) Codifying rules of thumb. *The Times Higher Education Supplement* **14.3.86:** 25.

BRATTON SP, MG HICKLER & JH GRAVES (1978) Visitor Impact on Backcountry Campsites in the Great Smoky Mountains. *J. Environ. Manage.* **2(5):** 431-442.

BRIGGS DJ & JD HANSOM (1982) Potential role of ecological mapping in coastal zone management in Europe. *Ekistics* **293(2):** 114-118.

BRINK ABA, JA MABBUTT, R WEBSTER & PHT BECKETT (1966) Report of the working group on land classification and data storage. *Military Engineering Experimental Establishment Report No. 940.* Christchurch, England.

BRINK ABA & TC PARTRIDGE (1967) : Kyalami Land System: An Example of physiographic classification for the storage of terrain data. *4th Regional Conference for Africa on Soil Mechanics and Foundation Engineering,* Cape Town, December 1967: 9-26.

BRINK ABA, TC PARTRIDGE & AAB WILLIAMS (1982): *Soil Survey for Engineering* Clarendon Press, Oxford: 378p.

BRINK J & A MARAIS (1985) Verslag oor Ontspanningsaktiwiteite in die Langebaan skiereiland. (Title tranlates as "Report on Recreation Activities on the Langebaan peninsula") Unpubl. Report to the National Parks Board. Dept. of Forestry, University of Stellenbosch.

BRISTOW D (1988) Hikers' Attitudes to the National Hiking Way System in the South-Western Cape. Unpubl. M.A. Thesis, Dept Environ. 7 Geog. Sciences, Univeristy of Cape Town, Rondebosch.

BROCKELMAN WY & P DEARDEN (1990) The Role of Nature Trekking in Conservation: A Case-study in Thailand. *Environmental Conservation* **17(2):** 141-148.

BROOKE RK (1984) South African Red Data Book: Birds. *S.Afr. Nat. Sci. Prog. Rep.* **97**, CSIR, Pretoria.

BROOKS H (1976) Environmental Decision Making: Analysis and Values. **In:** Tribe L H, C S Schelling & J Voss (eds) *When Values Conflict* (Chapter 5). . Ballinger Publishing Co., Cambridge, Mass.

BROTHERTON D (1973) The concept of carrying capacity of countryside recreation areas. *Recreation News Suppl.* **9**: 6-11.

BROWN PJ , BL DRIVER & C McCONNELL (1978) The Opportunity Spectrum Concept and Behavioural Information in Outdoor Recreation Resource Supply Inventories: Background and Application. *Proc. Workshop on Integrated Inventories of Renewable Resources. USDA. Gen. Tech. Rep. RM-55* .

BUDOWSKI G (1977) Tourism and conservation: Conflict, coexistence and symbiosis. *Parks* **1**:3-6.

BUIST LJ & TA HOOTS (1982) Recreation Opportunity Spectrum Approach to Resource Planning. *J For.* **80(2)**: 84-86.

BURY RL (1976) Recreation Carrying Capacity - Hypothesis or Reality? *Parks and Recreation*, January 1976: 23-25, 56-58.

BUTLER-ADAM JF (1980) A survey of Albert Falls public resort. Unpubl. report, Institute for Social and Economic Research, University of Durban-Westville, Durban.

CALDWELL LK (1987) The contextual basis for environmental decisionmaking: assumptions are predeterminants of choice. *The Environ. Prof.* **9**(4): 302-308.

CALLICOTT JB (1987) "Just the Facts, Ma'am" *The Environ. Prof.* **9**: 279-288.

CAPAS AS (ed) (1985) America's coasts: Progress and Promise. *Report by the Coastal States Organization*, Washington DC: 21p.

CAPE PROVINCE (1973) *Cape Coastal Survey: Report Number 2: Gouritz River to Elandsbaai:* 125p.

CAPE PROVINCIAL DEPARTMENT OF LOCAL GOVERNMENT (1988) Holiday Resorts and Recreational Facilities for the Cape coast: West coast: St Helena Bay to Buffels Bay. Unpublished Report: 178p.

CARLSON LH & PJ GODFREY (1989) Human Impact Management in a Coastal Recreation and Natural Area. *Biol. Conserv.* **49**: 141-156.

CARPENTER RA (1980) Using ecological knowledge for development planning. *Environ. Manage* **4**: 13-20.

CARPENTER RA (1987) What to do while waiting for an environmental ethic. *The Environ. Prof.* **9(4)**: 327-335.

CATTON WR Jnr (1983) Social and behavioral aspects of carrying capacity in natural environments. **In:** Altman I & J F Wohlwill (eds) *Human behavior and environment: Vol 6. Behavior and the natural environment*: 269-306. Plenum, New York.

CHAPMAN M (1981) Decision Analysis. *Civil Service College Handbook* **No. 21**, Her Majesty's Stationery Office, London.

CHRISTIAN CS (1958) The concept of land units and land systems. *Proc 9th Pacific Sci. Congr., 1957* **20**: 74-81.

CHRISTIAN CS & GA STEWART (1968) Methodology of integrated surveys. **In:** *Aerial Surveys and Integrated Studies*, Proc. Toulouse Conf. 1964, UNESCO, Paris: 233-280.

CHRISTIE ND & A MOLDAN (1977) Distribution of benthic macrofauna in Langebaan Lagoon. *Trans. R. Soc. S. Afr.* **42(3 & 4):** 273-284.

CHUBB M & EH BAUMAN (1977) Assessing the recreation potential of rivers. *J. Soil & Water Conserv.* **32(2):** 97-102.

CHURCHILL GA (1983) *Marketing research.* The Dryden Press, Chicago, New York.

CICIN-SAIN B (1990) California and Ocean Management: Problems and Opportunities. *Coastal Management* **18:** 311-335.

CLARK RN & GH STANKEY (1979) The Recreation Opportunity Spectrum: a framework for planning, management and research. *USDA Forest Service General Technical Report PNW-98:* 32p.

CLARK RN, JC HENDEE & FL CAMPBELL (1971) Values, behaviours, and conflict in modern camping culture. *J. Leisure Res.* **3(3):** 143-159.

CLAWSON M (1972) The Emerging American Lifestyle, Parts 1 and 2. **In:** Jensen CR & CT Thorstenson (eds) *Issues in Outdoor recreation*, Burgess Publishing Co., Minneapolis: 19-30.

CLAWSON M & J KNETSCH (1966) *Economics of Outdoor Recreation.* Johns Hopkins Press, Baltimore.

COLE DN (1981) Managing Ecological Impacts at Wilderness Campsites: An Evaluation of Techniques. *J. For.* **79:** 86-89.

COLE DN & EGS SCHREINER (compilers) (1981) Impacts of backcountry recreation: site management and rehabilitation - An annotated bibliography. *USDA For. Serv. Gen. Techn. Rep. INT-21*, Intermountain For. and Range Exp. Sta.

COLLINS R & J HODGE (1984) Clustering visitors for recreation management. *J. Environ. Manage.* **19:** 147-158.

CONNELL JH & MJ KEOUGH (1985) Disturbance and Patch Dynamics of Subtidal Marine Animals on Hard Substrata **In:** Pickett STA & PS White (eds) *The Ecology of Natural Disturbance and Patch Dynamics* (Chapter 8). Academic Press Inc., Orlando: 125-152.

CONOVER (1971) *Non-parametric Statistics* John Wiley & Sons, New YOrk.

COOK DD (1979) The fight to conserve California's coast. *The Geographical Magazine*: 625-629.

COOKE RU & JC DOORNKAMP (1974) *Geomorphology in Environmental Management: An Introduction.* Clarendon Press, Oxford.

COOPER J, RW SUMMERS & JS PRINGLE (1976) Conservation of coastal habitats of waders in the south-western Cape, South Africa. *Biol. conserv.* **10:** 239-247.

COPPOCK J & B DUFFIELD (1975) *Recreation in the Countryside.* Macmillan, London.

CORTNER HJ, PD GARDNER, JG TAYLOR, EH CARPENTER, MJ ZWOLINSKI, TC DANIEL & KJ STENBERG (1984) Uses of Public Opinion Surveys in Resource Planning..*The Environmental Professional* **6:** 265-275.

COUNCIL FOR THE ENVIRONMENT (1989) *Integrated Environmental Management in South Africa.* Joan Lotter Publications, Pretoria: 32p.

COX K (1972) *Man, Location and Behaviour* John Wiley, New York.

CROWE S (1979) The Master Plan for national parks and their regional setting. *Second World Conference on National Parks, Session VI, Paper 14* : 161-173.

CURRY N (1982) Factors affecting decision-making in rural recreation planning in England. *Planning Outlook* **25(2):** 21-25.

DAVID JHM (1981) The Mammals of the Coastal Lowlands of the Western Cape. *Proc. Symp. on Coastal Lowlands of the Western Cape,* March 19-20, University of the Western Cape: 53-56.

DAWSON JA & JC DOORNKAMP (1973) *Evaluating the Human Environment: Essays in Applied Geography.* Edward Arnold (Publishers) Ltd, UK: 288p.

DAY JH (1959) The biology of Langebaan Lagoon: A study of the effect of shelter from wave action. *Trans. Roy. Soc. S.Afr.* **35:** 475-548.

DEE N, JK BAKER, NL DROBNY, KM DUKE, I WHITMAN & DD FAHRINGER (1973) Environmental evaluation system for water resources planning *Water Resources Res.* **9:** 523-535.

DE JONGH P (1988) Uncertainty in EIA (Chapter 4) **In:** P Wathern (ed.) *Environmental Impact Assessment: Theory and Practice.* Unwin Hyman, London: 62-85.

DORFMAN PW (1979) Measurement and meaning of recreation satisfaction: A case study in camping. *Environ. & Behav.* **11(4):** 483-510.

DRAKE C (1982) Controversy over the Use of a Coastal State Park. *Coastal Zone Management Journal* **10(1 & 2):** 97-123.

DRIVER BL & R TOCHER (1970) Toward a behavioural interpretation of recreational engagements, with implications for planning. **In:** B L Driver (ed) *Elements of outdoor recreation planning.* Ann Arbor, Mich: 9-31.

DUSTIN DL & LH McAVOY (1982) The Decline and Fall of Quality Recreation Opportunities and Environments? *Environ. Ethics* **4:** 49-57.

DUINKER PN & GL BASKERVILLE (1986) A Systematic Approach to Forecasting in Environmental Impact Assessment *J. Environ. Manage.* **23:** 271-290.

EBERHARDT LL (1976) Quantitative Ecology and Impact Assessment. *J. Environ. Manage.* **4:** 27-70.

ERZ W (1979) Rapporteur's Summary. *Proc. Second World Conf. on National Parks, Session VI:* 153-154.

FATSEAS VA & TR VAGG (1982) *Quantitative Techniques for Managerial Decision Making.* Prentice-Hall of Australlia, Sydney: 278p.

FERGUSON BK (1981) The use of overlays in site quality mapping. *Can. J. For. Res.* **11:** 361-369.

FERRARIO FF (1978) An Evaluation of the Tourist Resources of South Africa. *Publication No. 1, Dept Geog.*, University of Cape Town: 319p.

FESENMAIER DR & SR LIEBER (1985) Evaluating the stability of outdoor recreation participation models. *Prof. Geographer* **37(1):** 15-21.

