

ENVIRONMENTAL STUDIES IN THE NEW NATAL EDUCATION  
DEPARTMENT THIRD AND FOURTH PHASE GEOGRAPHY SYLLABUS,  
WITH PARTICULAR REFERENCE TO THE STANDARD TEN SYLLABUS:  
AN EVALUATION

BY

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## ABSTRACT

The primary aim of this study is to attempt to evaluate by means of a case-study, the appropriateness of fieldwork as a way of teaching the new ecology section of the high school geography syllabus viz. 'Ecosystems, Environmental Balance and Conservation'. The study shows the value and importance of fieldwork to develop in pupils an awareness of environmental issues and conservation principles. Evidence collected during the course of the case-study is used to evaluate the nature of fieldwork.

The case-study which comprises this thesis concerns the ecological and environmental fieldwork undertaken by a randomly selected sample of 24 standard ten higher-grade pupils studying geography at Glenwood High School in Durban during August 1987. The case-study site was the Pigeon Valley natural area in Glenwood, Durban. The fieldwork undertaken used a field-research approach recommended for use by senior high school pupils.

Various conclusions and recommendations arising out of ecological fieldwork and the case-study evaluation, are presented. These include:

- 1) Fieldwork is a particularly appropriate method to use to teach this new section of the syllabus, as shown by pupil enjoyment and pupil success in completing the fieldwork tasks set them in the exercise.

- 2) Two fieldwork methods should be used - a traditional fieldwork approach for junior high school classes and a field research approach (with a built-in problem/issue based component) for senior high school classes.
- 3) Fieldwork is important not only as a substitute for systematic teaching of the section but also for revision purposes.
- 4) Case-study evaluation and the use of triangulation are appropriate for the purposes of this study.

This study is presented as a contribution to geography teaching in South Africa, particularly the area of fieldwork, but the qualitative nature of the study and the very nature of case-study research, however, prevent totally conclusive results from being obtained.

DECLARATION OF ORIGINALITY

I hereby state that this whole thesis, unless specifically indicated to the contrary in the text, is my own original work.

T.L. COWIE  
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## CHAPTER ONE

### INTRODUCTION

#### Man and his Environment

By their very nature geographic studies have over time highlighted the continuing and dynamic relationship between man and his environment. Since the early 1960's concern has been expressed about man's, particularly Western man's, ability to act destructively towards his natural environment shown not only by his rapid, indiscriminate depletion of non-renewable resources, but by his abuse and near destruction of his renewable resources as well. Ward and Dubos (1972) are among a host of writers who have expressed concern at man's deteriorating relationship with his environment.

The causes of this situation are many but mainly involve a) economic considerations, with economic growth and profits over the short term outweighing longer term environmental issues, and b) the exponential growth rate of human populations in many parts of the world, including parts of South Africa, which places a tremendous strain on the earth's resources. Man's actions are thus having a significant impact on what we now realise is a finite resource base. An environmental crisis situation has come about with the contemporary public slowly but surely being drawn into the debate. Fincham (1985) states that a key

reason for the keener public interest is the realization that the depletion of key resources can signal the end of (particularly Western) man's present material lifestyle as well as the 'destruction of ecological processes which ultimately sustain life on earth' (Fuggle and Rabie, 1983, cited in Fincham, 1985, p.2).

The Committee for Environmental Education of the South African Council for the Environment (1988) gives the following background to the environmental crisis:

It is only fairly recently that man has become generally aware that his habitat is a relatively limited asset. In the light of a world-wide population explosion, and the enormous technological progress made since World War II, he is beginning to realise that he cannot afford to continue unbridled utilisation of his resources at a rate bordering on wasteful exploitation. Population growth and human activities such as urbanisation, industrial and agricultural development and resource exploitation have a profound effect on all aspects of the environment. As the population grows, and per capita human requirements increase, this effect steadily increases and makes intolerable demands on the environment. The fundamental factor which distinguishes modern society from preceding societies is the accelerating pace of the changes caused in the environment by the scientific and technological revolution, the massive scale of those changes and the universality of some of their consequences. Environmental problems, which are often broadly referred to as the "environmental crisis" vary widely in nature, magnitude and complexity: hunger and malnutrition, considerable disparities between human populations the world over in respect of their quality of life, the degradation of natural ecosystems and landscapes, desertification, the depletion and wastage of resources, the many different forms of pollution or disturbance, and the deterioration of the living environment have become cause for great concern (p.1).



Fincham (1985) has identified the key issues in the environmental crisis debate. They are:

1. Population is growing exponentially (Haggett, 1979).
2. The philosophy of economic growth involves a drive for material wealth as the goal of human activities. To adhere to that goal man has come to believe in his mastery over nature (White, 1967; Simmons, 1974).
3. Rapid scientific and technological development results in the capability to manipulate the environment, without fully comprehending the possible adverse consequences of such action (Detwyler, 1971).
4. In advanced economies, a growing campaign for a better environment to be included amongst planning priorities (Poelmans - Kirschen in Park, 1980).
5. A questioning of the goals of the consumer society (Poelmans - Kirschen in Park, 1980).
6. Progress in the ability to think about our environment from a macro or holistic point of view (Poelmans - Kirschen in Park, 1980)(p.2).

The fact that, if the present situation continues, the earth's resources will not be able to provide the necessary sustenance, may not be openly obvious to many people and can become known to people through education, particularly the area called environmental education. The following statement by Aldrich and Blackburn (1975), referring to the United States, is pertinent to all mankind:

The U.S. will not become an environmentally conscientious country by passing legislation and developing environmental protection policies based on scientific soundness and sociological platitudes. Preservation of a quality environment will only become a reality if we can develop broad citizen understanding of the short-range and long-range objectives of sound environmental management, and citizen acceptance of the financial and personal commitment necessary to achieve those objectives. The gap between goals and actuality is the one to be filled by environmental education (cited in Irwin, 1982, p.2 ).

This relationship between environmental goals and environmental action can only be realised after an understanding of the relationship which exists between man and his environment.

Irwin (1982) states: 'In behavioural and holistic terms, only when we understand the relationship of individual and group behaviour to the environment at large, are we likely to be able to affect modifications leading to desired environmental changes' (p.2).

These statements by Aldrich and Blackburn (1975) and Irwin (1982) demonstrate that mankind needs to move rapidly away from a one-way, throwaway or throughput economy to a sustainable earth society or 'spaceship earth' model based on conservation of resources and recycling of matter. These two approaches are illustrated in Figures 1 and 2.

The one-way or throwaway society found in most industrialized countries is based on maximizing the rates of energy flow and matter flow. This results in a conversion of the world's mineral and energy resources to trash, pollution and waste heat at a very fast rate. This type of society is sustainable indefinitely only with essentially infinite supplies of mineral and energy resources and an infinite ability of the environment to absorb the resulting heat and matter wastes.

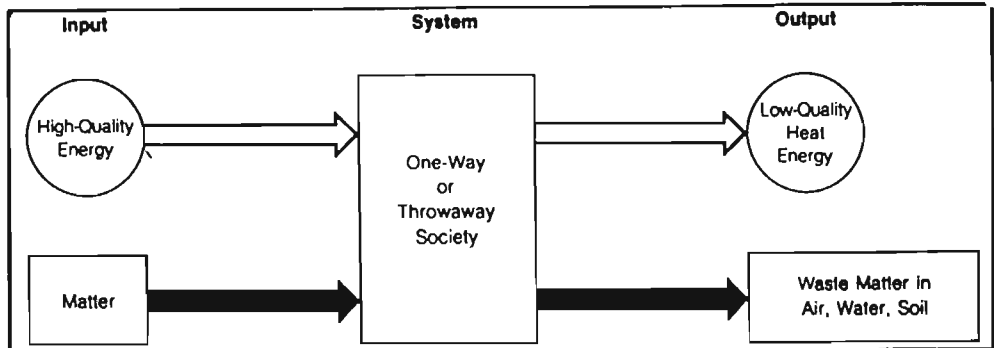


Figure 1 : The Throughput Economy  
Source : Tyler Miller, 1979, p.37

A sustainable earth society is based on energy flow and matter recycling. It is based on reusing and recycling renewable matter resources, not using renewable matter resources faster than they are replenished by natural processes, conserving energy (since it cannot be recycled), increasing pollution control, and deliberately lowering the rate at which matter and energy resources are used so that the environment is not overloaded and resources are not depleted.

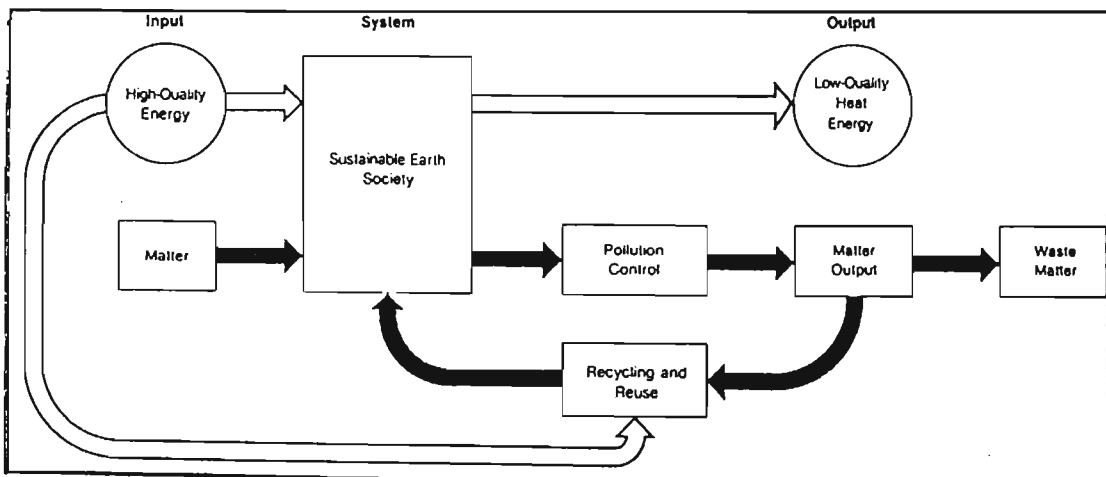


Figure 2 : The Spaceship Earth Model  
Source : Tyler Miller, 1979, p.38

After reviewing the factors which are seen to contribute to the environmental crisis, the Committee for Environmental Education of the South African Council for the Environment (1988) concludes:

If present trends continue, the world will be more crowded, more polluted, less stable ecologically and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources and environment are clearly visible ahead. Indeed, the problems of preserving the carrying capacity of the earth and of sustaining a decent life for human beings are enormous and close upon us. There are no easy answers, no simple solutions. The only solutions to the problems of population, resources, and environment are complex and long-term. These problems are inextricably linked to some of the most complex and persistent problems in the world. New and imaginative ideas - and a willingness to act upon them - are essential.

In the Republic of South Africa, we have most of the world's problems in microcosm: we have different cultures, different ethnic groups, different religions, technically highly advanced sections and subsistence farmers, and are in the midst of an industrial revolution. The problems of a population explosion which is a concomitant of good hygiene, preventive medicine and excellent medical care, place high demands on job creation, urbanisation, food production, resources utilisation and tempt short-term solutions. Yet it is only by standing back, by gaining a wide perspective and seeing the total picture that sound rational decisions can be made which will work in our country and which may possibly then serve as a model for the world. The peoples of the most highly developed countries of the world are so isolated by their wealth, technology and comfort, that there is a real danger they will not see the total picture in time.

It is therefore the great challenge and awesome responsibility of all teachers in the RSA to present the environmental crisis, which has been described above, to their pupils in such a way that they will become aware of it and be able to see it in perspective in their own country and in the world. Our pupils must be taught to think globally but to act locally. Together we must strive to find the

political, economic and ethical solutions and do what needs to be done. It is an issue that must include the problems of poverty, injustice and materialism. If human rights are ignored or merely paid lip-service, the consequences of the crises will be unavoidable - it is not possible to talk about conservation with hungry people.

President J.F. Kennedy noted that finding solutions to the environmental crisis is a "...race between education and erosion, between wisdom and waste. The crisis may be quiet, but it is urgent" (pp 3-4).

### The scope, aims and objectives of the study

There can be no doubt that formal education, in particular environmental education, has a very important role to play in helping to close the gap between the goals and actuality referred to in the statement by Aldrich and Blackburn (1975) and in bringing about an understanding of the relationship between individual and group behaviour and the environment referred to by Irwin (1982).

The public's heightened interest in the environmental crisis debate needs to be encouraged and geographers, among others, need to consider what contributions they can make to a better understanding and quicker resolution of environmental problems. As Fincham (1985) points out, however, the public's realisation of the crisis and its sense of helplessness at the hands of big business and government leads often to emotionally biased responses not grounded in a balanced scientific appreciation of the problems involved. Fincham warns that it is therefore very important, in the geographer's tussle with

environmental problems in the classroom and in the field, that he does not lose sight of the necessity to portray issues objectively with a view to examining possibilities for resolving them.

The new high school geography syllabus, the implementation of which was completed by the Natal Education Department in 1987, should be viewed as an attempt at the introduction of an element of environmental education. Pupils are encouraged to examine environmental issues throughout the syllabus and are assisted to appreciate their responsibility as humans who are collectively transforming the world/environment in which they live. In particular, the part of the Standard 10 syllabus viz. 'Ecosystems, Environmental Balance and Conservation' which deals directly with the area of environmental education, has assumed an increased importance in view of the nature of the environmental crisis alluded to earlier. An ecological perspective, it is recommended, will be required in the teaching of this section of the syllabus.

Fincham (1985) states that contemporary ecology and its concern with organisms and their environmental relationships have much in common with the time-honoured traditions of geography. He believes that the ecological perspective will assist geographers to overcome their somewhat over-simplistic conceptualisation of the relationship between man and his environment.

Burton (1985) believes that imaginative teaching and an ecocentric approach will be required to teach environmentalism in geography. This environmentalism, he believes, should be viewed as the missing link or the linking paradigm between the physical and human components of geography in the school syllabus. When covering the ecology/ecosystem section of the syllabus, teachers need to be made aware of the importance of such work in the reunifying of geography as a subject at school and university level.

Hurry (1980), after an extensive review of the position of environmental education in South Africa, highlights the problems which exist. These points should be borne in mind when considering any work done in the field of school-based environmental education. Hurry's six points are:

1. There appears to be a lack of suitable, broad-based aims and objectives relating to environmental education (Nightingale, 1977, p.14; Millar, 1980, p. 5-7).
2. Schools and other educational institutions appear to lack suitable facilities for conducting outdoor environmental education programmes (Nightingale, 1977, p.14; Hurry, 1978, (a), p.55).
3. There appears to be a lack of suitable resource materials for either teacher or pupil (Hurry, 1978, (a), p.21).
4. Teacher training programmes do not equip teachers for meaningful environmental education (Nightingale, 1977, p.37; Hurry, 1978(a), p.53).

5. School subjects are not taught holistically. It is therefore difficult to understand and gain insight into environmental matters (Tinley, 1974, p.5).
6. Teacher-initiated environmental education programmes are not given sufficient support by the education departments (Clayton, 1979, pp.112, 114-5) (pp.1-2).

This study will attempt to show that even though many schools themselves may lack suitable facilities for conducting outdoor environmental education programmes (point 2 in Hurry's list above), most will have nearby natural areas, usually controlled and administered by the local municipality where excellent facilities usually exist for geographical fieldwork. As its primary aim, this study will attempt to demonstrate that fieldwork is an appropriate method of teaching the ecology/ecosystems section of the new high school geography syllabus. It is hoped that field work will be shown to be a respected and highly valued educational tool which, if used correctly, will develop an awareness of environmental issues and conservation principles. The main focus of the study will be a case study evaluation of fieldwork carried out in the Pigeon Valley natural area in Glenwood, Durban, during August 1987 by a randomly selected group of 24 Standard 10 geography pupils from Glenwood High School.

It should be remembered at this point that the case study research undertaken, is by its very nature, the study of a particular case situation, where the particular



circumstances which prevailed determined the eventual outcome of the study. As a result of this, cautious generalisations should be made from the study although it is hoped that the study's conclusions and recommendations will have applicability to ecological fieldwork undertaken by high school geography teachers in Natal.

### Structure of the study

Chapter 2 of this thesis will seek to provide a theoretical overview or framework within which the study may be located. This chapter will contain definitions of terminology used in the thesis as well as containing discussion on the nature of environmental education, its position in geography as a field of study and in particular its inclusion in the new high school geography syllabus.

Chapter 3 will consist of a literature review which will focus on the various methodologies which can be used to teach environmental education as well as a fairly detailed examination of fieldwork as an appropriate method to teach the ecology/ecosystems section of the new high school geography syllabus.

Chapter 4 will consist of the thesis research methodology, in which case study research, particularly as it has been applied in this study, is examined. A case will be made

for the use of case study research in education, as well as in this study. The use of triangulation in case study research, as it applies to this study, will be examined. The chapter will end with a description of the research methodology steps used in the conduct of this study.

Chapter 5 will consist of a report of the case study evaluation in which the findings obtained in the research will be presented, interpreted and described.

Chapter 6 will consist of the research case study's conclusions and recommendations, with accompanying discussion and analysis. Appendices and a list of references will then follow.

#### Assumption upon which the study is based

Throughout the formulation and implementation of the study a basic assumption has been made and should be clearly stated viz.

that education to create and develop awareness of environmental issues and conservation principles is worthwhile and will have a beneficial effect in the future (Irwin, 1982 p.6).

While it will not be possible in this thesis to provide empirical evidence clearly demonstrating this particular relationship, it is simply an extension of the ultimate assumption upon which all education is based. Such an assumption underlies nearly all research in this field (I.U.C.N. 1979).

### Sources of Information

Environmental education is in its infancy in Southern Africa and there are few books on this subject dealing specifically with school-based environmental education. There are, however, several valuable dissertations and theses on South African conditions (by South African writers) which have proved invaluable to this study. The review of relevant literature in this field, which forms the focus of Chapters 2 and 3 draws upon mainly American or British literature, together with the South African material just mentioned. Considerable research is presently being carried out in environmental education in countries such as Great Britain, the United States and Australia. In addition to complete books on environmental education, use has been made of a few environmentally orientated periodicals, some specialising in the subject and others carrying articles from time to time, as well as government publications and teaching publications of the various provincial education departments which concern themselves at periodic intervals with environmental education.

## CHAPTER TWO

### ENVIRONMENTAL EDUCATION: THEORY AND PRACTICE

#### Introduction

The interpretation afforded terminology in any study may have an important effect on the interpretation of the study's conclusions. For this reason this chapter will deal with definitions of terminology used in the study as well as provide a theoretical background to the more practical aspects of the study to be covered in the following chapters.

In this chapter the nature of environmentalism and environmental education will be examined, followed by a clarification of some of the more important terminology used in environmental education. Geography as a field of study and the role of environmental education within it will then be considered, followed by a look at the place of environmental education in the new school geography syllabus.

#### Environmentalism

According to Johnston's (1981) Dictionary of Human Geography, environmentalism consists of 'the ideologies and practices which inform and flow from a concern with the environment' (cited in Pepper, 1984, p.13). The Oxford English Dictionary (1972 supplement) states

that 'an Environmentalist is one who believes or promotes the principles of Environmentalism, which is a theory of the primary influence of the environment on the development of a person or group', or simply, 'one who is concerned with the preservation of the environment (from pollution etc.)' (cited in Pepper, 1984, p.13).

O'Riordan of the School of Environmental Sciences at the University of East Anglia has been one of the acknowledged leading authors in the area of environmentalism and has been cited by a large number of other writers involved in exploring the topic (Pepper, 1984; Preston Whyte, 1983). He sees it as much an attitude of mind and a certain code of behaviour as an ideology. He therefore sees the educational challenge as making the concept of environmentalism real and not merely a classroom abstraction. He sees environmentalism as existing 'to change people's outlook on the world, their beliefs and behaviour' (O'Riordan, 1981, p.3). This view he sees as particularly 'apt to the reasonably comfortably-off (in global terms) teacher and student in the developed world where a study of environmental issues can .....create a ..... sense of complacency' (O'Riordan, 1981, p.3). He warns that 'environmentalism can be learned and taught as a subjective, deeply committing personal exercise, or as an objective non-involving run-of-the-mill academic experience, or somewhere in the great

void in-between' (O'Riordan, 1981, P.4). He makes the suggestion that the answer lies in the area of the middle ground where the approach would be to discuss ways in which environmentalism can be stimulating and reasonably committing on both a personal and social level without becoming all-consuming. He sees environmentalism as exposing both student and teacher to the contradictions between belief and action that beset us and states that the action component should be seen as the most important. This is the challenge facing environmental educators today and in the future.

## Environmental Education

### Introduction

Writers in the field of environmental education emphasise the unity of man and his environment and that the individual is constantly interacting with his total environment. Since the environment has cultural as well as physical elements, it follows that whatever pupils learn at school will have relevance to some aspect of the environment. As a result of this, all school subjects (maybe some more than others e.g. geography and biology) have environmental relevance for pupils and thus make a contribution to environmental education. In order to discuss the contributions made by geography and geographical fieldwork in the field of environmental education, it is necessary to first consider the nature of environmental education.

## Definitions of Environmental Education

The term 'environmental education' covers a multitude of meanings and intentions and therefore defining the concept is difficult for a number of reasons. As Irwin (1982) has pointed out :

to conservationists it is usually concerned with creating an awareness of the value of natural resources for man's overall welfare (cultural, aesthetic and material) and of the need for proper management and conservation. To educationists, environmental education will incorporate these ideas, but will also use the environment for concept and skill development. Between these two stances is a wide spectrum of opinion on what constitutes environmental education, so much so that despite the attention devoted to it by numerous writers and several international gatherings, including Carson City, Nevada in 1970, Belgrade in 1975 and Tbilisi in 1977, a universally acceptable definition has so far proved elusive (p.14).

There are several reasons for this:

a) 'There is as yet no unifying environmental or educational philosophy underlying the diverse ramifications of the world, or even national environmental education movements. The interests of these movements moreover extend right across the educational spectrum from pre-primary to tertiary level' (Irwin, 1982, p.14) Also, 'confusion arises from the variable uses of the term environmental studies which is sometimes used as a synonym for environmental education, sometimes to describe a method of study within a particular discipline, and sometimes as the name of a new and developing subject in its own right' (Nightingale, 1977b, p.1). What was stated

by the United States Council for Environmental Education in 1970 remains equally true today: '.... it is clear that different people mean different things by it (environmental education), and also that some of those who use it are not really certain what they mean' (Wheeler, 1975, cited in Irwin, 1982, p.15). South Africa would not be an exception in this regard.

b) While there seems to be general agreement that environmental education should take place within and outside the formal education system (Irwin, 1982; Nightingale, 1977b), extensive controversy exists over its status and function in formal education and its overall importance outside of it. Confusion also arises from the tendency for practitioners of various disciplines to use the word environmental for their own subjects whether this be archaeology, planning, history or sociology. Also, some think exclusively in terms of natural environments and others only of urban or man-built environments. The terms natural environment, living environment, human environment and total environment all occur in debate about the spirit and purpose of environmental education.

c) The concept is often confused with a number of related or near-synonymous terms including conservation education, conservation awareness, environmental awareness and outdoor education. Irwin (1982) in an attempt to make



order out of the muddle of terminology proposed the following model:

- (a) That the terms awareness and education be differentiated in meaning and usage as follows:
  - i. Awareness is having knowledge or consciousness (Longman's Dictionary of Contemporary English, 1978); it is compounded of factual knowledge, conceptual knowledge (including ethical aspects) and the attitude resulting from these. It may be termed 'high' or 'low' depending on the degree to which it is in harmony with its object of intention.
  - ii. Education is a process which among other things is aimed at achieving awareness.
- (b) That a clear difference be made between environmental and conservation i.e.:
  - i. Environment, following Monkhouse and Small (1978, p.105), "is the whole sum of the surrounding external conditions within which an organism, a community or an object exists". 'Environmental' is the adjectival form.
  - ii. Conservation is the attitude of using the environment wisely by exercising careful control and management.

This permits the delineation of the following compound terms:

- (a) Environmental awareness; the level or state of awareness about the environment including the need for conservation.
- (b) Environmental education; the process of achieving environmental awareness. It must therefore include a conservation component but is not composed exclusively of it.
- (c) Conservation awareness; the level of awareness about how to use or treat the environment. It is therefore a part of

environmental awareness.

- (d) Conservation education; the process aimed at achieving conservation awareness. It is therefore a part of environmental education (pp.24-25).

Other terminology sometimes used includes environmental studies and environmental science, rural studies and rural science. The United States Council for Environmental Education (1970) saw environmental education as embracing all four concepts viz. environmental studies, environmental science, rural studies and rural science, as well as the use of the environment as a teaching medium (in Nightingale, 1977b, p.2).

In the South African context Clayton (1980) has up to now made the most comprehensive attempt at defining outdoor education:

Outdoor education is an interdisciplinary and integrative method of teaching which should be an integral part of the educational system, and is based on the principle that the teacher should use the outdoors as a classroom, to lead the pupil into primarily affective, but also cognitive, psycho-motor and other valuable learnings and skills, which cannot be as effectively achieved in the indoor classroom. It is not a subject, nor is it just education out of school, but relates to man's love of, interest in, involvement in, enjoyment of, understanding of, wise use of, care of, as well as concern for, the environment, as a product of God's creative power, expressed through active participation in the solving of its problems (cited in Irwin, 1982, p.26).

As a result of Clayton's own acknowledged criticism of the above definition, that its academic nature and length have militated against its use as a working way by teachers and others, Clayton (1981) re-defined outdoor education, in a

more accurate and precise way as 'that method of education in which the teacher uses a natural or rural environment as a medium in the education of the whole child' (p.28). Clayton (1981) sees outdoor education as differing from environmental education in three main ways:

Outdoor education is a method; environmental education a process. Outdoor education has no aims except insofar as it seeks to make itself available to further the aims of existing disciplines; environmental education has diverse aims under the umbrella objective of environmental quality. Outdoor education relates exclusively to the outdoors; while environmental education is concerned with the total environment and may be pursued in any setting, indoor or outdoor, urban or rural (p.32).

In an attempt to reconcile partially the many differences and disagreements on terminology, Irwin (1982) proposed the following diagrammatic model (Figure 3), initially proposed by him at a 1980 UNISA workshop on Outdoor Education.

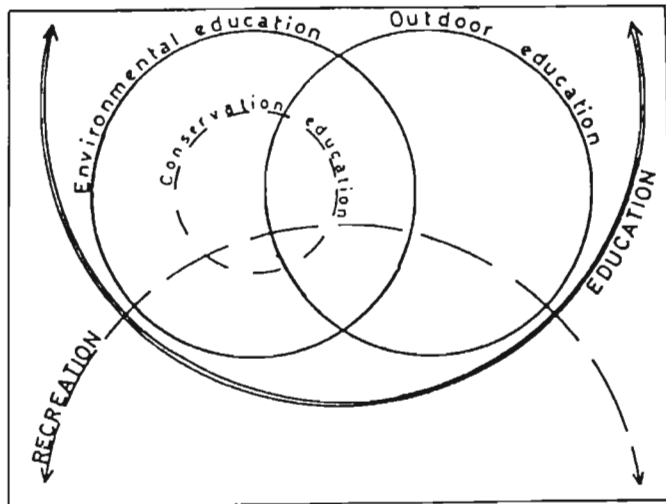


Figure 3: Diagrammatic Model illustrating the relationship of environmental education to other fields of education and to recreation.

Source : Irwin, 1982, p.27.

Returning to environmental education, although there are numerous definitions of the term in the literature, there are two which seem to contain those elements which the international community seems to consider as essential to the concept. These are the definitions put forward by the International Union for the Conservation of Nature (I.U.C.N.) in 1971 and that contained in the United States Environmental Education Act of 1970.

The International Union for the Conservation of Nature has provided the following definition:

Environmental education is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture and his bio-physical surroundings. Environmental education also entails practice in decision making and the self-formulation of a code of behaviour about issues concerning environmental quality (cited in Hurry, 1980, p.47).

The United States Environmental Education Act of 1970

stated:

Environmental Education is an integrated process which deals with man's interrelationship with his natural and man-made surroundings, including the relationship of population growth, pollution, resource allocation and depletion, conservation, technology and urban and rural planning to the total human environment (cited in Hurry, 1980, pp.47-48).

The Act continued:

Environmental education is a study of the factors influencing ecosystems, mental and physical health, living and working conditions, decaying cities, and population pressures. Environmental education is intended to promote among citizens the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to assure our survival and to improve the quality of life (cited in Nightingale, 1977b, p.3).

Nightingale (1977b) criticises the I.U.C.N. definition as being too conservation orientated and gives two areas of criticism of this definition. The first is the criticism of third world countries that the definition implies conservation by, and on behalf of, the middle classes of the third world and the second is that of some educationists who hold the view that the definition is orientated to the bio-physical world and rural areas, whereas it should include more aspects of the socio-cultural environment and urban areas.

Hurry (1980) agrees with this latter criticism since he feels that the environment should be investigated in its totality, and feels that environmental education should be as broad-based and multi-disciplinary as possible. He accepts the United States definition as the working

definition of his study.

Nightingale (1977b) also accepts the United States definition for the purpose of his study because it accommodates the views of both the conservationists and the social activists. He also points out that a growing list of overseas authorities are accepting the United States definition as a valid and definitive interpretation of environmental education.

As far as the Natal Education Department is concerned, the following definition of environmental education formulated by delegates to a 1984 workshop on a national policy for environmental education held at Midmar and hosted by the South African Council for the Environment, seems to have been accepted:

Environmental education is an ongoing process leading to the development of a Southern African population that is aware of, and concerned about, the total human environment and its associated problems, and which has the knowledge, attitudes, motivations, commitment and skills to work both individually and together towards the solution of current problems and the prevention of new ones (Natal Education Department, 1987, p.1).