FIELDING PJ, KStJ DAMSTRA & GM BRANCH (1988) Benthic diatom biomass, production, and sediment chlorophyll in Langebaan lagoon, South Africa. *Estuarine, Coastal and Shelf Science* **27:** 413-426

FISHER AC & JV KRUTILLA (1972) Determination of optimal capacity of resource-based recreation facilities. *Nat. Resources J.* **12:** 417-444.

FITZSIMMONS AK (1979) The impact of recreational facilities on national park landscapes. *J. Geog.* **Nov 1979:** 230-236.

FLEMMING BW (1977) Distribution of recent sediments in Saldanha Bay and Langebaan Lagoon. *Trans. R. Soc. S. Afr.* **42(3 & 4):** 317-340.

FOGG GE (1981) *Park Planning Guidelines Revised* National Recreation and Park Association, Washington D C: 202p.

FRISSELL SS & DP DUNCAN (1965) Campsite preference and deterioration. *J. For* **63:** 256-260.

FRISSELL SS, RG LEE, GH STANKEY & EH ZUBE (1980) A Framework for estimating the consequences of alternative carrying capacity levels in Yosemite Valley. *Landscape Planning* **7:** 151-170.

FRISSELL SS & GH STANKEY (1972) Wilderness Environmental Quality: Search for social and Ecological Harmony. *Proc. Soc. Amer. Foresters Ann. Meeting,* Hot Springs, Arkansas, October, 1972: 170-183.

FUGGLE RF (1977) A review of a symposium on research in the natural sciences at Saldanha Bay and Langebaan Lagoon. *Trans. Roy. Soc. S.Africa* **42(3 & 4):** 211-214.

FUGGLE RF (1981) Macro-climatic patterns in the fynbos biome. *Nat. Prog. for Environ. Sciences, Fynbos Biome Project Final Report,* December 1981.

FUGGLE RF (1983a) Nature and ethics of environmental concerns. **In:** Fuggle R F & M A Rabie (eds) *Environmental Concerns in South Africa* Juta & Co, Cape Town: 1-8.

FUGGLE RF (1983b) Environmental evaluation. **In:** Fuggle RF & MA Rabie (eds) *Environmental Concerns in South Africa.* Juta & Co, Cape Town: 483-515.

GARLAND GG (1988) Experimental footpath soil losses and path erosion risk assessment in the Natal Drakensberg. Unpubl. Ph.D. thesis, Dept Geographical and Environmental Science, University of Natal, Durban.

GHAZANSHAH IJ , TD HUCHEL & JS DEVINNY (1983) Alteration of Southern California Rocky Shore Ecosystems by Public Recreational Use. *J. Environ. Manage.* **16:** 379-394.

GILBERT CG, GL PETERSON & DW LIME (1972) Toward a model of travel behaviour in the Boundary Waters Canoe Area. *Environ. & Behav.* **4:** 131-158.

GILMOUR JSL (1951) The development of taxonomic theory since 1851. *Nature* **168:** 400-402.

GITTINS JW (1974) Recreational carrying capacity. *Area* **6(2):** 157-159.

GLAVOVIC BC (1988) A Proposed Framework for recreation Planning in South Africa, with particular reference to the Cederberg. M.Sc. Thesis(unpublished), Department of Environmental and Geographical Science, University of Cape Town: pp 178.

GODIN VB & RE LEONARD (1977) Design capacity for backcountry recreation management planning. *J. Soil & Water Conserv.* **32(4):** 161-164.

GODSCHALK DR & FH PARKER (1975). Carrying capacity: A key to environmental planning? *J. Soil & Water Conserv.* **30:** 160-165.

GOLD RL (1977) Linking social with other impact assessments. **In:** Jain RK & BL Hutchings (eds) *Environmental Impact Analysis: Emerging Issues in Planning*. University of Illinois Press, Chicago.

GOLDSMITH FB (1983) Ecological Effects of Visitors and the Restoration of Damaged Areas (Chapter 12). **In:** A Warren & FB Goldsmith (eds) *Conservation in Perspective*. John wiley & Sons, London:201-214 (474p).

GOLDSMITH FB, RJC MUNTON & A WARREN (1970) The impact of recreation on the ecology and amenity of semi-natural areas: methods of investigation used in the Isles of Scilly. *Biol. J. Limn. Soc.*: 287-305.

GOODE WJ & PK HATT (1952) *Methods in Social Research.* McGraw-Hill Book Company, Kogakusha Company, Tokyo

GOODALL B & JB WHITTOW (1975): Recreation Requirements and Forest Opportunities. *Reading Geographical Papers No. 37,* Department of Geography, University of Reading, England: pp 48.

GORDON SI (1978) Performing land-capability evaluation by use of numerical taxonomy: land-use and environmental decision-making made hard? *Environ. and Plann.* **10:** 915-921.

GRAEFE AR , JJ VASKE & FR KUSS (1984) Social Carrying Capacity: An Integration and Synthesis of Twenty Years of Research. *Leis. Sci.* **6:** 395-431.

GRAMMAN JH (1982) Toward a Behavioural Theory of Crowding in Outdoor Recreation: An Evaluation and Synthesis of Research. *Leis. Sci.* 5(2): 109-121.

GREIG P (1977) Data Collection for Recreation Research and Planning in Australia. **In:** Mercer (ed.) *Leisure and Recreation in Australia*. Sorrett, Melbourne.

GREIST DA (1976) The carrying capacity of public wild land recreation areas: evaluation of alternative measures. *J. Leis. Res.* **8:** 123-128.

GRINDLEY JR (1974) Estuaries: An endangered habitat. *African Wildlife* **28(1):** 23-26.

HAMILL L (1984) The outdoor recreation classification for British Columbia: the latest Canadian method for recreation resource analysis. *The Operational Geographer* **5/1984:** 39-42.

HAMMOND CM & BH WALKER (1984) A procedure for land capability analysis in Southern Africa, based on computer overlay techniques. *Landscape Plann.* **11:** 269-291.

HAMMOND R & P McCULLAGH (1974) *Quantitative techniques in Geography: An Introduction* Clarendon Press, Oxford: 318p.

HANSEN AJ & BH WALKER (1988) The Dynamic Landscape: Perturbation, Biotic Response, Biotic Patterns. *Bull. S Afr. Inst. Ecol.* **7**: 5-14.

HANSEN F (1972) *Consumer Choice Behaviour: A Cognitive Theory* The Free Press, New York: 548p.

HANSEN F (1976) Psychological theories of consumer choice. *J. Consum. Res.* **3:** 117-142.

HARDIN G (1978) *Stalking the Wild Taboo* William Kaufmann, Los Altos, Ca: 178p.

HARRIS SA (1984) An assessment of the role of the sand shark *Rhinobatus annulatus* as a predator in Langebaan Lagoon. Unpubl. Zoology Honours Project, October 1984, University of Cape Town, Rondebosch.

HARTZOG GB Jnr. (1979) : Management considerations for optimal development and protection of national park resources. *Second World Conf. Natl. Parks, Session VI, Paper 13*: 155-161.

HAYES-ROTH F, DA WATERMAN & DB LENAT (eds) (1983) *Building Expert Systems* Addison-Wesley, Reading, Massachusetts.

HEBERLAIN TA (1977) Density, crowding and satisfaction: Sociological studies for determining carrying capacities. *Proc. River Recreation Man. and Res. Symp (USDA Forest Service Gen. Techn. Report NC-28)*. St Paul, Minnesota: 67-76.

HELGRATH SF (1974) Trail deterioration in the Selway-Bitterroot Wilderness. M.Sc. Thesis (unpubl.) Department of Forestry and Range Management, Washington State University.

HENDEE JC, GH STANKEY & RC LUCAS (1978) eds. Wilderness Management. *Misc. Publ. No. 1365.* USDA Forest Service, Washington D.C.: 169-186

HENDEY QB & HJ DEACON (1977) Studies in palaeeeontology and archaeology in the Saldanha region. *Trans. R. Soc. S.Afr* **42(3 & 4):** 371-382.

HEY D (1977) Conservation management and human pressures in the Saldanha region. *Trans. R. Soc. S.Afr* **42(3 & 4):** 399-402.

HEYDORN AEF (1973) South African estuaries an economic asset or a national resource being squandered? *Natal Wildlife* **14(4):** 10-15.

HEYDORN AEF (1978) Coastal zone management and conservation. *Challenger Society Symposium on Biology and Marine Technology*, Brighton, March 1978: 1-11.

HEYDORN AEF & KL TINLEY (1980) Estuaries of the Cape, Part 1. Synopsis of the Cape coast. *C.S.I.R. Res. Rep.* **380**: 97p.

HILL RC (1988) *Integrated Environmental Management in the conflict over change in land tenure in the reserves of Namaqualand, South Africa.* Paper presented at the VIIth Annual Meeting of the International Association for Impact Assessment, Griffith University, Brisbane, 5-9 July 1988.

HILLS GA (1960) Regional site research. *For. Chron.* **36**: 401-423.

HILLS GA (1966) The Classification and Evaluation of Land for Multiple Uses. *For Chron.*, **June 1966**: 1-25.

HOBBS BF (1985) Choosing how to choose: comparing amalgamation methods for environmental impact assessment. *Environ. Impact Assessment Rev.* **5**: 301-319.

HOCKEY PAR (1985) This is a world famous haven for waders. *Custos* **14(7)**: 14-16.

HOCKEY PAR & J HALLINAN (1981) Effect of human disturbance on the breeding behaviour of the jackass penguin, *Spheniscus demersus*. *S.Afr.J. Wildl. Res.* **11(2)**: 59-62.

HOGG D (1977) The Evaluation of Recreational Resources. In: Mercer D (ed.) *Leisure and Recreation in Australia*, Sorrett, Melbourne: 101-110..

HOLLICK M (1981a) The Role of Quantitative Decison-making methods in Environmental Impact Assessment. *J. Environ. Manage.* **12**: 65-78.

(1981b) Environmental Impact Assessment as a Planning Tool. *J. Environ. Manage.* **12**: 79-90.

HOPKINS LD (1977) Methods for Generating Land Suitability Maps: A Comparitive Evaluation. *AIP Journal*, October 1977: 386-400.k

HOUGH JL (1988) Obstacles to Effective Management of Conflicts Between National Parks and Surrounding Human Communities in Developing Countries. *Environ. Conserv.* **15(2)**: 129-135.

HUDSON C (1987) A Regional Application of the SLEMSA in the Cathedral Peak Area of the Drakensberg. Unpublished MSc Thesis, Department of Environmental and Geographical Sciences, University of Cape Town: 185p.

HUGO ML (1980) Die onderlinge versoenbaarheid tussen landbou, natuurbewaring en buitelugontspanning. *S. Afr. Geograaf* **8(2)**: 137-149.

HUGO ML (1981) Ekologiese Terreinevaluering. *S Afr J Research in Sport, Phys Educ and Recr* **4(2)**: 69-79.

HUGO ML (1984) Ekologiese Terreinevaluering. Unpublished lecture notes, University of Potchefstroom, South Africa.

IGBOZURIKE UM (1981) The concept of carrying capacity. *J. Geog.* **80(4)**: 141-147..

I.U.C.N. (1978) *Categories, objectives and criteria for protected areas.* A Final Report prepared by the Committee on Criteria and Nomenclature Commission on National Parks and Protected Areas. pp26.

JAAKSON R (1970) Planning for the Capacity of Lakes to Accomodate Water-oriented Recreation. *PLAN 10: 29-40.*

JAAKSON R (1971) Zoning to Regulate On-water Recreation. *Land Econ.* **47**:382--388.