This definition, educationally speaking, with its stress on developing pupil knowledge, attitudes and skills shows that environmental education is a holistic approach involving all three domains of human development: the cognitive, the affective and the psychomotor.

The above definition was later circularised to delegates

at a Natal Education Department Environmental Education seminar held in Durban on 11 March 1987 by Mr P.R. Van den Berg, a Senior Education Planner responsible for environmental education. The South African Council for the Environment (1984) went on to state that environmental education must provide 'planned learning programmes which impart knowledge, skills and values to participants, in order to develop responsible lifestyles in harmony with the environment in its totality' (cited in O'Donoghue, 1987, p.20).

No major conflict or disagreement seems to exist between the United States definition of environmental education and the definition put forward by the South African Council for the Environment, which appears to have been accepted by the Natal Education Department. Since this study is working within the confines of the new Natal Education Department geography syllabus, the definition put forward by the South African Council for the Environment will be accepted as the working definition for this study.

#### The aims, objectives and guiding principles of environmental education

The complexity of the origins of the environmental education movement and the breadth of its interest have led a great number of agencies and organisations to become involved, while others have sprung up with the sole

purpose of improving and fostering its development. There are the conservationists who support programmes which preserve the environment and its resources. There are also the educationists who urge the inclusion of environmental education curricula in schools and universities. They vary in their objectives according to their respective emphasis upon environment as a concept, or on education as a process stimulated or hindered by environmental experiences. Finally, there are the professional environmentalists who have the direct responsibility for improving and developing the environment by implementing programmes to achieve these ends.

Thus the aims and objectives of environmental education will vary according to the values and interests held by those advocating the necessity to teach about the environment. The views of the conservationists, the educationists and the environmentalists are briefly reviewed by Martin (1975 in Martin and Wheeler 1975).

He points out that the real difference between the environmentalists and the educationists is that the former are concerned with the quality of the environment whereas the latter are concerned to improve the quality of life. He believes that a compromise between these two extremes is needed if further progress is to be made towards implementing environmental education objectives in the



school curriculum.

A large number of general aims have been put forward for environmental education. The following examples appear in Armstrong (1979):

A) Environmental education aims to:

1. provide knowledge, training in the appropriate skills and first hand experience.
2. introduce concepts and values, to give practice in decision-making and to afford opportunities for personal involvement.
3. train people to assess critically many views being expressed today on current issues.

Scottish Education Department (1978)

B) Environmental education aims to:

1. use the environment as a medium for teaching.
2. study the implications of scientific discoveries for environmental education.
3. introduce pupils to an understanding of the conflicts of environmental interests.
4. encourage pupils to participate in local affairs.

Mellars, Charles, from 'Environmental education and the search for objectives', Occasional Paper 6, Society for Environmental Education.

C) Environmental education aims to:

1. develop attitudes and level of understanding leading to a personal environmental ethic.
2. ensure that the actions and influence upon collective decisions of those so educated would be of positive benefit to the environment.

Morgan, R.F., from Occasional Paper 7, Society for Environmental Education.

D) What should the aims of environmental education be?

To educate for mastery of the environment. Nothing less than that. We are in the early stages of moving from a formal democracy to a participatory democracy in which people cherish their own environment because it's theirs.

Ward, Colin, Streetwork, Chapter 1 Routledge and Kegan Paul (p.16).

Hurry (1980) suggests that the long term aim of environmental education as laid down by the Belgrade Charter of 1975 should be:

to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skill, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and the prevention of new ones (p.48).

Harvey (1976) states that the single, superordinate goal for environmental education is the achievement of 'a homeostasis between quality of life and quality of environment' (cited in Hurry, 1980, p.49).

Regarding shorter-term objectives, the Belgrade Charter lists six objectives for environmental education. These are:

1. Awareness: to help individuals and social groups acquire an awareness of and sensitivity to the total environment and its allied problems.
2. Knowledge: to help individuals and social groups acquire basic understanding of the total environment, its associated problems and humanity's critically responsible presence and role in it.
3. Attitude: to help individuals and social groups acquire social values, strong feelings of concern for the environment and the motivation for actively participating in its protection and improvement.

4. Skills: to help individuals and social groups acquire the skills for solving environmental problems.
5. Evaluation ability: to help individuals and social groups evaluate environmental measures and education programmes in terms of ecological, political, economic, social, aesthetic and educational factors.
6. Participation: to help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems to ensure appropriate action to solve those problems (cited in Hurry, 1980, pp.49-50).

These six objectives have been accepted by the South African Council for the Environment's Committee for Environmental Education (1988) to serve as the basis for environmental education programmes in South Africa.

Harvey (1976) identifies three main objectives for environmental education which he sees as subordinate to the superordinate goal mentioned earlier:

- (a) The development of environmental literacy where this means the possessing of basic skills, understanding and feelings for the human environment. Here the emphasis is on knowledge.
- (b) The development of environmental competency where this means the ability to use environmental literacy to apply, analyse, synthesise and evaluate knowledge. Environmental competency also implies values

consistent with the subordinate goal mentioned earlier. Here the emphasis is on attitudes.

- (c) The development of environmental dedication whereby a person who has both environmental literacy and competency acts consistently in a manner compatible with homeostasis between quality of life and quality of environment. Here the emphasis is on behaviour (cited in Hurry, 1980, p.50).

As far as the local situation is concerned, the Natal Education Department has listed the following principles

which it feels should be incorporated into environmental education :

1. Environmental education is a life-long process beginning at pre-school level and continuing through all formal, informal and non-formal stages of education.
2. Environmental education must consider the environment in its totality and not only focus on any one aspect of it.
3. Environmental education must be interdisciplinary in approach and must therefore be present in all formal and non-formal educational programmes which deal with man and his environment.
4. Environmental education must encourage active participation by learners.
5. Environmental education should be relevant to the learner's immediate surroundings and culture.
6. Environmental education must stress individual responsibility towards the environment.
7. Environmental education should utilise diverse learning environments (Natal Education Department, 1988, p.1).

These principles have been based on a list of guiding principles for environmental education issued by the South African Council for the Environment's Committee for Environmental Education (1988) and will be accepted as the working principles of this study.

The Natal Parks Board, as part of its policy on environmental education, has identified the goals of environmental education (Table 1) and the principles of environmental education (Table 2).

GOALS OF ENVIRONMENTAL EDUCATION

	(oblivious of problems)	
(Passive)	Awareness (of) Concern (about)	Frequently achieved to varying degrees.
(Active)	Motivation (to do) Commitment (doing)	Seldom achieved by Environmental Educa- tion programmes.
	(rational behaviour change)	

Table 1 : Goals of Environmental Education  
Source : Natal Parks Board, 1984, p.3.

1.	<u>TOTAL ENVIRONMENT:</u>	(RURAL/URBAN)	(HUMAN/NATURE)	
		(BIOS/ABIOS)		
2.	<u>INTERDISCIPLINARY PROCESS</u>	(NOT SUBJECT):	This implies a set of dynamic interacting systems not bound to any subject discipline. (i.e. all subjects have a part to play).	
3.	<u>RESOURCE APPROACH:</u>	A resource is anything needed by an organism or an ecosystem, which by its increasing availability up to an optimal or sufficient level allows an increasing rate of energy conversion.		
4.	<u>LIFE-LONG PROCESS:</u>	- INFORMAL	(FAMILY/CULTURAL)	
		- FORMAL	(SCHOOLS/UNIVERSITY)	
		- NON FORMAL	(OUTSIDE)	
5.	<u>REAL WORLD</u>			
6.	<u>ENVIRONMENTAL ISSUES</u>		LOCAL	
	(CURRENT AND POTENTIAL)		REGIONAL	
			NATIONAL	
			WORLD	
7.	<u>PLANNING</u>			
	<u>OBJECTIVES</u>	- SENSITIVITY	(AWARENESS)	
		- KNOWLEDGE	(UNDER- STANDING)	
		- PROBLEM SOLVING ABILITY	(SKILLS)	'LITERACY'
		- VALUE SYSTEM	('LAND ETHIC')	
8.	<u>METHOD</u>	- (ACTIVE PARTICIPATION)		
		a) COMMUNICATION		
		b) INQUIRY		
		c) ROLE PLAYING		
9.	<u>TARGET GROUPS GOALS</u>	AWARENESS		(Passive)
		CONCERN		
		MOTIVATION		(Active)
		COMMITMENT		

Table 2 : Environmental Education Principles  
Source : Natal Parks Board, 1984, p.9.

These principles are very similar to those listed by the South African Council for the Environment's Committee for Environmental Education (1988) guide to teachers.

The various attempts to list the aims and objectives of environmental education, show the lack of a 'unifying environmental or educational philosophy' and 'underlies the diverse ramifications of the environmental education movement' (Martin, 1975, p.30). The complexity of the various approaches to environmental education has been summed up in diagrammatic form by Martin (Figure 4).

ENVIRONMENTAL EDUCATION

Environmentalists  
(concern for environment)

Educationists  
(concern for education)

METHODOLOGIES

Segmentalists	Inter-discip.	Multi-discip.	Holists
within separate subjects	within a few linked subjects	across a wide range of subjects	undifferentiated approach (Who cares which subject areas we use to understand the whole?)

ENVIRONMENTAL STUDIES

A subject or discipline within a curriculum

An educational approach to the whole curriculum

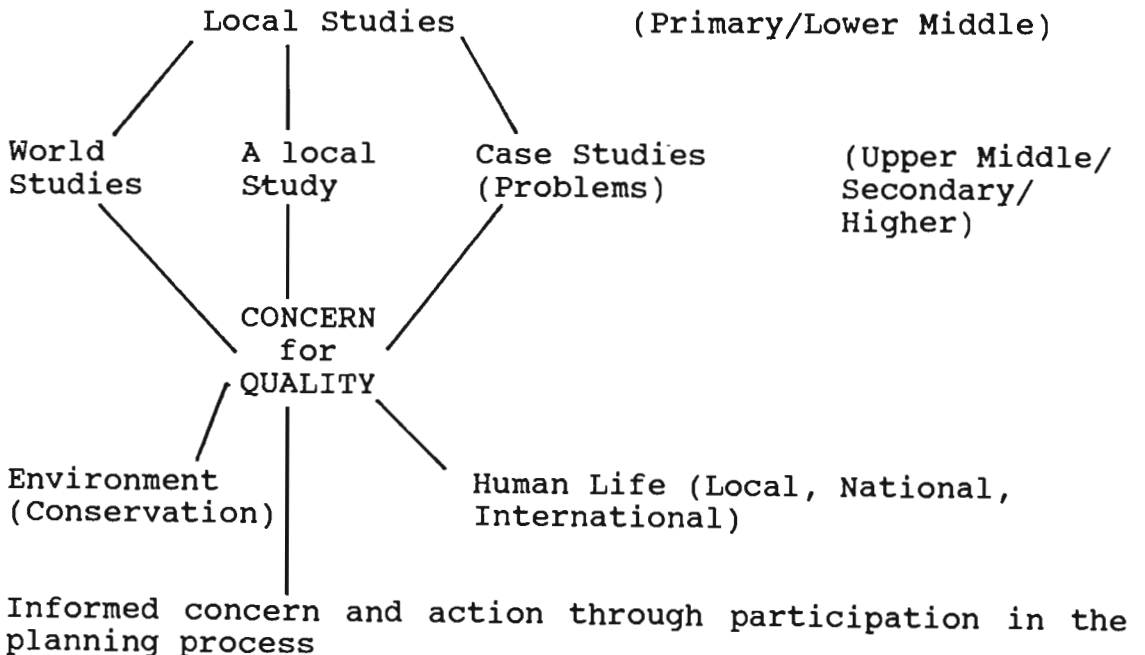


Figure 4: The complexity of Environmental Education  
Source : Martin, 1975, p.30



## Teaching approaches and methodologies in environmental education

Hurry (1980), after reviewing the ideas of various writers on what constitutes the fundamental principles of education implicit in all sound teaching situations, lists twelve points. They are:

- a) the principle of totality
- b) the principle of individuality
- c) the principle of socialisation
- d) the principle of development
- e) the principle of activity and self-activity
- f) the principle of motivation and interest
- g) the principle of observation and perception
- h) the principle of selection
- i) the principle of environmental teaching
- j) the principle of moving from the known to the unknown
- k) the principle of moving from the simple to the complex
- l) the principle of learning from the parts of the whole and back to the whole

At least two of the above principles viz. g) and i) have direct relevance to the subject matter of this thesis and will be briefly expanded on at this point.

The principle of observation and perception is based on the fact that knowledge is gained through experience and observation. Duminy and Sohng (1980, in Hurry, 1980, p.104) point out that perception and thought belong

together inseparably, and that the only effective way by which the child is introduced to his environment is through perception and direct experience. This has particular applicability to geographical fieldwork, to be discussed later.

The principle of environmental teaching according to Hurry (1980) refers to the view that children should learn through observation and perception of the local environment. This is seen as important for two reasons. Firstly, the child is already familiar with many aspects of the environment and the teacher can build on this knowledge, and secondly, by helping the child to a more conscious experience of the environment, the teacher (and therefore the school) is becoming more functional in the life of the child.

Hurry also states that the main elements of good teaching are planned actions and the achievement of goals - these would apply equally well to environmental education. The planned actions would include the use of the local environment in relevant situations, a holistic approach to environmental studies, the encouragement of self activity and the encouragement of observation, perception and activities aimed at developing the whole child. Planned action is thus required to achieve the important goals of environmental education as identified by Hurry viz. environmental literacy, the development of environmental

competency and the development of environmental dedication.

Hurry's research, however, revealed that in South Africa, with regard to the training of teachers at the colleges and universities, it was found that while certain institutions appeared to be orientated towards environmental education, others were not. He identified two particular areas of concern. The first was that a number of institutions do not give their students adequate training in fieldwork, and the second was that in most institutions there was a complete lack of subject integration. These concerns obviously have some relevance to the subject matter of this thesis and need to be borne in mind at all times.

Four main teaching approaches to environmental education were identified by Hurry in a later paper (1983). They are:

1. Environmental Education is problem orientated  
An important aspect of environmental education is that it is problem orientated. No man or woman has the right to call himself or herself educated until he or she understands something about the world in which we live, what harm we are doing to the world, and what we can do to save it.

Environmental education teaches young people how to analyse problems and what procedures to adopt to solve them (p.27).

Hopefully, the fieldwork programme undertaken by the target group of Standard 10 pupils in the Pigeon Valley

natural area will have prepared them to tackle confidently the problems posed at the end of their worksheets.

2. Environmental education must be taught holistically

In theory, environmental education deals with the total human environment. As far as possible, therefore, learners should be encouraged to think of wholes rather than parts.