JAAKSON R , MD BUSZYNSKI & D BOTTING (1976) Carrying Capacity and Lake Recreation Planning. A Case Study from North-Central Saskatchewan, Canada. *Town Planning Review* **47**: 359-373.

JARMAN ML (1982) A look at the littlest floral kingdom. *Scientiae* **23(3)**: 9-19.

JARMAN ML (ed.) (1984) Conservation Priorities in Lowland Regions of the Fynbos Biome. *S.Afr. Nat. Sci. Prog. Rep.* **No. 87**, CSIR, Pretoria.

JEFFERIES BE (1982) Sagarmatha National Park: The Impact of Tourism in the Himalayas *Ambio* **11(5)**: 274-281

JUBENVILLE A (1976) *Outdoor Recreation Planning.* (Chapter 12) W B Saunders Co., Philadelphia : 157-178.

KAPLAN R (1980) Citizen participation in the design nd evaluation of a park. *Environ. & Behav.* **12(4)**: 494-507.

KEENAN WJ (1979) Panel discussion on "Park planning in perspective". **In:** *Proc. Second World Conf. on National Parks*, Session VI: 173-179.

KEENEY RL (1982) Decision Analysis: An Overview. *Operations Research* **30(5)**: 803-838.

KLEIN RG (1974) Environment and subsistence of prehistoric man in the Southern Cape Province, South Africa. *Wld. Archaeol.* **5**: 249-284.

KOZLOWSKI J (1985) Threshold approach in environmental planning. *Ekistics* 311 March/April: 146-153.

KRAFT V (1981) *Foundations for a Scientific Analysis of Value.* Edited by H L Mulder, D Reidel, Dordrecht: 195p.

KRUMPE EE & PJ BROWN (1982) Redistributing backcountry use through information related to recreation experiences. *J. For.* **June 1982**: 360-364.

KRUMPE EE & WJ McLAUGHLIN (1985) Research needs of Wilderness Management. *Proc. Nat. Wilderness Res. Conf: Issues, State-of-Knowledge, Future Directions* (RC Lucas, compiler), Intermediate Mountain Research Station, Ogden, Utah: 59-62 (369p).

KUCHLER AW (1984) Ecological vegetation maps. *Vegetatio* 55: 3-10.

KUSHLAN JA (1987) External threats and internal management: The hydrologic regulation of the Everglades, Florida, USA. *Environ. Manage.* **11**: 109-119.

KUSLER JA (1980) *Regulating Sensitive Lands: A Guidebook* Ballinger Publ. Co., Cambridge, Mass: 248p.

KUSS FR & AR GRAEFE (1985) Effects of Recreation Trampling on Natural Area Vegetation. *J. Leis. Res.* **17(3)**: 165-183.

KUSS FR & JM MORGAN (1980) Estimating the physical carrying capacity of recreation areas: A rationale for application of the universal soil loss equation. *J. Soil and Water Conservation* March/April 1980: 87-89.

KUSS FR & JM MORGAN (1986): A First Alternative for Estimating the Physical Carrying Capacities of Natural Areas for Recreation. *Environ. Manage.* **10(2):** 255-262.

LACATE DS (1969) Guidelines for bio-physical land classification - for classification of forest lands and associated wildlands.*Can For Serv Publ.* **1264**, Ottawa: 61p..

LANE SB (1980) Interpretation of Digital Landsat-1 Imagery from Verlorenvlei, South Western Cape. *Res. Rep. No. 19*, School of Environmental Studies, University of Cape Town.

LAVERY P (ed.) (1971, 1974) *Recreational Geography.* David & Charles, London.

LAWRENCE CJ, R WEBSTER AND PHT BECKETT (1977) The use of air photo interpretation for land evaluation in the western highlands of Scotland *Catena* **4**: 341-357.

LEATHERBERRY EC (1979) River Amenity Evaluation: A Review and Commentary. *Water Resources Bull.* **15(5):** 1281-1292.

LEE N (1982) The future development of environmental impact assessment *J.Environ. Manage.* **14:** 71-90.

LEMONS J (1987) Environmental Science and Values *The Environ. Prof.* **9:** 277-278.

LEONARD R E & PLUMLEY H J (1978): The use of soils information for dispersed recreation planning. *Recreational Impact on Wildlands Conf. Proc., October,* US Forest Service Pacific North West Region: 50-63.

LIDDLE M J & H R A SCORGIE (1980) The effects of recreation on freshwater plants and animals: a review. *Biol. Conserv.* **17**: 183-206.

LIME DW (1972) Behavioural research in outdoor recreation management: an example of how visitors select campgrounds. **In:** J F Wohlwill & D H Carson (eds) *Environment and the social sciences: perspectives and applications.* American Psychological Association, Washington D. C.: 198-206 (300p).

LIME DW (1977): Principles of Recreation Carrying Capacity. IN: Proceedings of the Southern States Recreation Research Application Workshop, September 16-18, Ashville, North Carolina. *Gen. Techn. Report SE-9,* South-eastern Forest Exp. Stn, Ashville: 122-134.

LIME DW & GH STANKEY (1971) Carrying capacity: Maintaining outdoor recreation quality. *Recreation Symp. Proc.*, USDA For. Serv., Upper Darby, Pennsylvania: 174-184.

LIME DW & GH STANKEY (1979) Carrying Capacity: Maintaining Outdoor Recreation Quality. IN: (Eds) C S Van Doren, G B Priddle & J E Lewis *Land and Leisure: Concepts and Methods in Outdoor Recreation.* Methuen & Co Ltd.: p I05-117 (317 p).

LINTON DL (1968) The assessment of scenery as a natural resource *Scott. Geogr. Mag.* **84**: 219-238.

LUCAS RC (1964) Wilderness perception and use: the case of the Boundary Waters Canoe Area. *Natural Resources J.* **3(1)**:394-411.

LUCAS RC (1973) Wilderness: a management framework. *J. Soil & Water Conserv.* **28(4)**: 150-154.

LUCAS RC (1982) Recreation regulations - when are they necessary? *J. For.* **80**: 148-151.

LUCAS RC (1985) Visitor Characteristics, Attitudes, and Use Patterns in the Bob Marshall Wilderness Complex, 1970-82 *USDA For. Serv. Res. Paper INT-345.* Ogden, Utah.

MABBUTT JA (1968) Review of Concepts of Land Classification. **In:** G A Stewart (ed), *Land Evaluation.* MacMillan, Johannesburg: 11-28.

MACHLIS GE & DL TICHNELL (1985) *The state of the world's parks: An international assessment for resource management, policy, and research.* Westiew Press, Boulder, Colorado: 131p.

MANNING RE (1986) *Studies in outdoor recreation: Search and research for satisfaction.* Oregon State University Press, Corvallis.

MARGULES CR & MB USHER (I984) Conservation Evaluation in practice: I. Sites of different habitats in North-east Yorkshire, Great Britain. *J. Envir. Manage.* **18**: 153-168

MARTINO JP (1972) *Technical forecasting for decision making.* American Elsevier, New York.

MASLOW AH (1954) *Motivation and Personality Harper and Row, New York.*

MATTHEWS WH (1975) Objective and Subjective Judgements in Environmental Impact Analysis. *J. Environ. Conserv.* **2(2)**: 121-130.

MCALLISTER DM (1980) *Evaluation in Environmental Planning: Assessing Environmental, Social, Economic and Political Trade-Offs.* Cambridge: M I T Press ,308p.

McCLELLAN K & EA MEDRICH (1969) Outdoor Recreation: Economic Considerations for Optimal Site Selection and Development. *Land Econ.* **45**: 175-182.

McCOOL SF (1986) Experiencing management for quality: implementing the Limits of Acceptable Change Planning System. Paper presented at the *Conference on Science in the National Parks*, July 13-16, 1986, Fort Collins, Co.

McCOOL SF (1988) (compiler) *Application of the Limits of Acceptable Change Planning System: A set of readings.* University of Montana, Missoula.

McCOOL SF & JL ASHOR (1985) Politics and Rivers: Creating effective citizen involvement in management decisions. **In:** McCOOL S F (compiler) (1988) *Application of the Limits of Acceptable Change Planning System: A set of readings.* University of Montana, Missoula.

McCOOL SF, DN COLE, RC LUCAS & GH STANKEY (1988) Maintaining wilderness quality through the Limits of Acceptable Change Planning System (Draft). **In:** McCool (1988).

McCOOL SF & GH STANKEY (1986) Planning and Social Change: Responding to the Revolution in Recreation Demand IN: *Proc. 18th INFRO*, Ljubljanana, Yugoslavia: 67-77.

McDONNELL MJ (1981) Trampling effects on coastal dune vegetation in the Parker River National Wildlife Refuge, Massachusetts, USA. *Biol. Conserv.* **21**: 289-301.

McHARG I (1963) Regional Landscape Planning. IN: Scheffy A J W (ed.),*Resources, the Metropolis, and the Land-Grant University.* Dept of Landscape Architecture, University of Pennsylvania: 31-35.

McHARG I (1969) *Design with Nature.* The Natural History Press, New York.

McKENRY K (1977) Value Analysis of Wilderness Areas **In:** D Mercer (ed.) *Leisure and Recreation in Australia* (Chapter 20). Sorrett Publishing, Sydney.

McLAUGHLIN BP & P SINGLETON (1979) Recreational Use of a Nature Reserve: A Case Study in North Norfolk,U.K. *J. Environ. Manage.* 9: 213-223.

McLUSKY DS, FE ANDERSON & S WOLFE-MURPHY (1983) Distribution and population recovery of *Arenicola marina* and other benthic fauna after bait digging. *Mar. Ecol. Prog. Ser.* **11**: 173-179.

MELNICK RZ (1983) Protecting Rural Cultural Landscapes: Finding Value in the Country. *Landscape J.* 2(2): 85-96.

MERCER D (1970) Urban recreational hinterlands: a review and example *Prof. Geographer* **22(2)**: 74-78.

MERCER D (ed.) (1977) *Leisure and Recreation in Australia.* Sorrett, Melbourne.

MERCER D (1980) *In Pursuit of Leisure.* Sorrett, Australia: 104p.

MIDGELEY DC & WV PITMAN (1969) Surface Water Resources of South Africa. *Hydrol. Res. Unit Rep. No. 2/69,* Department of Civil Engineering, University of the Witwatersrand, Johannesburg.

MILES C & W SEABROOKE (1977) *Recreational Land Management* Spon, London.

MILLER A (1983) The Influence of Personal Biases on Environmental Problem-solving. *J. Environ. Manage.* **17**: 133-142.

MILLER A (1984) Professional Collaboration in Environmental Management: the Effectiveness of Expert Groups. *J. Environ. Manage.* **16**: 365-388

MILLER A (1985) Psychological biases in environmental judgements. *J. Environ. Manage.* **20**: 231-243.

MITCHELL B (1979) *Geography and Resource Analysis* (Chapter 7). Longman, London: 177-200 (399 p).

MITCHELL CW. (1973) *Terrain Evaluation.* Longman Group Limited, London: 221p.

MOLL E (1985) Cape vegetation most endangered. *Custos* **14(7)**: 46-48.

MOORE CA, M VAN VEELEN, PJ ASHTON & RD WALMSLEY (1991) *Preliminary Water Quality Guidelines for the Kruger National Park Rivers.* Kruger National Park Rivers Res. Prog. Rep. No. 1: 91p.