Holistic teaching encourages learners to consider all the important environmental factors affecting the element or elements they are studying. It also encourages the learner to look for inter-relationships between the element they are studying and the rest of the environment. The level of complexity reached will depend upon the age level of the learners (p.27).

Pupils when taught this section of the syllabus are continually encouraged to integrate it where possible with other sections of the syllabus so as to see geography as a series of interlinking parts making up an integrated whole.

3. Fieldwork and/or practical work is essential for a thorough grasp of environmental concepts

It is only by experiencing the environment at first hand that the learner can begin to understand the concepts involved. Fieldwork and/or practical work gives credibility to theoretical work (p.28).

The extensive fieldwork programme carried out in the Pigeon Valley area was seen as essential to a thorough grasping by the pupils of the main concepts of the Ecology/Ecosystems section of the new high school geography syllabus.

4. An environmental education co-ordinator (eco-teacher) is needed

Environmental education is not a separate school subject. It therefore needs an individual teacher to look after its interests. The eco-teacher would assist in compiling and implementing programmes. The work could be done on a full-time or on a part-time basis (p.28).

Teachers competent and knowledgeable in the field of environmental education are required to teach this section of the syllabus. The specialised knowledge required will necessitate a re-structuring of many present-day teacher training programmes in South African educational institutions which, according to Hurry (1980), are not adequate. Many local writers, such as Nightingale (1977), and overseas writers, such as Armstrong (1979) recognise the importance of fieldwork. Lucas (1972) and Linde (1976) are both overseas writers who concern themselves with the notion of education about, for and in the environment.

Linde (1976) points out that:

Education about the environment could well define the cognitive domain, in the taxonomic sense of Bloom (1956), of interrelationships between man and environment. It includes both the provision of information on environmental issues and the teaching of appropriate technical and intellectual skills required for investigating environmental problems. Education for the environment covers the affective concern for the quality of life and commitment to environmental conservation.

Education in the environment refers to a particular pedagogical technique i.e. fieldwork. Thus acceptance of this as a valid model of environmental education involves the recognition of the vital role of fieldwork in this form of education (cited in Nightingale, 1977b, p.6).

The Natal Education Department's policy is that environmental education should be taught by means of planned learning programmes i.e. a continuous programme stretching across the curriculum starting in the junior school phases and extending to secondary and tertiary levels. It believes that by casually exposing pupils to nature or involving them in isolated activities related to environmental matters is totally inadequate.

This policy, it is suspected, has not been implemented by the teachers of Natal who have generally failed to rise to its challenge. Much work needs to be done to redress the situation. Geography teachers too must acknowledge the environmental component throughout the syllabus and not just in the section 'Ecosystems, Environmental Balance and Conservation' in the Standard 10 syllabus.

#### Environmental education and the curriculum in schools

Gayford (1986) states that environmental education in secondary schools in Britain has had a somewhat uneven and disappointing existence to date. From its emergence as a recognised area of the curriculum nearly twenty years ago, consistent efforts have been made to introduce environmental education into the formal curriculum of schools. Almost twenty years later with various changes in thinking within the educational system, the situation is far from encouraging. Gayford believes that this is

especially disappointing when it is considered that many people generally subscribe to the idea and importance of environmental education. Indeed, Gayford points out that an extremely strong case has already been made for the importance of environmental education in terms of human survival. He believes that the limited interest in environmental education has also been reflected in the small number of published studies relating to this part of the curriculum.

Various problems which exist to bedevil the advancement of environmental education as part of the school curriculum will now briefly be discussed:

- 1) Gayford (1986) states that part of the problem lies in initial confusion, even among its advocates, over the nature and identity of environmental education and how it should relate to the curriculum. He sees the reasons for this stemming from the variety of sources from which environmental education has been developed. He reviews problems which have arisen over the two main approaches to the inclusion of environmental education into the formal curriculum, the approaches being the development of environmental studies as a separate area of the timetabled curriculum and attempts to identify environmental components within established subject areas of the curriculum. The policy in South Africa, as stated by the South African Council for the Environment's Committee for

Environmental Education (1988) is that there is no need, nor indeed any place, for a separate subject - environmental education - in the existing school curriculum. Teachers are encouraged to teach their existing subjects with an emphasis on the environment e.g. the new high school geography syllabus has a built-in environmental education component.

2) Shaw (1975 in Martin and Wheeler, 1975) reviews four problem areas facing teachers of environmental studies in schools but believes these problems to be soluble with keen staff and sufficient finances. He identifies the problems as:

a) The problem of integration of the various subject departments in a school to integrate environmental education courses across the curriculum.

b) The problem of organising techniques of environmental enquiry and the logistical requirements of setting up fieldwork programmes.

c) The problem of course content of deciding just what is to be covered and what is to be left out.

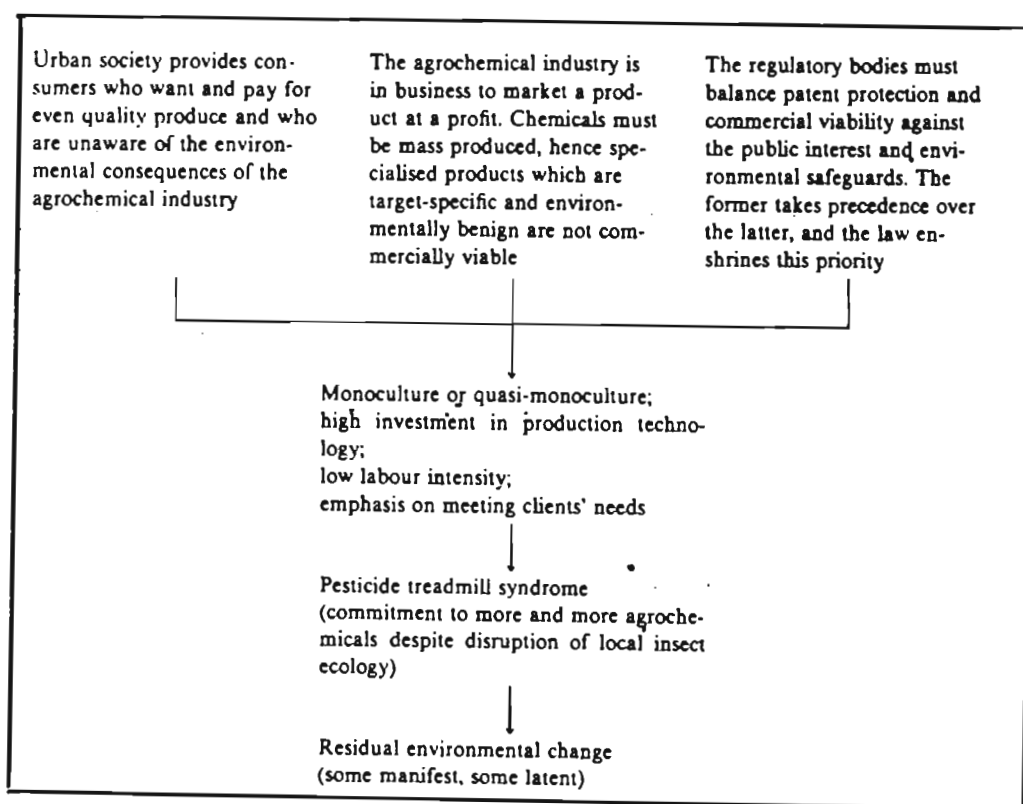
d) The problem of assessment of pupils as they progress through the planned environmental education programme.

3) O'Riordan (1981) examines some further problems which he has identified regarding environmental education in



schools. Briefly, these are:

a) the problem posed by the contradictions between a person's beliefs about the environment and how one's actions are influenced by forces that shape our very lives. He uses the example of a commercial farmer who is trapped by commercial, legal, psychological and social forces into embarking upon a path of action (the use of pesticides) which in the long run may well prove to be environmentally destructive to his land, a fact he is only too aware of. O'Riordan has illustrated this situation as follows (Figure 5).



**Figure 5:** Institutional forces that shape environmentally damaging behaviour

**Source :** O'Riordan, 1981, p.9



c) the problems that may be posed providing the pupils with the very necessary institutional perspective on environmentalism. As O'Riordan (1981) states:

Pupils need to know something about legal statutes, upcoming bills, consultative documents, reports of legislative committee hearings, environmental policy making: how ideas are transformed into policies, by whom and through what consultative mechanisms and how these interact with various interest groups in society (pp.10-11).

Pupils therefore need to realise that environmentalism is very much about ideology, but it is also the product of social, political and legal circumstances.

d) the difficulties of creating genuine involvement by pupils in issues of an environmental nature for only then will environmental education have taken place. Pupils must be made aware of the importance of their personal action (micro-behaviour) in bringing about macro-consequences. Also, O'Riordan (1981) believes that some sort of collective social or political action by pupils is required in local issues for pupils to achieve a state of environmental education.

4) Hurry (1980) summarises some of the main problems facing the core Joint Matriculation Board geography and biology school syllabi, on which the Natal Education Department syllabi are based, regarding environmental education. These are:

a) the lack of environmental education aims stated in behavioural terms in these two subject syllabi.

b) the lack of integration between subjects regarding the concepts of environmental education. He points out that biology and geography are compulsory subjects in the junior secondary phase which means the potential here is good for environmental education to take place.

c) there is little correlation between the different syllabi and little contact exists between teachers of the two subjects to deal with areas of overlap and complementarity.

The various problems facing the implementation of environmental education into the school curriculum need to be taken into account and should form a theoretical background against which this thesis should be viewed. Certainly the Natal Education Department has played its part over the years in its encouragement of fieldwork and outdoor educational activities, even though a great deal more could have been done.

#### Environmental education in schools overseas and in South Africa

Some indication of the importance which should be accorded to environmental education in South Africa can be gained by examining the role it plays in education in other countries.

a) Environmental education in Britain

This subject has been reviewed by Johnson (1975 in Martin and Wheeler, 1975, and Nightingale (1977b). It was not until the late 1960s that environmental education was taken seriously by the teaching profession in Britain. In 1970 the Schools Council set up their Project Environment and in 1974 the Sussex University Environmental Education Research Project was formed. During the 1970s environmental studies courses greatly increased in British schools and universities; candidates sat the first 'A' level examination in Environmental Studies in 1975 and since then several more C.S.E., 'O' and 'A' level syllabi have been devised. Additional momentum was provided by the European Conservation Year (1971) and the efforts of organisations such as the National Council for Environmental Organization, the Council for Environmental Education and the Town and Country Planning Association. There has also been a parallel and growing interest in outdoor education, including canoeing, camping, orienteering, which has been encouraged by the creation of Outdoor Study Centres by educational authorities. This increased interest in environmental education can be demonstrated by the following figures:

75% of teachers think that 'developing an understanding that the world is an interrelated, interdependent system of lands and peoples' is very important or crucial in the promotion of a global perspective in education.

46% of teachers indicated that their school had policies or guidelines which feature environmental education.

69% of teachers think that environmental and development education are relevant to their subject areas.

67% of teachers think that the political aspects of development and environmental education are not too controversial to be dealt with in the classroom.

88% of primary and secondary school teachers think that the children they teach are not too young to develop a global awareness or empathy with people from other lands and cultures.

78% of primary and secondary school teachers think that development and environmental education are central to achieving an understanding of, and active participation in, the world today.

65% of primary and secondary teachers would welcome in-service training on ways of incorporating development and environmental issues into their teaching.

These figures are taken from the 'Global Impact' survey (1986) of over 800 primary and secondary school teachers in 21 randomly selected local education authorities throughout the United Kingdom.

(cited in Grieg, Pike and Selby, 1987, p.1).

Johnson (1975) reviews the position in Britain under the headings:

- a) Environmental education within the formal education system.
- b) Resources for environmental education.
- c) Organisations with an interest in environmental education.
- d) Informal environmental education.

She concludes by saying that interest in environmental education has grown rapidly over the past few years, with

an encouraging number of organisations, educational institutions, commercial concerns, government departments and individuals now expressing an interest in it. She states that in fact the situation in Britain is now reaching the stage where increased co-ordination between interested parties is vital to avoid duplication of effort. The current position of environmental education in Britain can be gauged from a selection of quotations and statements made by some relevant authorities (Figure 7).

b) Environmental education in the United States.

This subject has been reviewed by Aldrich and Blackburn (1975 in Martin and Wheeler, 1975) and Nightingale (1977b). In the United States increased public pressure resulting in government legislation has provided considerable impetus to environmental education. During the late 1960s and early 1970s there was a sharp rise in the number of citizens who experienced a decreasing quality of life due to deterioration of their environment and the government was forced to legislate a number of measures to protect the environment. Among these was the Environmental Education Act which identified, as a national educational priority, 'the educational process dealing with man's relationship with his natural and man-made surroundings including the relation of population, pollution, resource allocation and depletion,

## Where we stand! Positional Statements from Those of Influence in the World of Education

### Reasonable Expectations by Age 16.

It seems important that those who will shortly become autonomous citizens should, to the extent of their capacities:

- view their surroundings with an eye both appreciative and critical;
- be competent in a range of environmentally-related skills;
- understand something of the processes of the physical world, and especially have a basic knowledge of ecological principles and relationships;
- understand something of the economic, technological, planning and political processes which affect man's use of the environment.
- have a degree of insight into other peoples' environments, life-styles and predicaments;
- understand something of the interdependence of peoples and the nature of the resource-base upon which mankind relies;
- show developing attitudes of concern towards their environment and the environment of others;
- in so far as environmental issues are concerned, have a basis on which to develop the ability to make informed decisions affecting themselves and society - and the interest to do so.

- HMI, *Curriculum 11-16*, Department of Education and Science, 1977.

Many of the areas covered by peace education will overlap with the 'family' of studies which includes multicultural, environmental and development education and world studies. The Union believes that these fields should not be seen as competing for timetable space but rather as offering different, often complementary approaches.

- NUT, *Education for Peace*, 1984.

The ultimate aims of environmental education are the creation of responsible attitudes and the development of an environmental ethic.

- HM Inspectors of Schools for the Scottish Education Department, 1974.

We live in a complex, interdependent world and many of our problems in Britain require international solutions. The curriculum should therefore reflect our need to know more about and understand other countries.

- Department of Education and Science, *Education in Schools: a Consultative Document*, 1977.

A good knowledge must in our view give every youngster the knowledge, understanding and skills to function effectively as an individual, as a citizen of the wider national society in which he lives and in the interdependent world community of which he is also a member.

- Swann Committee, *Education for All*, 1985.

International tensions, the continuing expansion of nuclear and conventional armaments, and the negative response of the developed nations to the needs of the Third World... all demonstrate the relevance and indeed urgent importance of peace education as part of an overall strategy for the elimination of conflict and the reallocation of resources.

- NUT/NATFHE, *Education for Peace*, 1981.

We call on leaders of public opinion, on educators, on all interested bodies to contribute to an increased public awareness of both the origins and the severity of the critical situation facing mankind today.