MOORE DM, BG LEES & SM DAVEY (1991) A New Method for Predicting Vegetation Distributions using Decision Tree Analysis in a Geographic Information System. *Environ. Manage.* **15(1):** 59-71.

MORGAN JM & FR KUSS (1986) Soil Loss as a Measure of Carrying Capacity in Recreation Environments. *Environ. Manage* **10(2):** 263-270.

MORGAN RPC (1986) *Soil Erosion and Conservation* Longman Group, Hong Kong: 298 p.

MOSS MR (1983) Landscape Synthesis, Landscape Processes and Land Classification, some Theoretical and Methodological Issues. *GeoJournal* **7(2):** 145-153.

MOSS MR (1985) Land Processes and Land Classification. *J. Environ. Manage.* 20: 295-319.

MUELLER-DOMBOIS D & H ELLENBERG (1974) *Aims and Methods of Vegetation Ecology* John Wiley & Sons, London, New York: 547p.

MUNN RE (1979) *Environmental Impact Assessment* Scope 5 (Second Edition) John Wiley & Sons, Chichester: 190p.

MURPHY K (1988) An expert systems approach to decision-making in coastal zone management. Unpublished M.Sc. Thesis, Department of Environmental & Geographical Science, University of Cape Town, Cape Town.

MURPHY JF & DR HOWARD (1977) *Delivery of Community Leisure Services: An Holistic Approach.* Lea and Febiger, Philadelphia: 219p.

MWALYOSI RBB (1991) Ecological Evaluation for Wildlife Corridors and Buffer Zones for Lake Manyara National Park, Tanzania, and its Immediate Environment. *Biol. Conserv.* **57:** 171-186.

NASH C, D PEARCE & J STANLEY (1975) Criteria for Evaluating Project Evaluation Techniques. *J. Amer. Inst. Plan.* **1(2):** 83-89.

NASH R (1982) *Wilderness and the American Mind* (Third Edition) Yale University Press, New Haven: 425p.

NEWMARK WD (1987) A land-bridge island perspective on mammalian extinctions in Western North American Parks. *Nature* (London) **325:** 430-433.

NICKERSON NH & FR THIBODEAU (1983) Barefoot and shod trampling of dunes on Province Lands, Cape Cod, Massachusetts. *Biol. Conserv.* **27:** 277-287.

OBERHOLZER & VAN PAPENDORF (1986) Abrahamskraal Development Proposal (unpublished plan proposal)

ODUM EP (1969) The Strategy of Ecosystem Development. *Science* **164:** 262-270.

ODUM EP (1971) *Fundamentals of Ecology* (Third Edition) W B Saunders Co., London.

O'KEEFE JH, DB DANIELEWITZ & JA BRADSHAW (1986) The River Conservation System: A Users Manual. *CSIR Ecosystem Programmes Occasional Report Series No. 9,* Council for Scientific and Industrial Research, Pretoria.

O'LEARY JT, TL NAPIER, FD DOTTAVIO, D YOESTING & J CHRISTENSEN (1982) Examining Predictor Variables Used in Outdoor Recreation Planning. IN: Countryman D W & Sofranks D M (eds) *Guiding Land Use Decisions: Planning and Management for Forests and Recreation.* John Hopkins: 140-149

OPPENHEIM AN (1966) *Questionnaire Design and Attitude Measurement.* Heinemann, London.

O'RIORDAN T (1969) Planning to improve environmental capacity: a case study in Broadland. *Town Plann. Rev.* **40(1)**: 39-58.

O'RIORDAN T (1971) *Perspectives on Resource Management* Pion Ltd., London.

OUDE POST SYNDICATE (undated) Information pamplet and permit for visitors to the Postberg Nature Reserve

OUTDOOR RECREATION RESOURCES REVIEW COMMISSION (1962) *Outdoor Recreation for America: A Report to the President and to the Congress* (Study Reports 1-27, Chapter 6), USA Government Printer: 95-120

OWENS PL (1984) Rural leisure and recreation research: a retrospective evaluation. *Prog. in Human Geogr.* **8(2)**: 157-188.

PARKS CANADA (1979) *Parks Canada Policy* Parks Canada, Ottawa : 37-46.

PATMORE J (1970) *Land and Leisure* Penguin, Harmondsworth, Middlesex.

PATTERSON ME & WE HAMMITT (1990) Backcountry Encounter Norms, Actual Reported Encounters, and Their Relationship to Wilderness Solitude. *J. Leis. Res.* **22(3)**: 259-275.

PEARCE DG (1985) Tourism and environmental research: A Review. *Int. J. Environ. Studies* 25: 247-255.

PEARCE DG & RM KIRK (1986) Carrying capacities for coastal tourism. *UNEP Industry and Environ.* **9(1)**: 3-7.

PETERSON GL (1974) Evaluating the quality of the wilderness environment: Congruence between perception and reality. *Environ. & Behav.* **6(2)**: 169-193.

PFISTER RE & RE FRENKEL (1975) *The concept of carrying capacity: its application for management of Oregon's Scenic Waterway System.* Dept. of Geography, Oregon State Univ., Corvallis: 50p.

PICKETT STA & PS WHITE (eds) (1985) *The Ecology of Natural Disturbance and Patch Dynamics* (Chapter 1) Academic Press Inc., Orlando: 3-13 (472p).

PICKLES I (1978) Images of landscape in South Africa with particular reference to landscape appreciation and preferences in the Natal Drakensberg. Ph.D. Thesis (Unpubl), University of Natal, Pietermaritzburg.

PIELOU EC (1981) The Usefulness of Ecological Models: A Stock-taking. *Quart. Rev. Biol.* **56 (1)**: 17-31.

PIERCE TH, JR GUSTAFSON & J KOUTSANDREAS (1978) Remote Sensing and Land Use Impact Assessment. *Int. Symp. Remote Sensing Environ.*, Manila, 20-26 April, 1978: 271-276.

PIGRAM P (I983) *Outdoor Recreation and Resource Management.* St. Martin's Press, New York; 262pp.

PITT DG & ZUBE EH (1989) Management of Natural Environments. **IN:** Stokols D & I Altman (eds) *Handbook of Environmental Psychology* (2 volumes), John Wiley & Sons, New York: 1009-1042.

PRESTON GR & RF FUGGLE (1988) Profiles and Preferences of Visitors to Three South African Nature Reserves. *J. Wildlife Manage.* **18(1):** 1-5.

PROSSER G (1986) The Limits of Acceptable Change: An Introduction to a Framework for Natural Area Planning. *Austr. Parks and Recr.* **22(2):** 5-10.

PUTTICK GM (1977) Spatial and temporal variations in inter-tidal aniimal distribution at Langebaan Lagoon, South Africa. *Trans. R. Soc. S. Afr.* **42(3 & 4):** 403-440.

RAAL PA (1989) The Mapping and Conservation Importance Rating of the Cape Coastal Vegetation as an Aid to Development Planning. *CSIR Report EMA-C 89153,* CSIR, Stellenbosch: 20p.

REIMOLD RJ, RA LINTHURST & PL WOLF (1975) Effects of grazing on a saltmarsh. *Biol. Conserv.* **8:** 105-124.

ROBERTSHAW PT (1977) Excavations at Paternoster, South Western Cape. *S. Afr. Archaeol. Bull.* **32:** 63-73.

ROBERTSHAW PT (1978) Archaeological investigations at Langebaan Lagoon, Cape Province. **In:** van Zanderen Bakker SR & JA Coetzee (eds, 1975-1977): *Palaeoecology of Africa and Surrounding Islands* Vol 10/11. A A Balkema, Rotterdam: 139-148.

ROBINSON G (1984) Draft Management Guidelines for the Proposed West Coast National Park. George, South Africa.

ROBINSON G (1985) Management Plan for a new National Park. *Custos* **14(7):** 48-49.

RODGERS HB (1969) Leisure and recreation. *Urban Studies* **6:** 368-384.

ROGERS P & C STEINITZ (1969) *A Comparative Evaluation of Resource Analysis Methods*(Sections III and IV). Graduate School of Design, Department of Landscape Architecture, Harvard University, Massachusetts: 82-382.

ROOME NJ (1983) Preferences of national nature reserve users. *J. Environ. Manage.* **17:** 143-152.

ROOME NJ (1984) Evaluation in Nature Conservation Decision-making. *Environ. Conserv.* **11(3):** 247-252.

ROSIER J, G HILL & J KOZLOWSKI (1986) Environmental Limitations: A Framework for Development kon Heron Island, Great Barrier Reef. *J. Environ. Manage.* **23:** 59-73.

ROWE JS (1980) The Common Denominator of Land Classification in Canada: an Ecological Approach to Mapping. *For. Chron.* (February): 19-20.

ROWE JS & R SHEARD (I981) Ecological Land Classification: a survey approach. *Environ. Manage.* **5:** 451-464.

ROWLANDS BW (1984) The effects of recreational activities on aquatic avifauna. Unpubl. M.Sc. Thesis, School of Environmental Studies, University of Cape Town, Rondebosch.

RUNYON D (1977) Tools for community-managed impact assessment. *J.Amer. Inst. Planning* **43(3)**: 125-135.

RUSSELL B (1931) *The Scientific Outlook* W W North & Co., New York.

RUTHERFORD MC & RH WESTFALL (1986) Biomes of Southern Africa - An Objective Categorization. *Mem. Bot. Surv. S. Afr.* No. **54**: 98p.

RYAN PG, LG UNDERHILL, J COOPER & M WALTNER (1987) Waders (Charadrii) and other water birds on the coast, adjacent wetlands and offshore islands of the southwestern Cape Province, South Africa, summer 1980/81. *Bontebok* **6**: 1-19.

S. A. DEPARTMENT OF AGRICULTURE (1985) Land Types Inventory *Mem. on the Agric. Resources of S. Afr.* (series). Government Printer, Pretoria.

S. A. DEPARTMENT OF AGRICULTURE, Winter Rainfall Region (1985) *Agricultural Development Program: Swartland Sub-region.* Elsenberg, Cape.

S. A. DEPARTMENT OF FINANCE (1988) Statistical/ economic review 1987/88. Government Printer, Pretoria.

S. A. DEPARTMENT OF PLANNING AND THE ENVIRONMENT (1975) *Guidelines for the Future Development of Vredenburg-Saldanha and Surroundings.* (English Translation of Afrikaans original). Dept. Planning & the Environment, Cape Town: 42p.

SAATY TL (1986) *Decision Making for Leaders.* Thomas Saaty, Pittsburgh: 291p.

SALM RV (1985) Integrating marine conservation and tourism. *Int. J. Environ. Studies* **25**: 229-238.

SALM RV (1986) Coral reefs and tourism: The Indian Ocean experience. *UNEP Industry and Environment* (Jan/Feb/March 1986): 11-14.

SAVIGEAR RAG (I956) Techniques and terminology in the investigation of slope forms. *Premier Rapport de la Commission pour l'Etude des Versants, Union Geographique Internationale*: 66-75.

SAX JL (1982) In Search of Past Harmony. *Natural Hist.* **91(8)**: 42-51.

SCHOLES RJ (1989) Change in nature and the nature of change: the response of terrestrial organisms and ecosystems to climatic change. Paper presented at the *IGBP Conference on Geosphere-Biosphere Change in Southern Africa,* held at the University of Cape Town, Cape Town, 4-8 December 1989.