Everybody has the right to understand fully the nature of the systems of which he is a part, as a producer, as a consumer, as one among the billions populating the earth. He has the right to know who benefits from the fruits of his work, who benefits from what he buys and sells, and the degree to which he enhances or degrades his planetary inheritance.

A United Nations Meeting, Mexico, 1974

Learning for living means growing up learning to take responsibility for one's own learning and the quality of one's environment, with an increasing awareness of obligations to others and to the natural world. A constructive environmental policy backed by a balanced educational programme aimed to foster environmental competence, to identify the health of one's environment with one's own health, to encourage national participation in the development for all of a sustainable life-style, for the future as well as for the present, this is the policy we must continue to work for.

- Scottish Environmental Education Council, *Learning for Living*, 1985

### Suggested aims for schools:

- to help pupils to develop lively, enquiring minds, the ability to question and argue rationally and to apply themselves to tasks, and physical skills;
- to help pupils to acquire knowledge and skills relevant to adult life and employment in a fast changing world;
- to help pupils to use language and numbers effectively;
- to instill respect for religious and moral values, and tolerance of other races, religions and ways of life;
- to help pupils to understand the world in which they live, and the interdependence of individuals, groups and nations.

A Framework for the School Curriculum, Department of Education and Science, 1981 (am. ed.)

**Figure 7:** Positional Statements from Those of Influence in the World of Education in Britain.  
Source: Greig, Pike and Selby, 1987, pp.80-81.



conservation, transportation, technology, and urban and rural planning to the total human environment' (Aldrich and Blackburn, 1975, p.170).

The results of this Act have not been totally satisfactory for not only have educators and scientists been hard pressed to meet the challenge posed, but unfortunately the situation has also brought about the widespread production of largely useless materials and programmes labelled as 'environmental education' by persons taking advantage of the situation. Aldrich and Blackburn (1975) have pointed out that 'while there has been a lot of activity in the United States under the Environmental Education label, there has been little progress towards the kind of education that is needed' (p.173).

Similarly, Nightingale (1977b) has pointed out that:

There have been some excellent programmes but these represent only segments in a continuum, segments because most of the programmes have stemmed from some individual's or group's desire to promote their interests. The grand aim of the Environmental Education Act has not as yet been achieved; it pointed to the need for the American people to redirect their attitudes and behaviour, but education is not as yet playing an important part in this process (p.8).

c) Environmental education in Australia.

This subject has been reviewed by Smith (1975 in Martin and Wheeler, 1975) and Nightingale (1977b).

In Australia there has been a strong upsurge in environmental education in recent years as was evidenced by the development of the Australia Conservation Foundation in 1976 and which has been supported both by private conservation organisations and (until recently, in contrast to South Africa) by State Education Departments. No national policy is discernible as individual states develop their environmental education policies in different ways. In some states (like Victoria and New South Wales) private organisations have provided the main thrust while in others (like Queensland) the State Education department has taken the lead. The Education Departments of the various States also support numerous groups working in the area of environmental education such as the School Forestry Camps Branch, Curriculum and Research, Zoo and Museum educational services and the National Parks and Wildlife Service. Environmental science has been introduced into secondary schools either as optional one-year courses or as full matriculation courses. Numerous in-service training programmes are also run for teachers both by the state and private organisations.

In his conclusion Smith (1975) states that:

- a) there has been a slow movement towards the establishment of separate programmes in environmental education, although a general environmental consciousness has influenced the development of a number of curricula.

- b) although there is a wide diversity of environmental experience, the plea for a comprehensively organised programme of environmental education has not been realised.
- c) the approach has often been piecemeal, lacking rigorous analysis and characterised by confusion due to a failure properly to identify the implications for the curriculum (pp.164-165).

Australia's growing environmental problems, like those of other industrial nations, have brought about increased concern for man's use and modification of his environment. This concern has manifested itself in public protests, increased media attention and more stringent government legislation.

In 1980 the World Conservation Strategy was jointly launched by the World Wildlife Fund, the United Nations Environment Programme and the International Union for the Conservation of Nature and Natural Resources. The strategy underlined the interdependent nature of all components of the biosphere, including human communities, and thus directly linked the future of the planet's life-support systems to human behaviour and development decisions. As a result of the strategy, teaching and learning about the environment in Britain, the United States and Australia has been increasingly marked by:

- i) a recognition that the local environment is caught up in the global ecosystem;
- ii) an awareness that human and natural systems interact in myriad ways and that there is no part of human activity which does not have a bearing on the environment and vice versa;

- iii) a dawning acknowledgement of how much we can learn from other cultures and, perhaps especially, indigeneous peoples, about how to relate to the environment;
  - iv) an emphasis on the development of environment-friendly values, attitudes and skills (including, very importantly, those skills appropriate to influencing public opinion and political decision making).
- (cited in Greig, Pike and Selby, 1987, p.26)

The world Conservation Strategy has also influenced environmental education in South Africa.

d) Environmental education in South Africa

None of the subjects taught in South African schools has environmental education as a primary aim, nor until the mid-1980s did official statements of the basic aims of education set out by the various education authorities make detailed reference to promoting environmental concerns.

It was only in 1972 that the government Minister of Planning was charged with the overall responsibility for the environment and he established in that year a Cabinet Committee on Environmental Conservation. A South African Committee on Environmental Conservation (which became the Council for the Environment) followed. The name of the Department of Planning was changed to Planning and the Environment in 1973.

In 1980 the White Paper on a National Policy regarding Environmental Conservation (WPO 80) was tabled in Parliament which proposed a consolidated and up-to-date

Environmental Conservation Act. The White Paper stated that, broadly, the Government's policy was that a golden mean between dynamic development (to provide work and food for an exploding population) and the vital demands of environmental conservation should constantly be sought. The aim was that man and nature should co-exist in productive harmony to satisfy social, economic and other expectations of the present and future population. The need for environmental education was one of the main points in the White Paper's recommendations:

Because the Government considers it extremely important that all individuals and institutions should have the right attitude to the environment, attention must be given to environmental education in general and the concomitant shaping of public opinion (cited in Diepeveen, 1983, p.21).

The 1980 White Paper stated (in the South African Council for the Environment's 1988 Report of the Committee for Environmental Education) that it was part of the proposed and existing policy that:

1. the actions of the State and of the private sector be co-ordinated to ensure maximum effective use of the available machinery used in all phases and aspects of education;
2. a better general understanding is instilled and public awareness of all the environmental factors is stimulated, as well as of their complex interaction and dependence on constant equilibrium and harmony in the environment;
3. each individual is brought to a thorough realisation of his personal responsibility towards the environment, so that a constant harmonious interaction between man and his habitat can be pursued. This involves not only knowledge of environmental matters in which man fulfills the passive role of a spectator, but the

realisation that he forms an integral part of the environmental system and that he must contribute positively towards this interaction. It also brings about an appreciation of the resources on which his existence depends and the acceptance of an environmental ethic which may serve as his guide-line;

4. an understanding is instilled of the most important contemporary environmental problems for which policy makers are endeavouring to find solutions, so that steps taken by the Government are understood against that background. Such an undertaking will also lead to community involvement and participation in decision-making processes conducive to a better quality of life;
5. the approach is multi-disciplinary, so that all related disciplines throughout all phases of education will take their rightful place;
6. bottle-necks are identified and purposeful research is initiated;
7. the mass media is effectively exploited as advertising channels to ensure maximum publicity;
8. sufficient information, audio-visual programmes and other relevant material are made available and disseminated;
9. steps are taken to provide adequate specialised training up to the tertiary level for the variety of occupations for which good basic environmental expertise is indispensable, eg. engineers, planners, architects, leaders of commerce and industry and many others whose activities have an impact on the environment;
10. training in the professional disciplines of the specialised environmental occupations such as those of ecologists, ecological planners and landscape architects be supported and extended to ensure a sufficient number of environmental experts;
11. the voluntary conservation and education bodies and their co-ordinating body, the Council for the Habitat, are supported in their educational task (pp.5-6).

The 1980 White Paper became the subject of an investigation by a select committee and the resulting report was the basis for the Environment Conservation Act of 1982 which recommended the establishment of a Council for the Environment. The 1980 White Paper contained a list of the main goals and objectives of the Belgrade Charter on environmental education which the government recommended teachers use to teach their subjects from an environmental bias. Professor William B. Stapp, former advisor to UNESCO's environmental education programme, and co-ordinator of the Belgrade Charter defined and specified a model for environmental education (Figure 8) which the government felt merited the consideration of teachers in designing their approach. The Government's report also made mention of recommendations made by the Stockholm and Tbilisi conferences on the environment. In summarised form the Tbilisi recommendations were:

The goals of environmental education:

(a) to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;

(b) to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;

(c) to create new patterns of behaviour of individuals, groups and society as a whole towards the environment.

Tbilisi Recommendations (1980)  
(cited in Greig, Pike and Selby, 1987, p.26)

SYMPTOMS VERSUS ROOT CAUSES OF THE ENVIRONMENTAL CRISIS

WHAT ARE SOME OF THE ENVIRONMENTAL ISSUES FACING OUR SOCIETY?	Environmental pollution (air, water, noise etc) Urbanisation (housing transportation, growth) Land-use planning		Unwise use of natural resources Energy consumption and waste Waste disposal (solid, gas, liquid) Food supply
WHAT ARE SOME OF THE MAJOR REASONS FOR ENVIRONMENTAL ABUSES?	Individual behavioural patterns	Corporate behavioural patterns	Governmental behavioural patterns
	Consumerism Individual choices Behavioural actions	Passing on social costs Unaccountable to society	Low environmental priorities Lack of sound environmental legislation
WHAT ARE SOME EFFECTIVE ENVIRONMENTAL ACTIONS TO REDUCE ENVIRONMENTAL ABUSES?	Sound environmental choice	Economic pressure	Influencing sound environmental policies and priorities
	<u>Individual and group life-style</u>		
WHAT ARE SOME MAJOR OBJECTIVES OF ENVIRONMENTAL EDUCATION?	Environmental awareness Environmental knowledge Environmental values		Problem-solving skills Self-concept Environmental commitment
WHAT SHOULD BE THE PRIME FOCUS OF ENVIRONMENTAL EDUCATION?	Attitude-formation Environmental sensitivity Environmental knowledge (ecological, economic, political, social and technological) Environmental concern	Valuing Values clarification Values Modelling Values analysis	Skill-development Problem-solving skills Communication skills Social-change skills Critical-thinking skills

From Stapp & Cox "E.E. Activities Manual" (1981)

Figure 8: A model for environmental education  
Source : Diepeveen, 1983, p.46



The Cape Province Department of Education guide (Diepeveen, 1983) states that teachers must bear in mind that all pupils in South Africa are compelled to follow the general science and geography courses up to the end of standard 7. In the senior secondary phase (fourth phase) geography and biology are optional subjects with biology a very popular option with over 80% of the pupils taking biology or geography and fully 30% taking both. The guide continues to say that all pupils are therefore exposed to at least nine years of geography and general science while a majority do geography and/or biology for their matriculation examinations.

As Nightingale (1977b) points out, with large numbers of pupils (mainly Black) never reaching standard ten and large numbers not doing biology or geography in the fourth phase, it becomes apparent that many pupils receive a minimum amount of environmental education in South African schools.

Hurry (1983), based on an analysis of his two earlier studies in 1978 and 1980 has identified the following problems which would appear to constrain effective environmental education in most schools in South Africa.

Following Hurry, these problems have been listed and discussed in point form:

a) Problems with terminology and confusion of concepts

As Hurry explains:

Some people see a difference between 'nature' (i.e. the natural world "out there") and the environment (surroundings) they live in. They use the term 'nature' mainly in the context of "Nature Conservation". Because of this attitude, studies of the natural environment are very different to environmental studies. While other people agreed that man and his activities are an integral part of Nature/the environment, their school programmes nevertheless show a tendency towards 'nature studies' rather than environmental studies (p.29).

b) General attitudes to subject teaching. Teachers are seen to be only concerned with subject teaching - they do not look for, nor teach, inter-relationships beyond those which are immediately obvious (either within the subject or between subjects).

c) Constraints with regard to school syllabuses

- i) no aims for general education
- ii) syllabuses not holistic in conception
- iii) syllabuses problem orientated, not solution orientated
- iv) syllabuses lack internal linkages eg. geography - no links between local geomorphology and local ecology
- v) syllabuses too long thus not enough time for fieldwork.

d) The school situation

- i) fieldwork is neglected both at the primary and secondary levels
- ii) few schools have developed fieldwork (outdoor education) facilities
- iii) little or no co-ordination between schools and between teachers with regard to environmental

education

- iv) teachers lack confidence in planning and running fieldwork
  - v) pupils are not trained in problem solving. They do not know how to analyse a problem, nor do they know how to approach its solution.
- e) Syllabus and subject committees
- i) no meaningful contact between eg biology and geography committees at national or departmental level
  - ii) little or no curriculum development occurring in South Africa.
- f) Teacher training
- i) not holistic in conception. Little or no co-operation between geography and biology on common-ground topics eg fieldwork
  - ii) little formal training in fieldwork management
  - iii) too few in-service centres for environmental education in South Africa.
- g) Resource materials
- i) few SA based materials
  - ii) few activity orientated materials.

Hurry is of the opinion that environmental education in South Africa has not received the attention that it deserves from the educational authorities. However, the new high school geography syllabus should be viewed as an attempt by the educational authorities to redress the situation.

As far as the Natal Education Department is concerned, a review by Clayton (1981) of the contribution of each of the Provincial education departments to his concept of

'outdoor education', revealed that there appeared to be more of a commitment in this province than in the others. O'Donoghue (1987) is another who commends the Natal Education Department, through its environmental education section, for being a leading stimulator of conservation and the structured use of the outdoors. He states that it has also shown how conservation and environmental issues, far from being irrelevant, are readily applicable as a source to enhance learning outcomes by increasing curriculum relevance. He recommends the use of the World Conservation Strategy logo (Figure 9) to 'create enquiry contexts for curriculum content concerned with:

- natural systems and processes ((a) in figure)
- studies of plants and animals ((b) in figure)
- man/land interactions ((c) in figure)' (p.22).