SHANNON LV & GH STANDER (1977) Physical and chemical characteristics of water in Saldanha Bay and Langebaan Lagoon. *Trans. Roy. Soc. S. Afr.* **42(3 &4)**: 441-460.

SHELBY B (1981) Encounter norms in backcountry settings: Studies of three rivers. *J. Leis. Res.* **13**: 129-138.

SHELBY B & R HARRIS (1985) Comparing Methods for Determining Visitor Evaluations of Ecological Impacts: Site Visits, Photographs, and Written Descriptions. *J Leis. Res.* **17(1)**: 57-67.

SHOPLEY JB & RF FUGGLE (1984) A comprehensive reveiw of current environmental impact assessment methods and techniques. *J. Environ. Manage* **18:** 25-47.

SIEGFRIED WR (1978) Estuaries, ecology and conservation in South Africa. *S. Afr. J. Sci.* **74:** 106-107.

SIEGFRIED WR (I985) The perfect opportunity to be innovative. *Custos* **14(7)**: 36-37.

SIMON HA (1955) A behavioral model of rational choice. *Quart. J.Econ.* **69:** 99-118.

SIMON HA (1956) Dynamic programming under uncertainty with a quadratic criterion function. *Econometrica* **24:** 74-81.

SIMON HA (1988) Rationality as Process and as Product of Thought **In:** Bell DE, H Raiffa & A Tversky (eds) *Decision making: Descriptive, normative and prescriptive interactions* (Chapter 3) Cambridge University Press, Cambridge/London: 58-77.

SIMON RH (1977) The algal flora of Saldanha Bay. *Trans. R. Soc. S. Afr.* **42 (3 & 4)**: 461-482.

SINDEN JA & AC WORRELL (1979) *Unpriced values: Decision without market prices.* John Wiley and Sons, New York.

SKOLOMOWSKI H (1975) Knowledge and Values. *The Ecologist* **5(1):** 8-15.

SMARDON C (1988) Visual Impact Assessment for Island and Coastal Environments. *Impact Assessment Bull.* **6(1):** 5-24

SMITH PGR & JB THEBERGE (1987) Evaluating Natural Areas Using Multiple Criteria: Theory and Practice. *Environ. Manage.* **11(4):** 447-460.

SONDHEIM MW (1978) A comprehensive methodology for assessing environmental impact. *J. Environ. Manage.* **6(1):** 27-42.

SOUSA WP (1985) Disturbance and Patch Dynamics on Rocky Intertidal Shores **In:** Pickett STA & PS White (eds) *The Ecology of Natural Disturbance and Patch Dynamics* (Chapter 7). Academic Press Inc., Orlando: 101-124.

SOWMAN MR (I984) *An Assessment of Recreational Carrying Capacity at Infanta, South Cape.* Masters Thesis, School of Environmental Studies, University of Cape Town, South Africa: 149p.

SOWMAN MR (1986) *Assessment of the recreational carrying capacity of the Kromme River estuary.* Environmental Evaluation Unit, University of Cape Town, February 1986: 52p.

SOWMAN MR (1987) A Procedure for Assessing Recreational Carrying Capacity of Coastal Resort Areas. *Landscape and Urban Plann.* **14**: 331-344.

SOWMAN MR & RF FUGGLE (1987) Assessing Recreational Carrying Capacity: A Case Study of the Kromme River Estuary, South Africa. *J. Shoreline Manage.* **3:** 53-75.

SOWMAN MR & P MORANT (1989) Recreational pressures in the South African coastal zone - can we alleviate the problems? Paper presented at *Coastal Zone '89,* The Sixth Symposium on Coastal and Ocean Management. July 11-14, 1989, Charleston, South Carolina.

SOWMAN M, JB SHOPLEY & RF FUGGLE (in press) Applying the component interaction technique to the identification of secondary impacts for EIA.

SPEIGHT JG (1968) Parametric Description of Land Form. Papers of a CSIRO Symposium on Land Evaluation. MacMillan of Australia, Melbourne.

SPIES TA & BV BARNES (1985) A multifactor ecological classification of the northern hardwood and conifer ecosystems of the Sylvania Recreation Area, Upper Peninsula, Michigan. *Can. J. For. Res.* **15:** 949-960.

SPRUGEL DG (1991) Disturbance, Equilibrium, and Environmental Variability: What is "Natural" Vegetation in a Changing Environment? *Biol. Conserv.* **58:** 1-18.

STANKEY GH (1973) Visitor Perception of Wilderness Carrying Capacity. *USDA For. Serv. Res. Paper INT-142,* Intermountain Forest and Range Experiment Station, Ogden, Utah: 61p.

STANKEY GH (1974) Criteria for the Determination of Recreation Carrying Capacity im the Colorado River Basin **In:** AB Crawford & D.F.Petersen (eds) *Environmental Management in the Colorado River Basin* Utah State University Press: 82-101.

STANKEY GH & J BADEN (1977) Rationing Wilderness Use: Methods, Problems and Guidelines. *USDA For. Serv. Res. Paper INT-192,* Ogden Utah.

STANKEY GH, PJ BROWN & RN CLARK (1983) Monitoring and Evaluating Changes and Trends in Recreation Opportunity Supply. **In:** McCool (1988).

STANKEY GH & CLARK RN (1976) Analysing public input to resource decisions: criteria, principles & case examples of the Codinvolve system: Natural Resources Journal **In:** T O'Riordan (ed.) *Environmentalism* Pion Ltd., London: 189-193.

STANKEY GH, DN COLE, RC LUCAS, ME PETERSEN & SS FRISSELL (1985) The Limits of Acceptable Change (LAC) System for Wilderness planning. *USDA For. Serv. Gen. Tech. Rep.* **INT-176,** Intermountain For. & Range Exp. Sta., Ogden, Utah: 37p.

STANKEY GH & DW LIME (1973) Recreational carrying capacity: an annotated bibliography. *USDA For. Serv. Gen. Tech. Rep.* **INT-3,** Intermountain For. & Range Exp. Sta., Ogden, Utah: 45p.

STANKEY GH & SF McCOOL (1984) Carrying Capacity in Recreational Settings: Evolution, Appraisal and Application. *Leisure Sciences* 6(4): 453-472.

STANKEY GH, SF McCOOL & GL STOKES (undated) Limits of Acceptable Change: A new framework for managing the Bob Marshall Wilderness Complex. **In:** *Application of the Limits of Acceptable Change Planning System: A Set of Readings.* Compiled by S F McCool, School of Forestry, University of Montana. 1988.

STARFIELD AM & AL BLELOCH (1983) An approach to problems in ecological management that are difficult to quantify. *J. Environ. Manage.* **16:** 261-268.

STARFIELD AM & AL BLELOCH (1986) *Building Models for Conservation and Wildlife Management*, MacMillan, New York.

STAUTH R (1983) Environmental Evaluation Manual. *School of Environmental Studies Research Report No. 5,* University of Cape Town.

STAUTH R (1989) An Environmental Evaluation Methodology for Improving Resource Allocation Decisions: A Treatise with Selected South African Case Studies. Unpublished Dissertation submitted for the degree of Doctor of Philosophy in the Department of Environmental and Geographical Sciences, University of Cape Town, October 1989:

STEINER F, G YOUNG & E ZUBE (1988) Ecological Planning: Retrospect and Prospect. *Landscape J.* 7(1): 31-39. STEWART (I958)

STOCKLY M (1984) Tourism and conservation: Compatible Ideas? *Nexus* **6(3)**: 1-7.

SUDMAN S (1976) *Applied Sampling* Academic Press, San Francisco.

SUMMERS RW (1977) Distribution, abundance and energy relationships of waders (Charidrii) at Langebaan Lagoon. *Trans. R. Soc. S. Afr.* **42(3 & 4)**: 483-496.

SUTCLIFFE MO (1981) A Behavioural Study of Recreation in the Natal Drakensberg. *Natal Town and Regional Planning Commission* **48**, Pietermaritzburg.

TALBOT WJ (1947) *Swartland and Sandveld* Struik Publishers, Cape Town.

TALJAARD EPS (1984) Rekreasi in die Metropolitaanse Gebiede van Kaapland Deel 1: Metrogebied van Kaapstad. Unpubl. Ph D Thesis, University of Stellenbosch

TANGLEY L (1988) Beyond National Parks. *BioScience* **38(3)**: 146-147.

TAYLOR HC (1978) Capensis. **In:** MJA Werger *The biogeography and ecology of southern Africa* Junk, The Hague.

TAYLOR V (1984) Outdoor Recreation of Whites in the Cape Town Metropolitan Area: The Resource Base and Utilization Patterns. *Institute of Cartographic Analysis Publication No/13/1984,* University of Stellenbosch, Stellenbosch: 217p.

TERRY CE (1977) A filter system for determining river suitability for national Wild and Scenic River status **In:** Proc. River Recreation Management and Research Symp., Jan 24-27, Minneapolis, Minnesota *USDA For. Serv. Gen. Tech. Rep. NC-28,* N. Central For. Exp. Stn., St Paul, Minnesota.

TIMMERMANN LRA (I985) Possibilities for the development of groundwater from the Cenozoic sediments in the lower Berg River region. *Technical Report GH 3374,* Directorate of Geohydrology, Dept Water Affairs, Cape Town: 27p.

TINLEY KL (undated) Establishment of Wildlife Resource Areas in Rural Africa - Values and Objectives.

TIVY J (1972) The concept and determination of carrying capacity of recreational land in the USA. *CCS Occasional Paper No. 3.* Countryside Commission for Scotland, Redgorton, Perth: 20p.

TIVY J (1980) *The effect of recreation on freshwater lochs and reservoirs in Scotland.* Report commissioned by the Countryside Commission for Scotland: 202p.

TOBIN RB (1983) Recreation Planning in the White Mountains National Recreation Area. *Agroborealis* January 1983: 18-23.

TROEH FR (1965) Landform equations fitted to contour maps. *Am. J. Sci.* **263:** 616-627.

TUBBS CR & JW BLACKWOOD (1971) Ecological Evaluation of Land for Planning Purposes. *Biol. Conserv.* 3(3): 169-172.

TULL DS & DI HAWKINS (1976) *Marketing Research* (Chapter 7). MacMillan & Co., London.

TURNER A (1988) Impact, Damage and Management: The place of measurement in public policy making. *Workshop paper, presented at the Institute of British Geographers' Annual Conference,* Loughborough University of Technology, England, January 1988: 29p.

TURNER JR (1975) Applications of landscape evaluation: a planner's view. *Trans. Inst. Brit. Geographers* **66**: 156-161.

TVERSKY A & D KAHNEMAN (1988) Rational Choice and the Framing of Decisions **In:** Bell DE, H Raiffa & A Tversky (eds) *Decision making: Descriptive, normative and prescriptive interactions* (Chapter 3) Cambridge University Press, Cambridge: 167-192

UNDERHILL LG (I987) Waders (Charadrii) and other waterbirds at Langebaan Lagoon, South Africa, 1975-86 *Ostrich* **58:** 145-155.

UNITED STATES ARMY CORPS OF ENGINEERS (1968) Costa Rica Resource Inventory. Analysis of, **In:** Rogers and Steinitz (1969).

USHER MB (1973) *Biological Management and Conservation.* Chapman and Hall, London: 394p (274-315).

VAN DOBBEN WH & RH LOWE-McCONNELL (eds.) (1975) Unifying Concepts in Ecology. *Report of the plenary sessions of the First International Congress of Ecology, the Hague,* September 8-14, 1975. Dr W Junk B V Publishers, The Hague: 5-167.

VAN DOREN CS, GB PRIDDLE & JE LEWIS (eds) (1979) *Land and Leisure: concepts and methods in outdoor recreation*, Second Edition. Methuen & Co., London: 317p.

VAN OOSTERZEE P (1984) The Recreation Opportunity Spectrum: Its Use and Misuse. *Austr. Geogr.* **16(2)**: 97-104.

VISSER HN & SCHOCH AE (1973) The geology and mineral resources of the Saldanha Bay area. *Dept. of Mines, Geol. Surv. S. Afr. Mem.* **63:** 150p.

WAGAR JA (1964) The Carrying Capacity of Wildlands for Recreation. *For. Sci. Monograph No 7,* Society of American Foresters, Washington D..

WAGAR JA (1974) Recreational Carrying Capacity Reconsidered. *J. For.* **72(5)**: 274-278.

WAGNER TW & DS LOWE (1978) Ground Truth Collection Techniques. *Int. Symp. on Remote Sensing of Environ.*, Manila, 20-26 April, 1978: 277-

WALL G & C WRIGHT (1977) The environmental impact of outdoor recreation. *Dept Geog. Publ. Ser. No. 11*: 53p.

WALLACE-McHARG (undated) *Plan for the Valleys.* Development Plan Report, Philadelphia, Pennsylvania.

WALTHER P (1986) The meaning of zoning in the management in natural resource lands. *J.Environ. Manage.* **22:** 331-343.

WALTHER P (1987) Against Idealistic Beliefs in the Problem-Solving Capacities of Integrated Resource Management. *Environ. Manage.* **11(4):** 439-446.

WANDERSMAN A (1979) User Participation in Planning Environments: a Conceptual Framework. *Environ & Behav.* **11(4):** 465-482.

WASHBURNE RF (I981) Carrying capacity assessment and Recreational use in the national wilderness preservation system..*J. Soil and Water Conserv.*: 162-166.

WASHBURNE RF (I982)..Wilderness recreational carrying capacity:are numbers necessary? *J. For.* **80**: 726-728.

WASHBURNE RF & DN COLE (1983) Problems and Practices in Wilderness Management: A Survey of Managers. *USDA For. Serv. Res. Paper INT-304*, Intermountain For.& Range Exp. Sta., Ogden, Utah: 56 p.

WATHERN P (ed.) (1988) *Environmental Impact Assessment: Theory and Practice* (Introduction). Unwin Hyman, London: 332p.

WEATHER BUREAU (1972) Annual Report on Meteorological Data. Government Printer, Pretoria

WEATHER BUREAU (1981) Annual Report on Meteorological Data. Government Printer, Pretoria.

WERGER MJA (1974) On concepts and techniques applied in the Zurich-Montpellier method of vegetation survey. *Bothalia* **11(3):** 309-323.

WHIPPLE W Jnr (1974) *Environmental quality and its evaluation.* Report to the National Science Foundation RANN Project, Washington, January 1974.

WHITAKER C (1984) Environmental Impact Assessment in Land-use Planning. Presented at *The International Training Course on Environmental Impact Assessment and Land-use Planning*, Hong-Kong, 16-21 January, 1984. Centre for Environmental Management and Planning Ltd., University of Aberdeen, Scotland: 50p.

WHITE DJ (1969) *Decision Theory* George Allen & Unwin, London: 185p.

WHITE PS (1979) Pattern, Process, and Natural Disturbance in Vegetation *The Bot. Rev.* **45(3):** 229-299.

WHITE PS & STA PICKETT (1985) Natural Disturbance and Patch Dynamics: An Introduction (Chapter 1). **In:** Pickett & White (eds) *The Ecology of Natural Disturbance and Patch Dynamics* Academic Press, New York, London: 3-13(472p).

WILEY J (1985) An opportunity to prove our good intent. *Custos* **14(7):** 7-8.

WILLIAMS WT (I967) Numbers, taxonomy, and judgement. *Bot. Rev.* **33**: 3799-86.

WILLIS JP & HHG FORTUIN (1979) Geochemical and Pollution Studies from Saldanha Bay and Langebaan Lagoon. *Geocongress '79 Extended Abstracts*, University of Port Elizabeth, Port Elizabeth: 450-453.

WOLCOTT TG & DL WOLCOTT (1984) Impact of off-road vehicles on macroinvertebrates of a mid-Atlantic beach. *Biol. Conserv.* **29**: 217-240.

WREN C (1970) How to wreck a National Park *Look Magazine* **34**: 77-78.

WYNBERG R (1991) The Ecological Effects of Collecting *Callianassa kraussi* and *Upogebia africana* for Bait: Impacts on the Biota of an Intertidal Sandflat. Unpubl. M.Sc. Thesis, University of Cape Town.

WYNBERG R, D GLASSON, S HARRIS & A PRINGLE (1990) Sand-sharks, Flamingos and Bait-digging for Prawns: An Analysis of their effects on estuarine organisms and sediments (Final Report 1988-89). Unpubl. Rep. to the National Parks Board, Dept of Zoology, University of Cape Town, Cape Town.

YAPP GA & GC BARROW (1979) Zonation and Carrying Capacity Estimates in Canadian Park Planning. *Biol. Conserv.* **15**: 191-206.

ZETTER JA (1974) The Application of Potential Surface Analysis to Rural Planning. *The Planner* **60(2)**: 544-549.

ZUBE EH (I967) *Study of Visual and Cultural Environment: Visual Landscape Quality Constraints*. Prepared for N. Atlantic Region Water Res., Study Co-ord. Committee.

ZUBE EH (1986) Local and Extra-local Perceptions of National Parks and Protected Areas. *Landscape and Urban Plann.* **13**: 11-17.

ZWAMBORN JA (1978) Small craft harbour and launching sites: Preliminary Evaluation, Vol 5: West Coast, Cape Point to Orange River. *Report SEA IR 7801*, Nat. Res. Inst. for Oceanology, CSIR, Stellenbosch.

PERSONAL COMMUNICATIONS

BATE Dr G, Professor, Department of Zoology, University of Port Elizabeth, Port Elizabeth

BENNETT Dr B, Research Fellow, Department of Zoology, University of Cape Town

BOUCHER Dr C, Department of Botany, University of Stellenbosch, Stellenbosch

BRANCH Dr G, Professor, Department of Zoology, University of Cape Town, Cape Town

BRAND Mr, Town Clerk, Langebaan

FERREIRA V, resident commercial fisherman, Langebaan

FRAQUET T, Vice-President, South African Powerboating Association, Cape Town

GASSON B, Senior Lecturer, Town and Regional Planning, University of Cape Town

HOCKEY Dr PA, Percy Fitzpatrick Institute of Ornithology, University of Cape Town, Cape Town

HUIZINGA P, Coastal Engineering and Hydraulics Division, CSIR, Stellenbosch

KOEN Mr, Langebaan beachfront resident

LELLO B, owner, Oostewal farm, Langebaan

LITTLEWORT, P, botanist (specialist, Strandveld vegetation), Cape Town

MELCK R, manager, Langebaan Yacht Club

MOLDAN Dr A, Director Marine Pollution Unit, Division of Sea Fisheries, Department of Environment Affairs, Cape Town

PRINGLE A, graduate student, Marine Biology, Department of Zoology, University of Cape Town

SCHLOMMS B, soil scientist, Elsenberg Agricultural College, Stellenbosch

TIMMERMANN L, Directorate of Geohydrology, Department of Water Affairs, Cape Town

UNDERHILL Dr L, Professor, Department of Applied Mathematics, University of Cape Town, Cape Town

APPENDIX F

UNDERTAKING

ereby undertake:

1. To inform the Park Warden of the intended date of arrival in the park at least two weeks in advance.

2. To make the necessary arrangements through the booking offices if tourist accommodation is required. (Pretoria, Tel. 012 3431991 or Cape Town, Tel. 021 222810.

3. To submit a short report on the results of the trip (where relevant listing all specimens collected) to the Manager Scientific Services, Rondevlei and to the Park Warden concerned.

4. To present the Manager: Scientific Services, Rondevlei with a copy of all scientific publications resulting from the visit.

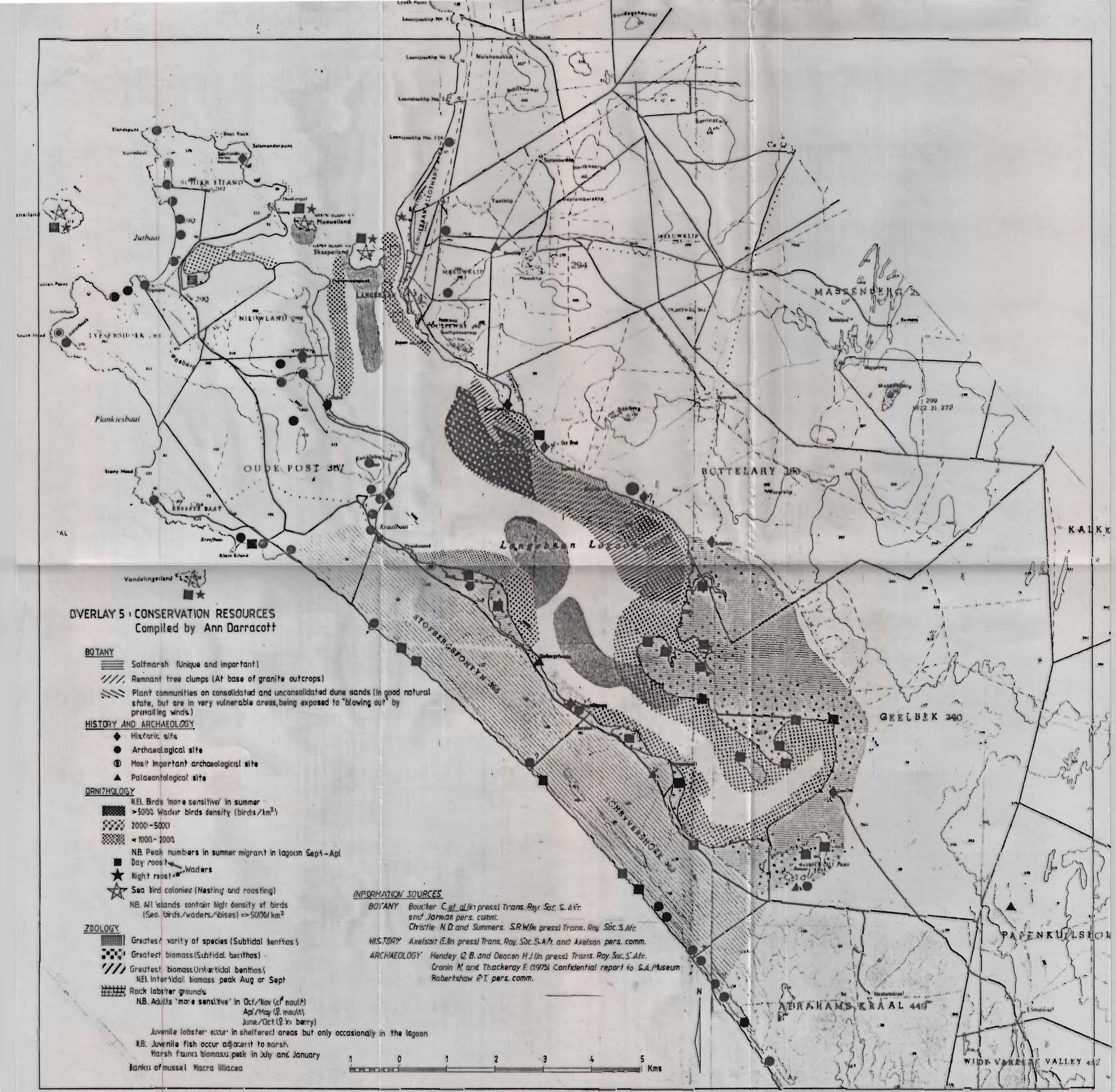
5. To acquaint myself with and obey all rules and regulations laid down by the Parks Board while carrying out my project (rules are available from the Park Warden).