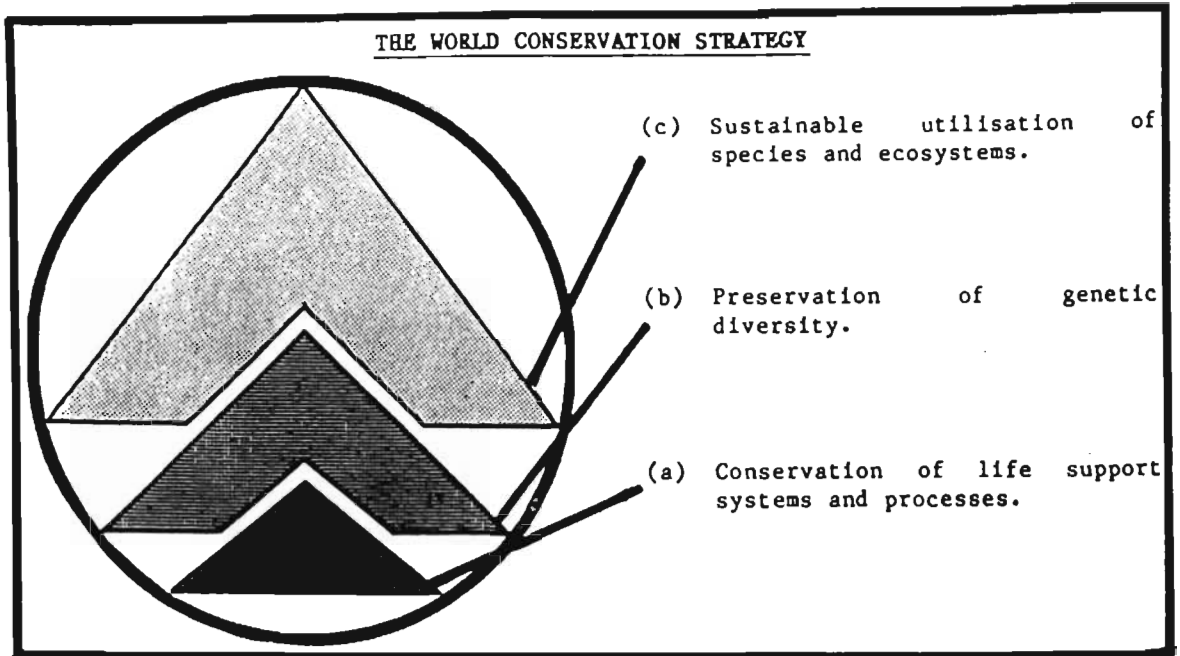


Figure 9: The World Conservation Strategy Logo  
Source : O'Donoghue, 1987, p.22

The Environmental Education section of the Natal Education Department initiates and co-ordinates environmental education activities in Natal schools. These activities include :

- Research with the view to obtain information on places or areas with potential for environmental education.
- Supply of information to schools.
- Assistance to schools in the organising of tours and excursions.
- Interpretation in the field with the view to train teachers.
- The organising of workshops/courses for teachers to introduce them to field study opportunities.
- Liaison with outside organisations offering environmental education activities and facilities e.g. the Natal Parks Board, the National Parks Board, the Department of Environmental affairs, the Department of Education and Culture, the Wildlife Society of Southern Africa, Veld and Vlei and several private persons or organisations.

- The organising of the annual environmental education symposium for high schools and primary schools.

(NED, 1987, p.3)

From the above list of activities it can be seen that fieldwork is encouraged in Natal schools. A field studies section exists to encourage schools to undertake field studies, to provide field study centre facilities and to assist with the production of work sheets and other resources. This section needs to make itself known more to the individual teacher struggling to implement a fieldwork programme.

The field studies section encourages the use of all three types of field study method used in schools viz. field teaching at the earlier stage, traditional fieldwork at the intermediate stage and field research at the advanced stage. These field study methods will be discussed in detail in Chapter 3 of this thesis.

The above discussion reveals a fairly recent awakening of the State education departments to the values and importance of teaching environmental education. The efforts of various other government departments and institutions, like the Department of the Environment, the Land Service Movement of the Department of National Education and the Museum Services, organisations like The Environmental Education Association of Southern Africa, The Wilderness Trust, The Natal Parks Board, The Durban

Corporation Parks, Recreation and Beaches Department, public companies and individuals to promote environmental education should also not be underestimated. In particular, the substantial efforts of The Wildlife Society of Southern Africa are acknowledged by the Council for the Environment's Committee for Environmental Education in its 1988 report.

### Environmental education and the future

O'Riordan (1981) believes that environmentalism as an ideology for the next generation will fall between the realms of the technocentric environmental managers and the ecocentric soft technologists (Figure 6).

The great struggle, particularly in environmental higher education, will lie in the consciences of teachers and students alike in working out their sense of the future. Comprehensive training in the skills of self-reliance and communal living, and enjoying the full advantages of the new technology should offer the best answer. We may have to educate for a wholly different approach to life, to work, to leisure, to social relations, to money, to communal maintenance and to technology. To establish institutions to allow new approaches to education to occur will be just as great a task as the design and execution of new curriculum (O'Riordan, 1981, pp.15-16).

There can be no doubt that environmental education and fieldwork will feature prominently in the future new education and will play a very important role, without being a panacea on its own (Pepper, 1984), in the attempts to find solutions to the environmental crisis.

## Clarification of terminology used in environmental education

The following terms will be discussed: a) Ecology, b) Ecosystems, c) Biogeography

### a) Ecology

According to Fincham (1985) the word 'ecology' was first used by Ernst Haeckel in 1869. It is derived from two Greek words, 'oikos' meaning 'a dwelling place' and 'logos' meaning 'the study of' (Bennett, 1975, cited in Fincham, 1985, p.6). Ecology is accordingly the study of: 'how plants, animals and their biological and physical environments interact and how they influence one another' (Bennett, 1975, cited in Fincham, 1985, p.6).

Tyler Miller (1985) defines ecology as: 'the study of the structure and function of nature or the study of the relationships among living organisms and to the totality of physical and biological factors making up their environment' (p.28). The essence of this definition has been more simply stated by, among others, Haggett (1983) who defines ecology as 'the study of plants and animals in relation to their environment' (p.52).

Odum (1959) examines in some detail the scope of ecology and traces how the science of ecology has had a gradual, if spasmodic, development through recorded history, stating that the writings of Hippocrates, Aristotle and other philosophers of the Greek period contain material



which is clearly ecological in nature. The Greeks, however, did not seem to have a word for it, with the German biologist Haeckel, as mentioned previously, being the first to propose it. Odum believes that the best definitions for such a broad subject field as ecology is probably the shortest, least technical one and suggests: 'the science of the living environment' (p.4). He believes that to best understand the scope of ecology, the subject must be considered in relation to other branches of biology and to academic disciplines in general. He puts forward a model of a biology layer cake (Figure 10) which is cut into small pieces in two distinct ways viz. horizontally into what are usually called basic divisions, because they are concerned with fundamentals common to all life or at least are not restricted to particular organisms. Ecology forms one of these horizontal slices. The cake is also divided vertically into taxonomic divisions, which deal with various characteristics of specific kinds of organisms. Ecology forms an integral part of any and all of the taxonomic divisions.

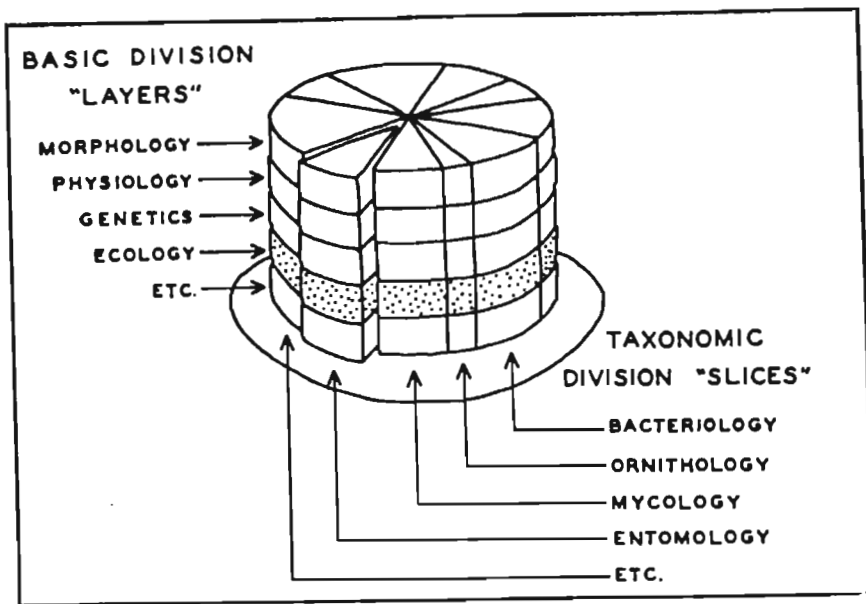


Figure 10: The biology "layer cake", illustrating "basic (horizontal) and "taxonomic" (vertical) divisions

Source: Odum, 1959, p.4

Odum suggests that perhaps the best way to delimit modern ecology is to consider it in terms of the concept of levels of organisation. Odum identified ten levels of organisation which he sees as a sort of biological spectrum as illustrated in Figure 11. Ecology is concerned largely with the right-hand end of this spectrum that is, the levels beyond that of the organism.

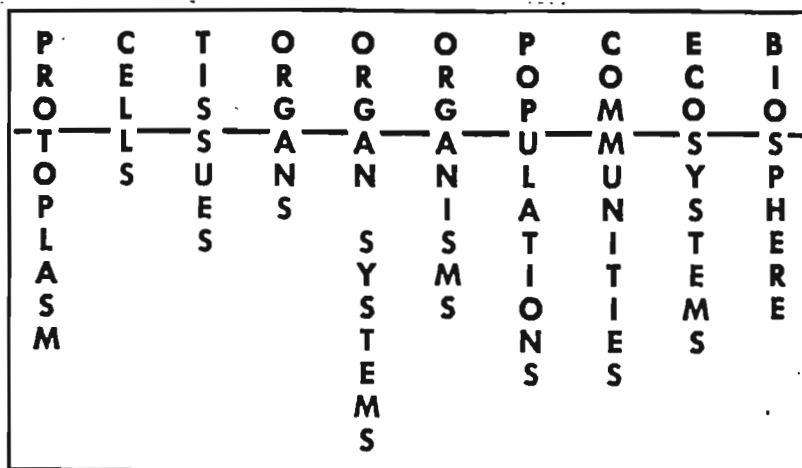


Figure 11: The Biological Spectrum

Source: Odum, 1959, p.6

Odum states that subdivisions in ecology, as in any other subject, are useful because they facilitate discussion and understanding as well as suggest profitable ways to specialise within the field of the study.

Fincham (1985) states that contemporary ecology is marked by a move towards ecological systems analysis (the ecosystem concept). This ecosystems analysis has fostered, to an even greater extent, applied ecological studies making the ecologist an expert to be consulted by planners about policy issues which affect the impact of man's activities on the environment. Fincham (1985) continues: '... one of the prime qualities of ecology is its ability to provide a holistic view for the study of almost all phenomena. This particular characteristic of ecology has emerged as a result of the orientation in the discipline towards systems analysis, including the ecosystems concept' (p.7).

b) Ecosystems

According to Odum (1959), 'living organisms and their nonliving (abiotic) environment are inseparably interrelated and interact upon each other. Any area of nature that includes living organisms and non-living substances interacting to produce an exchange of materials between the living and nonliving parts is an ecological system or ecosystem' (p.10). The term ecosystem was first

proposed by English botanist A.G. Tansley in 1935 and should be seen as the basic functional unit in ecology, since it includes both organisms (biotic communities) and the abiotic environment, each influencing the properties of the other and both necessary for maintenance of life as we have it on the earth.

Odum goes on to briefly describe the main components and constituents of an ecosystem:

From a functional standpoint, an ecosystem has two components (which are usually partially separated in space and time), an autotrophic component (autotrophic = self-nourishing), in which fixation of light energy, use of simple inorganic substances, and buildup of complex substances predominate; and, secondly, a heterotrophic component (heterotrophic = other-nourishing) in which utilisation, rearrangement and decomposition of complex materials predominate. It is convenient to recognise four constituents as comprising the ecosystem: (1) abiotic substances, basic inorganic and organic compounds of the environment; (2) producers, autotrophic organisms, largely green plants, which are able to manufacture food from simple inorganic substances; (3) consumers (or macro-consumers), heterotrophic organisms, chiefly animals, which ingest other organisms or particulate organic matter; (4) decomposers (micro-consumers, saprobes or saprophytes), heterotrophic organisms, chiefly bacteria and fungi, which break down the complex compounds of dead protoplasts, absorb some of the decomposition products and release simple substances usable by the producers (pp.10-11).

Odum (1959) continues by giving the example of a freshwater pond as an example of an ecosystem and shows in diagrammatic form its main units (Figure 12).

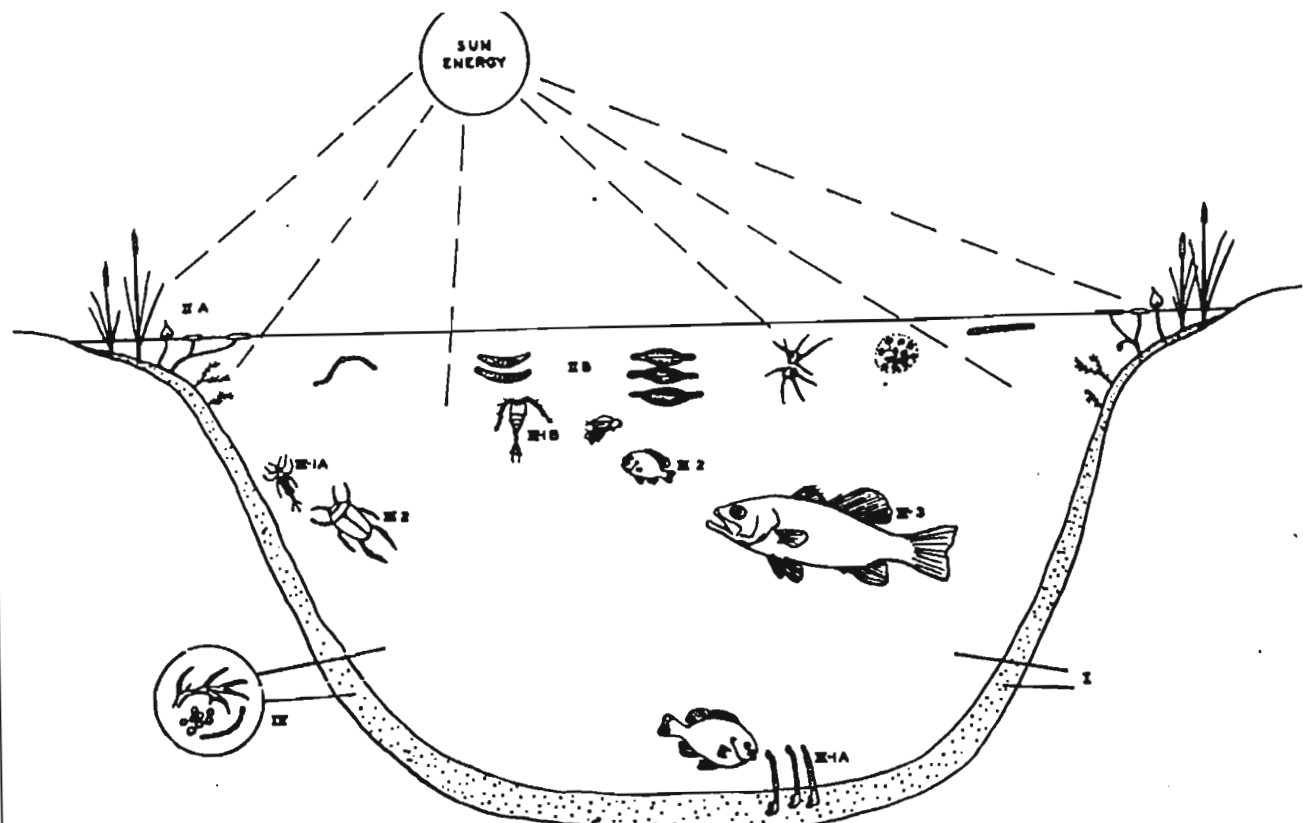


Diagram of the pond ecosystem. Basic units are as follows: I, abiotic substances—basic inorganic and organic compounds; IIA, producers—rooted vegetation; IIB, producers—phytoplankton; III-1A, primary consumers (herbivores)—bottom forms; III-1B, primary consumers (herbivores)—zooplankton; III-2, secondary consumers (carnivores); III-3, tertiary consumers (secondary carnivores); IV, decomposers—bacteria and fungi of decay.