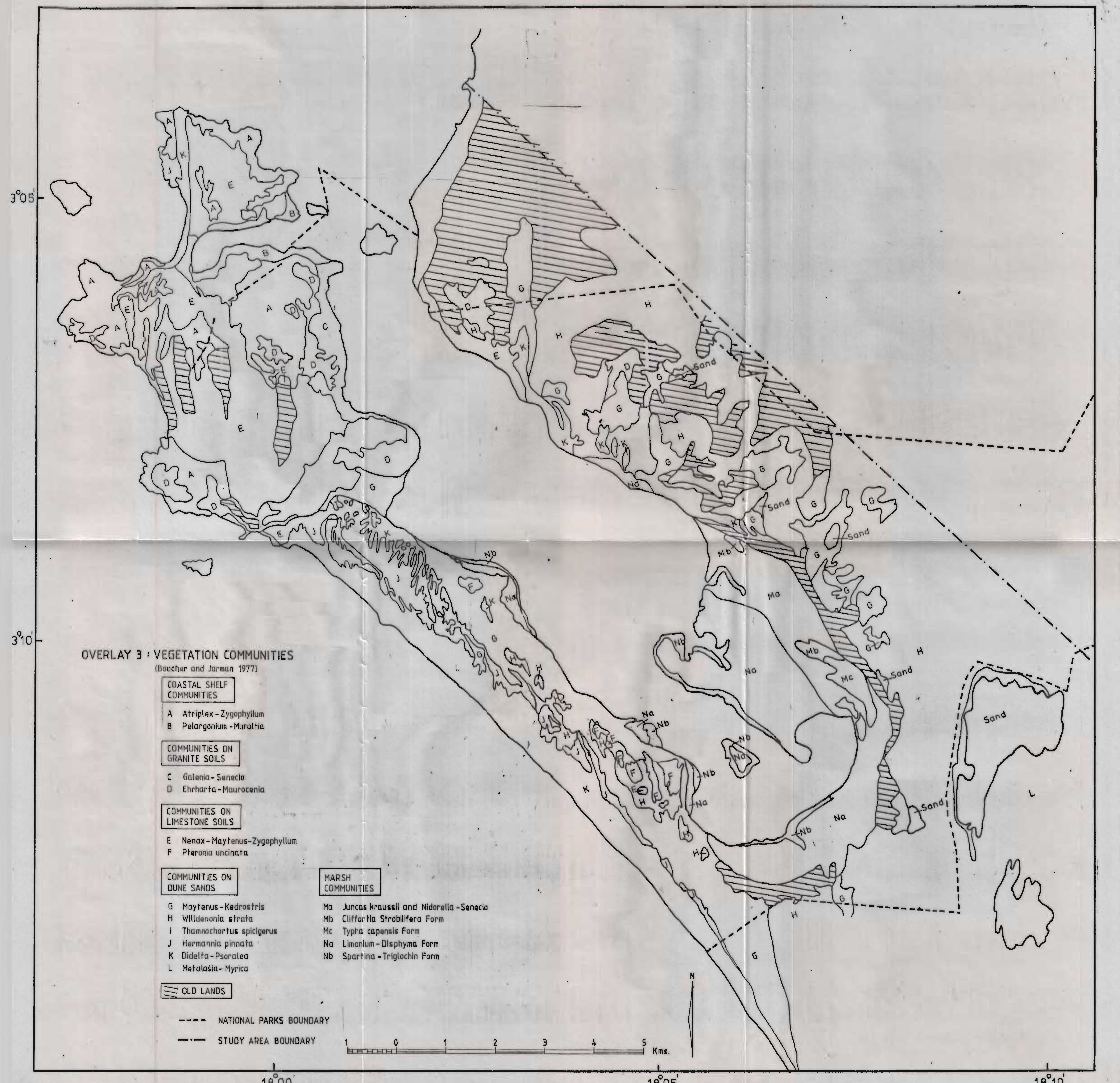
6. Not to publish or cite from any unpublished information obtained from the National Parks Board, including internal reports, without written approval from the relevant authors.

7. Not to hold the National Parks Board or any of its employees liable for any injury, or damage to equipment, that may occur in any situation or due to any negligent act, or the negligence of any of the above people during my research. I am aware that conducting field work in a national park can be dangerous, and I fully accept the risk of any possible injury.