Figure 12: A Freshwater Pond Ecosystem  
Source : Odum, 1959, p.14

Another definition of ecosystems is given by Haggett (1983):

ECOSYSTEMS ARE ECOLOGICAL SYSTEMS IN WHICH PLANTS AND ANIMALS ARE LINKED TO THEIR ENVIRONMENT THROUGH A SERIES OF FEEDBACK LOOPS (positive or negative). Positive feedback increases change in the ecosystem while negative feedback suppresses change. The latter type acts as a stabilizer in an ecosystem, while the former breeds unstable conditions.

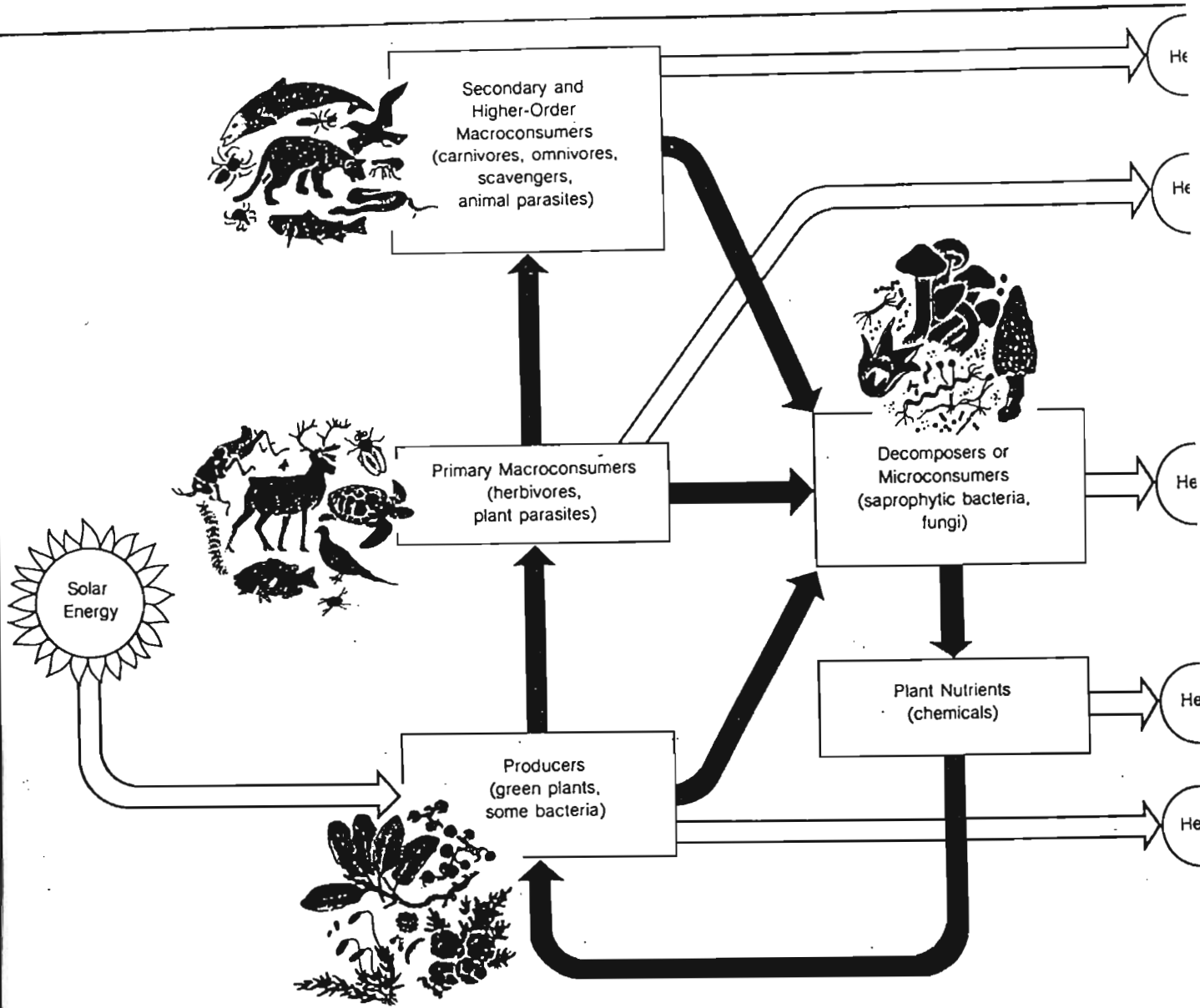
The atmosphere, hydrosphere, lithosphere (non-living abiotic component) and biosphere (biotic component) are closely related through a network of links and feedbacks to form ecosystems (p.52).

Taylor's (1984) definition is: 'A community of organisms linked to each other and to their abiotic environments by the energy flow through trophic levels (food chains) and the cyclic interchange of materials' (p.387). These

definitions have caused Stoddard (1965, cited in Fincham, 1985) to list four main properties which recommend the systems concept in ecosystems to geographical investigation:

- a) An ecosystem is holistic and so brings together man, environment and the plant and animal kingdom within a single unit within which the interaction between the components can be analysed.
- b) Ecosystems are structured in an orderly, rational way. Once structures are recognised they may be investigated in depth.
- c) Ecosystems function: they therefore have continuous throughput of matter and energy.
- d) Ecosystems are a type of general open system with the characteristics of being dynamic and displaying homeostatic characteristics (pp.11-12).

The following diagram (Figure 13) of a natural balanced ecosystem demonstrates the dynamic characteristic of these systems and the systems of matter and energy which are involved.



The basic components of an ecosystem. Solid lines represent the cyclical movement of chemicals through the system, and unshaded lines indicate one-way energy flows.

The basic components of an ecosystem. Solid lines represent the cyclical movement of chemicals through the system, and unshaded lines indicate one-way energy flows.

Figure 13: The Basic Components of an Ecosystem  
Source : Tyler Miller, 1979, p.45

c) Biogeography

At the outset it needs to be clearly stated that there is at present a lack of consistent definitions and procedures among writers in the area of biogeography due mainly to a lack of consensus regarding the position and role of ecology in the field of study. Poynton (1986) has attempted to clarify the situation. To most geographers he believes that 'biogeography largely is ecology, that is, ecology or environmentalism as taught to geography students' (p.141). To biologists generally, 'biogeography' means something completely different, namely the study of plant and animal distribution per se, in which taxonomy and phylogenetic evolution form the main theoretical backdrop, not ecology.

To give an example, Meadow's (1985) book, which contains the term 'biogeography' in its title, states that it is based on an ecosystems approach. Being a geographer one would expect this approach to be adopted. However, to a biologist his book would more suitably be characterised as a book solely on ecology, there being virtually nothing in it that would be covered in a course on biogeography offered by a university biology department.

Tivy (1982a) sees biogeography as both a biological and a geographical science. She sees its field of study as: 'the biologically inhabited biosphere' (p.1) and its



subject matter as covering 'the multitudinous forms of plant and animal life inhabiting this zone, as well as the complex biological processes which control their activities' (p.1). She goes on to say that the approach to and aim of the subject is geographical insofar as it is primarily concerned with the distribution (together with the causes and implications hereof) of organisms and biological processes. However, although this field of study is shared by, and is common to, both biology and geography, it is not the exclusive preserve of either and by its very character it is situated at, and overlaps, the boundaries of a great number of other disciplines. As a result, the approach to, or concept of, biogeography is in large measure determined by the training, interest, and objectives of a particular student. The geographer's focus will be on the reciprocal relationship between man and the biosphere. The study of the science of ecology and its concept of the ecosystem help the geographer to understand some of the complexities of this relationship.

Tivy (1982b) began an article on biogeography written by her in 1971 by describing it as the 'Cinderella' (p.1) of physical geography. In comparison with geomorphology and climatology it was relatively neglected and underdeveloped at all educational levels. She believed that before biogeography could even start establishing itself as an academic discipline, three areas in biogeographical curricula merited attention at both secondary and tertiary

educational levels:

1. The nature of ecological processes such as energy flow, biological cycling and eco-regulation.
2. The role of humans as the most important ecological factor affecting the operation of the above processes.
3. The resource value of ecosystems and the associated problems of planning and managing organic resources (in Tivy, J. 1982b).

She stressed the importance of the ecosystem concept as having considerable pedagogic potential by which the relevance of biogeography to the understanding of modern environmental problems and as an integrative element in geography can be most effectively illustrated.

Developments in biogeography were forthcoming and by 1978 Watts stated that he felt that it had at last come of age. He maintained that what he called the new biogeography had started to emerge and to take its rightful place as a universally accepted and reasonably, if not at that time completely, respectable member of the geographical academic establishment.

His call for a greater interest in the new biogeography helped to increase society's concern about environmental problems in general. The new Natal Education Department's high school geography syllabus with its environmental bias and its section on 'Ecosystems, Environmental Balance and Conservation' should be seen as part of the whole process of the coming to fruition of the so-called new biogeography.

## The place of environmental education in geography

Geography has undergone accelerating change since its early days. In a thesis of this nature it is necessary to arrive at some sort of understanding of modern geography so that the topics studied and the methods employed correspond with those used by researchers in the forefront of geographical thought. Hopefully, this thesis will show that environmental studies/environmentalism in geography fits in as one of the essentials of modern geography and that fieldwork constitutes an essential method of teaching the environmentalism component.

A review of the available literature on environmental education and geography reveals the close interrelationship which exists between them (Hurry 1980, Fincham 1985, Nightingale 1985b, Tivy 1982b). One of the basic objectives of environmental education is knowledge of the environment. Geography, probably more than any other subject, aims to provide much of this basic knowledge, as well as an appreciation of the interdependence of the various regions of the world and of man and his environment. In this sense the entire geography syllabus at school, as well as at the tertiary level, is a form of environmental education. An examination of the aims of teaching geography reveals an attempt to inculcate an element of environmental knowledge, attitudes and behaviour in its adherents. The

development of an awareness in the individual of his relationship and inter-dependence with the ecosystem of which he is an integral part, and the development of actions and activities which contribute to the well-being of the ecosystem, is seen as a fundamental aim of geography (Hurry 1980).

Studies of climate and geomorphology in geography give insights into the abiotic elements of the environment. Regional geography emphasises linking the physical environment and its exploitable resources. In dealing with the world's major natural regions there is an opportunity for pupils to learn about ecology and human environments other than their own. These areas in geography serve as examples of the contribution geography can make to the development of environmental awareness in those who study the subject.

Likewise the development in recent years of biogeography as a major point of growth within physical geography (Tivy 1982b, Watts 1978) has highlighted the close interrelationship between the two. Tivy sees the geographical focus in biogeography as, firstly, the study of the intimate interrelationship between the organic and inorganic elements of the earth's environment and, secondly, the reciprocal relationship between man and his environment. Watts believes that the relationship between biogeography and environmental education within the study of modern geography has yet to realise its full potential.

He argues :

Clearly an understanding of the functioning of the contact zone between earth and atmosphere in which soil, vegetation and most animal life exists is of prime importance to any explanation of process in most of physical geography, and certainly in geomorphology, hydrology and microclimatology : it also has further far-reaching applications in the study of the geography of agriculture, and of many other human activities. And yet this understanding has, in the past, often been lacking. A new physical geography (indeed, a new geography) with biogeography at its core may well be necessary if the discipline is to continue to develop strongly at both school and university level in the next decade (p.335).

Tivy agrees with the sentiments expressed above and sees the ecosystem concept in particular, as having considerable pedagogic potential as a means of effectively illustrating the relevance of biogeography to an understanding of modern environmental problems. She also sees it as an important integrative element within the subject itself.

Fincham (1985) is one of many concerned geographers who see the intrinsic value of ecology, the ecosystem concept and environmental education in geography as that of facilitating holistic thinking. He sees geography as being in danger of disintegration, with a widening rift between physical and human geography. He agrees with Preston-Whyte (1983) that geography's greatest value lies in its ability to straddle the natural and social sciences. He regards as most apt Preston-Whyte's call for environmentalism and environmental education to be seen as

the cement between man and his environment. Later, an attempt will be made to show, again with reference to the work of Preston-Whyte, that the new environmental bias in the school syllabus leads to a decrease in the divergence between the human and the physical components of the subject.

An attempt has been made in the above discussion to locate environmental education in geography and focus of attention will now shift to the role fieldwork plays in the teaching of the environmentalism component of the new high school geography syllabus.

In this regard, Webster (1979) believes that the end result should be an understanding of the environment as a whole, a covering of the perspectives of the three sets making up the field of knowledge called geography viz. the natural, mathematical and social science sets.

Webster continues by examining modern approaches to education in an effort to establish whether it is educationally sound to learn geography through field studies. He compares so-called Traditional methods of teaching geography with Progressive/Experience centred methods by discussing John Dewey's definitions of these two opposing approaches towards education.

Recent changes in attitude to the teaching of geography, according to Webster, have led to a slow movement away from the stifling Traditional mode towards the Progressive mode with its active participation by the learner in the development of the subject matter, and the learner gaining an increasing amount of his education through his own efforts and experiences. Education based upon personal experience of, among other things, the natural environment is advocated by proponents of Progressive education. Curriculum reform, which has swept the world over the last two decades and is reflected in the works of Bruner, among others, has stressed the central role of pupil activity and experience.

Geographical fieldwork as a teaching method encourages pupil activity and experience. Fieldwork programmes need to become 'educative experiences' (Webster, 1979, p.17) for the pupils. He continues: 'To be of educative value an experience must be 1) selected, 2) planned and organised, 3) sufficiently motivating to induce the learner to work by himself' (p.17).

Webster continues his examination of progressive education by looking at the heightened motivation levels required of the learner and the lower profile expected of the teacher in the learning process.

One of the primary aims of Webster's (1979) thesis was to plan a fieldwork programme which increased the popularity

of fieldwork amongst pupils by increasing the novelty and excitement of approaching outdoor geography directly, of recognising problems and of attempting to find solutions. The teacher must not destroy the enthusiasm which accompanies the pupil's own discovery. He must beware of dominating the study outdoors in an effort to ensure that the pupils learn what he intends them to learn, for this can create opposition to outdoor learning experiences. Non-participant observation methods were employed in this study in an effort to try and overcome problems like these.