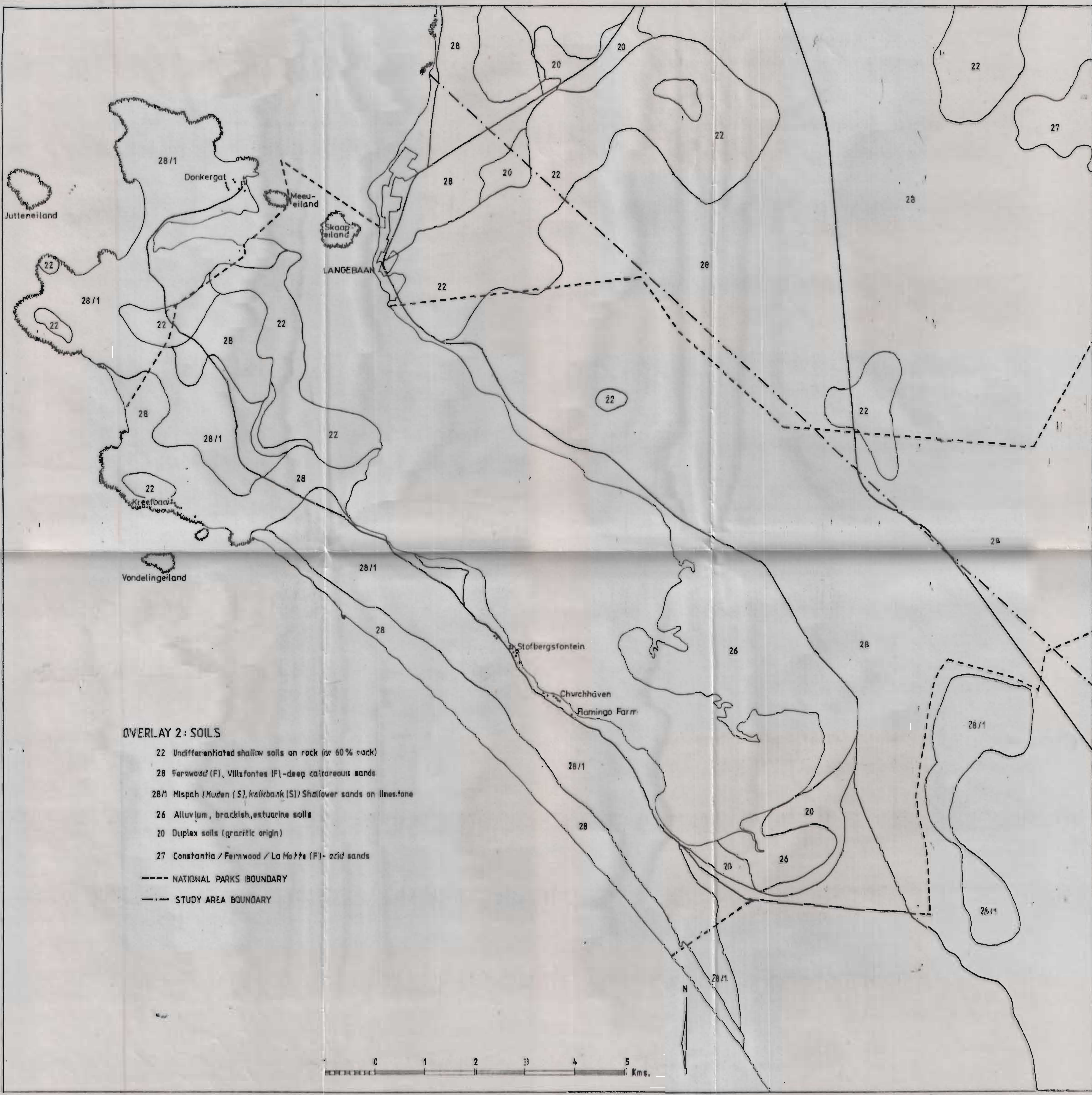
SIGNATURE: BBarrett

DATE: 05/05/95

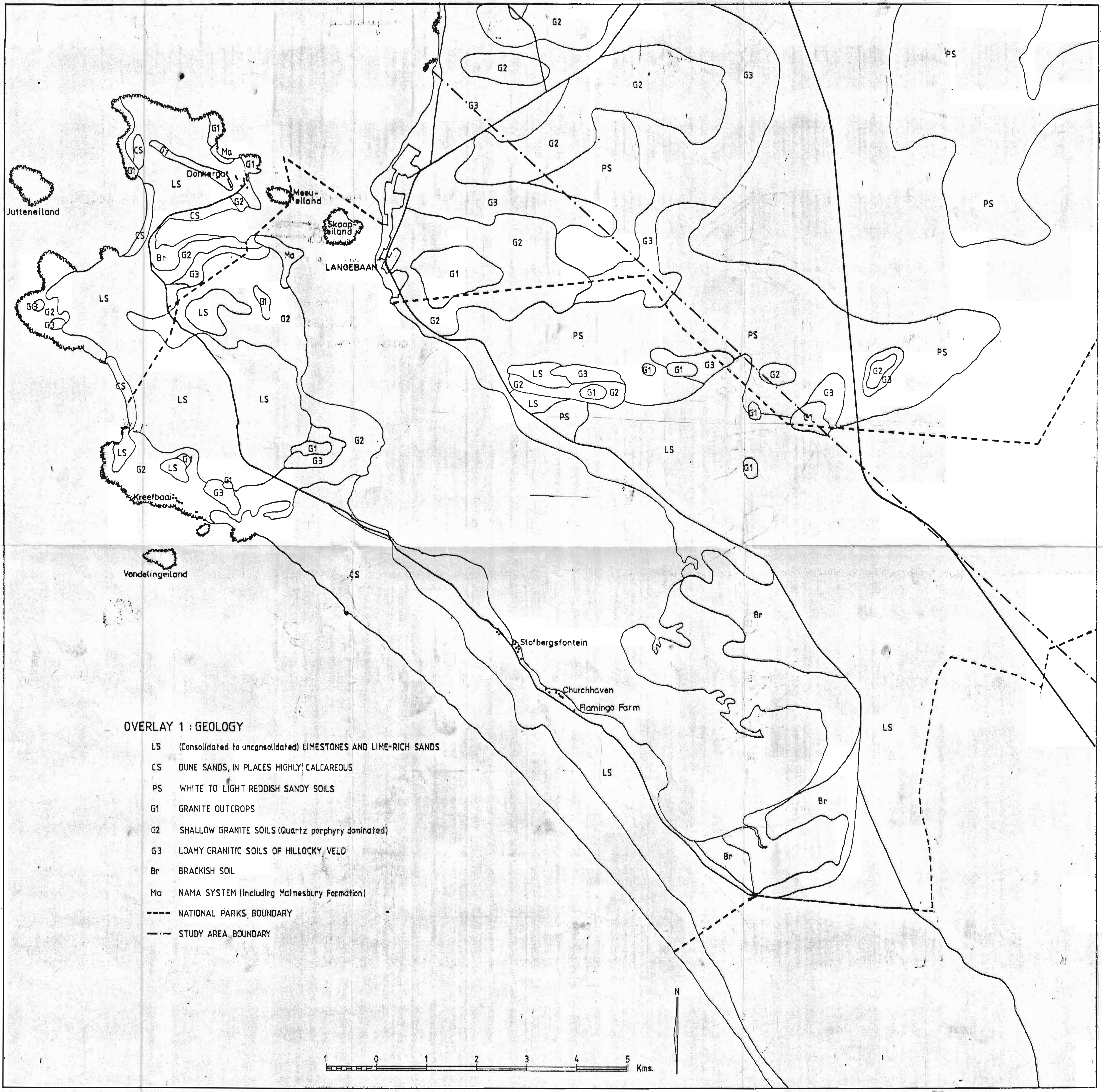

OVERLAY 5 : CONSERVATION RESOURCES
Compiled by Ann Darracott
BOTANY
Saltmarsh (Unique and important)
Remnant tree clumps (At base of granite outcrops)
Plant communities on consolidated and unconsolidated dune sands (In good natural state, but are in very vulnerable areas, being exposed to "blowing out" by prevailing winds.)
HISTORY AND ARCHAEOLOGY
Historic site
Archaeological site
Most important archaeological site
Palaeontological site
ORNITHOLOGY
N.B. Birds 'more sensitive' in summer
>5000 Wader birds density (birds/km²)
2000-5000
< 1000-2000
N.B. Peak numbers in summer migrant in lagoon Sept-Apl
Day roost
Night roost
Waders
Sea bird colonies (Nesting and roosting)
N.B. All islands contain high density of birds (Sea birds/waders/ibises) => 5000/km²
ZOOLOGY
Greatest varity of species (Subtidal benthos)
Greatest biomass (Subtidal benthos)
Greatest biomass (Intertidal benthos)
N.B. Intertidal biomass peak Aug or Sept
Rock lobster grounds
N.B. Adults 'more sensitive' in Oct/Nov (♂ moult)
Apl/May (♀ moult)
June/Oct (♀ in berry)
Juvenile lobster occur in sheltered areas but only occasionally in the lagoon
N.B. Juvenile fish occur adjacent to marsh.
Marsh fauna biomass peak in July and January
Banks of mussel Macra lilliacea
INFORMATION SOURCES
BOTANY Boucher C. et al (in press) Trans. Roy. Soc. S. Afr. and Jarman pers. comm.
Christie N.D. and Summers. S.R.W. (in press) Trans. Roy. Soc. S. Afr.
HISTORY Axelson E. (in press) Trans. Roy. Soc. S. Afr. and Axelson pers. comm.
ARCHAEOLOGY Hendey Q. B. and Deacon H.J (in press) Trans. Roy. Soc. S. Afr.
Cronin M. and Thackeray F. (1975) Confidential report to S.A. Museum
Robertshaw P.T. pers. comm.
1 0 1 2 3 4 5 Kms
N
Langebaan Lagoon
OUDE POST 367
BOTTELARY 365
GEELBEK 360
MASSENBERG
STOFBERGSFONTEYN 363
SCHRYVERSHOEK 362
ABRAHAMS KRAAL 449
PAPENKUILSFON
WIDE VAKKERS VALLEY
Jutbaai
Plankiesbaai
Kraalbaai
Meeueiland
Skaapeiland
Vondelingeiland
Klein Eiland
Elandspunt
Salamanderpunt
Stony Head
South Head
Bontheuwel
Meeuwklip



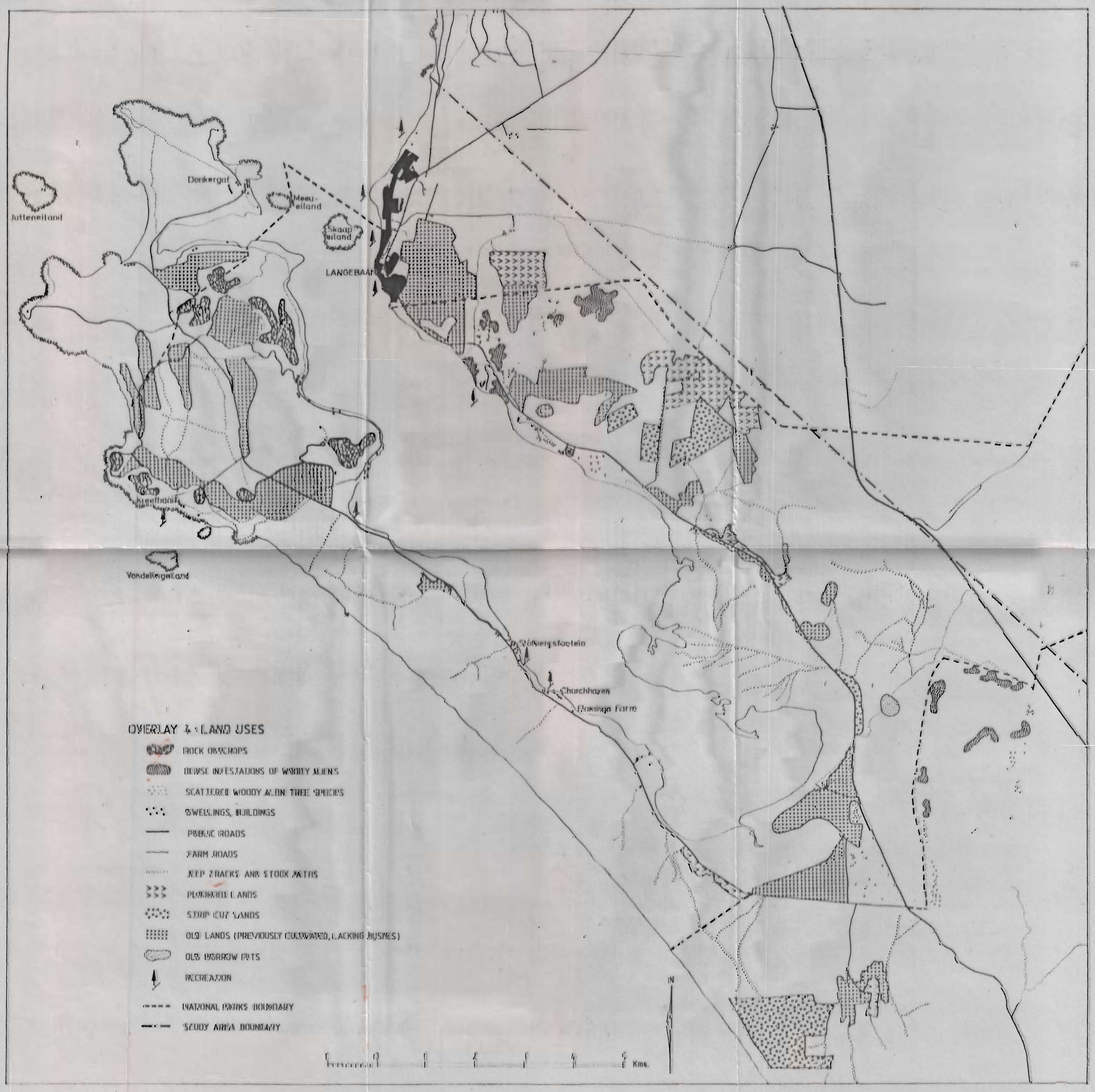
OVERLAY 3 : VEGETATION COMMUNITIES
(Boucher and Jarman 1977)
COASTAL SHELF COMMUNITIES
A Atriplex - Zygophyllum
B Pelargonium - Muraltia
COMMUNITIES ON GRANITE SOILS
C Galenia - Senecio
D Ehrharta - Maurocenia
COMMUNITIES ON LIMESTONE SOILS
E Nenax - Maytenus - Zygophyllum
F Pteronia uncinata
COMMUNITIES ON DUNE SANDS
G Maytenus - Kedrostris
H Willdenonia strata
I Thamnochortus spicigerus
J Hermannia pinnata
K Didelta - Psoralea
L Metalasia - Myrica
MARSH COMMUNITIES
Ma Juncas kraussii and Nidorella - Senecio
Mb Cliffortia Strobilifera Form
Mc Typha capensis Form
Na Limonium - Disphyma Form
Nb Spartina - Triglochin Form
OLD LANDS
NATIONAL PARKS BOUNDARY
STUDY AREA BOUNDARY
1 0 1 2 3 4 5 Kms.
N
Sand
3°05'
3°10'
18°00'
18°05'
18°10'



OVERLAY 2: SOILS
22 Undifferentiated shallow soils on rock (or 60 % rock)
28 Fernwood (F), Villafontes (F) - deep calcareous sands
28/1 Mispah (Muden (S), kalkbank (S)) Shallower sands on limestone
26 Alluvium, brackish, estuarine soils
20 Duplex soils (granitic origin)
27 Constantia / Fernwood / La Motte (F) - acid sands
NATIONAL PARKS BOUNDARY
STUDY AREA BOUNDARY
Jutteneiland
Donkergat
Meeu-eiland
Skaap-eiland
LANGEBAAN
Kreefbaai
Vondelingeiland
Stofbergsfontein
Churchhaven
Flamingo Farm
N
1 0 1 2 3 4 5 Kms.



Jutteneiland
Donkergat
Meeu-eiland
Skaap-eiland
LANGEBAAN
Kreefbaai
Vondelingeiland
Stofbergsfontein
Churchhaven
Flamingo Farm
LS
CS
PS
G1
G2
G3
Br
Ma
OVERLAY 1 : GEOLOGY
LS (Consolidated to unconsolidated) LIMESTONES AND LIME-RICH SANDS
CS DUNE SANDS, IN PLACES HIGHLY CALCAREOUS
PS WHITE TO LIGHT REDDISH SANDY SOILS
G1 GRANITE OUTCROPS
G2 SHALLOW GRANITE SOILS (Quartz porphyry dominated)
G3 LOAMY GRANITIC SOILS OF HILLOCKY VELD
Br BRACKISH SOIL
Ma NAMA SYSTEM (Including Malmesbury Formation)
NATIONAL PARKS BOUNDARY
STUDY AREA BOUNDARY
N
1 0 1 2 3 4 5 Kms.


Jutteneiland
Donkergat
Meeu-eiland
Skaap eiland
LANGEBAAN
Kreeftbaai
Vondelingeiland
Stofbergsfontein
Churchhaven
Flamingo Farm
OVERLAY 4 : LAND USES
ROCK OUTCROPS
DENSE INFESTATIONS OF WOODY ALIENS
SCATTERED WOODY ALIEN TREE SPECIES
DWELLINGS, BUILDINGS
PUBLIC ROADS
FARM ROADS
JEEP TRACKS AND STOCK PATHS
PLOUGHED LANDS
STRIP CUT LANDS
OLD LANDS (PREVIOUSLY CULTIVATED, LACKING BUSHES)
OLD BORROW PITS
RECREATION
NATIONAL PARKS BOUNDARY
STUDY AREA BOUNDARY
N
Kms.