Peters (1964) has stated that, while certain experiences may be educative, indiscriminate experiences are not necessarily educative. Similar caution needs to be applied to fieldwork, for unless the proposed study has been carefully selected and planned, it will be of doubtful educative value.

Bruner (1960) emphasised that all learning must be designed to reveal the essential structure of a subject, its central concepts. The Pigeon Valley ecology/ecosystem worksheets used in this study have attempted to reveal in some way the central concepts of environmental education.

The Pigeon Valley worksheets have also attempted to show that Hutchings' (1962 in Webster, 1979, p.23) suggestion that a programme of field studies should advance gradually from field teaching (primary school level) to fieldwork



(junior high school level) to field research (senior high school level) has been complied with in this study.

The South African Council for the Environment's 1988 Report of the Committee for Environmental Education sees the teaching of environmental education in the following way:

In earlier societies, and still today in large sectors of preliterate rural communities, man's preparations for adult life involved an intimate practical experience of life. Educational philosophers such as Rousseau, Pestalozzi, Herbart, Froebel, Spencer, Dewey, James and Thorndike have all stressed the importance of practical learning with concrete experience. Many modern curricula tend to stress abstract knowledge, but because of the environmental crises, the need to teach with a practical holistic and environmental emphasis has become urgent and imperative (p.4).

This study has made an attempt at progress in the achievement of the above.

#### Opportunities for environmental education in the new high school geography syllabus

Nightingale (1985 a) has stated that the new school geography syllabus disappoints in that it does not go far enough to capitalise on recent developments in the subject. This missed opportunity Nightingale ascribes to the direct result of poor curriculum research and syllabus revision. Be that as it may, the syllabus does incorporate a tentative attempt at environmental education with its section on 'Ecology, Environmental Balance and Conservation'.

In another article Nightingale (1985 b) states that, of necessity, when considering the new syllabus pupils must be encouraged to examine environmental issues. Education has a vital role to play in confronting people with environmental problems and their implications. By directing attention to real problems and manifestly important issues, Nightingale believes that education for environmental concern will not suffer, as does so much teaching, from appearing to be irrelevant. The distinguishing contribution of environmental education to a pupil's education is seen by Nightingale as the promotion of a feeling of concern for the quality of life and a commitment to environmental conservation. Pupils must be prepared for their future roles as participants in environmental decision making. The aim of all environmental education taught in school and any related fieldwork which may be done must be towards the development of values education in the pupils, the creation of right attitudes towards the environment and a commitment to an environmental philosophy.

Just how the above can be achieved is a difficult question to answer. Burton (1985) believes that with imaginative teaching and a belief in Preston-Whyte's (1983) ideas on environmentalism as a paradigm for geography, progress will be made towards the achievement of a state of environmental ethic in our pupils. Meadows (1985) says that: 'Geography is in danger of disintegration' (p.12)

with the physical and human components drifting apart. Preston-Whyte (1983) sees geography's greatest value as lying in its ability to straddle the natural and social sciences. He calls for environmentalism to be seen as the cement between man and his environment. The concepts of ecology and ecosystems are inherent in the concept of environmentalism, as spelt out by Preston-Whyte and based on the writing of O'Riordan (1976; 1981). As such they provide the geographer with a means of moving from a simplistic notion of man and his relationship to his environment to one in which description, explanation and prognosis are central concerns of enquiry. Participation in issues of resource management and assessing man's impact on the environment therefore become important issues in geography, which they should be if environmentalism is to be the central core of the new school syllabus. Fincham (1985) continues: 'Such concerns, if handled well - and the ecological perspective should help us - will make geography a more sought after subject at school, at universities and by clients in the community who will value the contribution that geography can make to conflict resolution in our intricate, complex world' (p.13).

Preston-Whyte's (1983) suggested restructuring of the high school geography syllabus from the present structure (Figure 14) to the suggested model (Figure 15) attempts to establish coherence of the syllabus in a logical,

sequential manner with interconnections providing continuous feedback between course elements. This feedback is the mortar which binds the structure, and represents environmentalism.

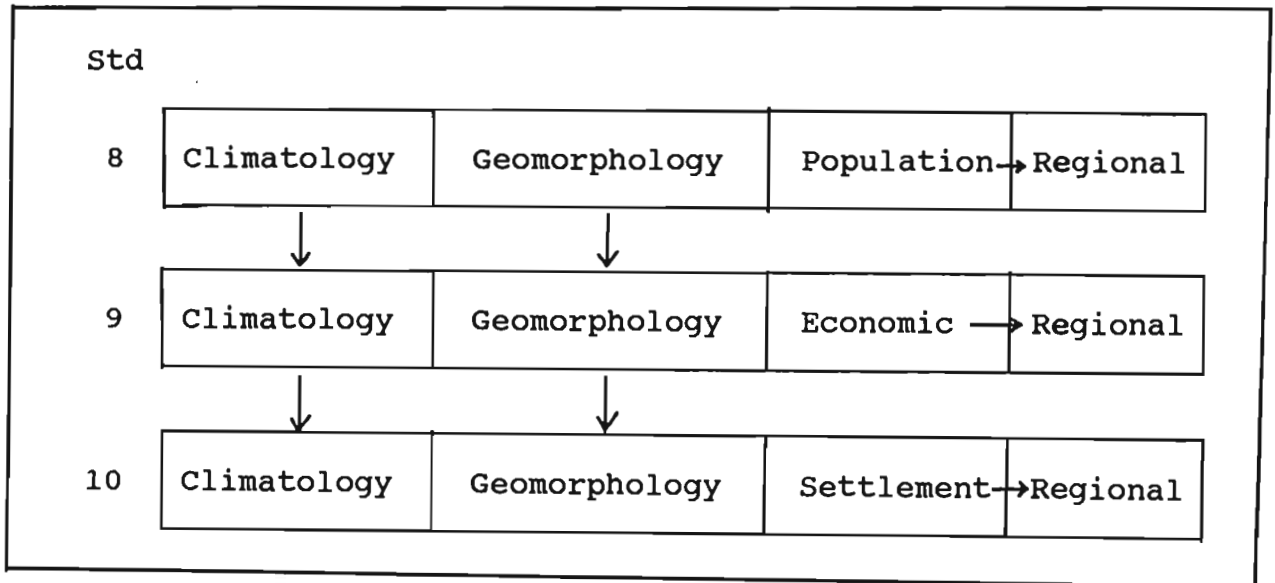


Figure 14: Structure of the core geography syllabus for Standards 8, 9 and 10 in white South African schools.

Source: Preston-Whyte, 1983, p.7

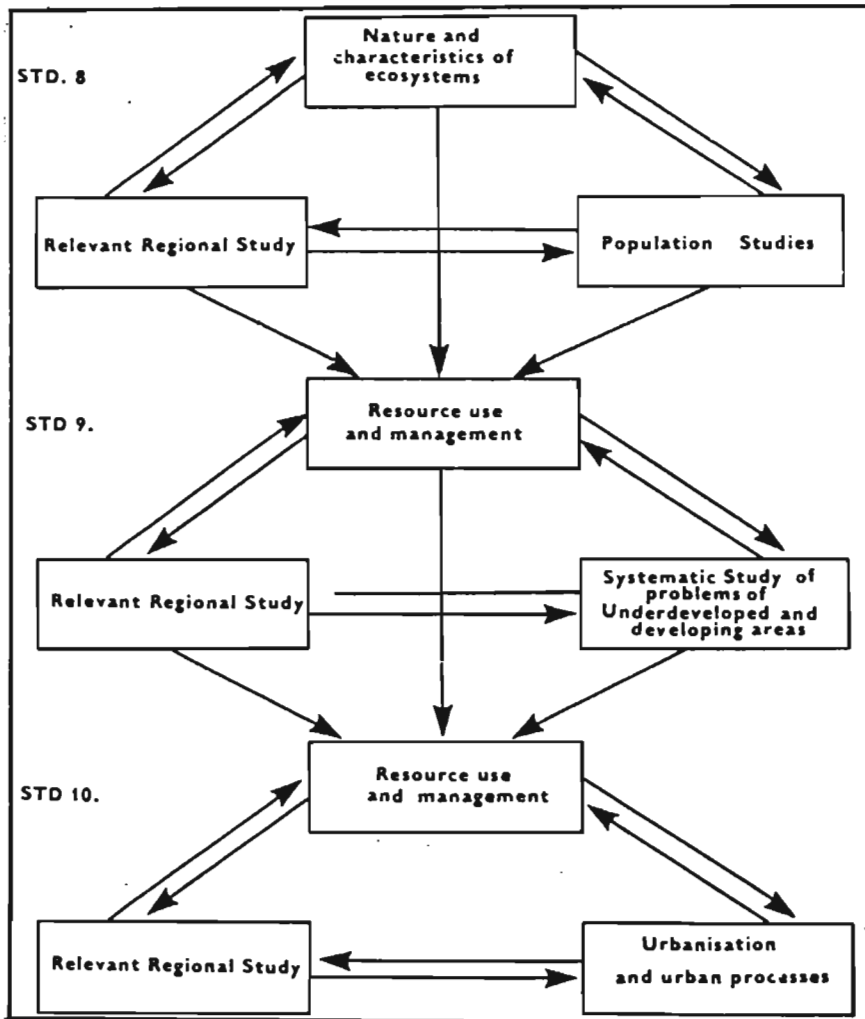
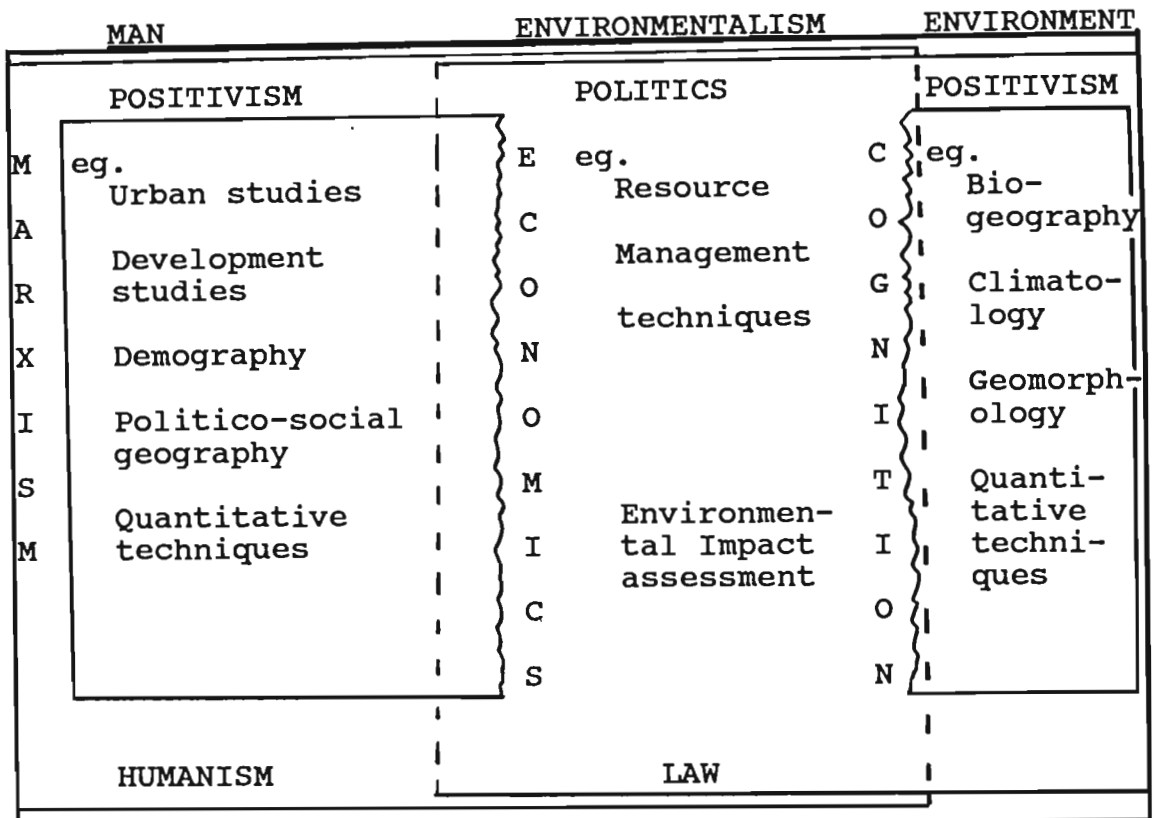


Figure 15: A restructured geography syllabus for Standards 8, 9 and 10

Source: Preston-Whyte, 1983, p.8

Figure 16 below illustrates Preston-Whyte's (1983) rendition of the place of environmentalism in geography.



**Figure 16:** The location of environmentalism in a geography syllabus

Source: Preston-Whyte, 1983, p.9

Nightingale (1985a) has bemoaned the fact that South African geographers, especially those involved in syllabus and curriculum design and structure, have not responded to Preston-Whyte's challenge. However, his lead has indicated that we can, through an ecocentric approach, teach environmental geography and the new syllabus encourages us as teachers to do so. The development of an ecological fieldwork programme in Pigeon Valley is an attempt at teaching environmental geography through the

ecocentric approach.

The Natal Education Department (1984) has stated the importance of fieldwork and environmentalism in high school geography teaching in Natal:

- a) the importance of the earth-science component as one of the major traditions in geography
- b) provision must be made for the practical aspects of the subject
- c) fieldwork techniques: using either the traditional (survey) or the scientific approach is a skill which geography must encourage
- d) in order to heighten the pupils' perception of their environment, it is necessary for them to, among other things, recognise the relationships that exist between people and their environment
- e) pupils need to develop an environmental awareness. They need to feel a commitment towards the environment by developing a caring attitude. This means they are expected to:
  - i) recognise the need for conservation
  - ii) understand that the balance of nature is largely dependent on man's wise management of his environment . Pupils should be aware of how man uses/abuses his environment, particularly the resources available to him; the options and constraints that are placed on his actions
  - iii) realise that the quality of life is influenced by the aesthetic aspects of man's environment as well as by an appreciation of the grandeur and wonder of Creation
- f) regarding the systems approach to teaching:
  - i) it is recommended that teachers introduce the concept of systems into their teaching

- ii) pupils should be aware that geography encompasses the study of a very complex man-environmental ecosystem. This complex system is broken down into a number of sub-systems to facilitate its study.
- g) An inter-disciplinary approach is required with concepts studied in geography overlapping with those of other subjects, particularly biology, science and economics
- h) pupils should be trained in the scientific method of inquiry (*i.e.* statement of hypothesis, followed by the collection and classification of information and finally the testing of the hypothesis)
- i) teachers must ensure that pupils become competent in the use of various measuring instruments and other apparatus
- j) pupils must undertake well planned and meaningful fieldwork including observation and measurement in the field, the recording and processing of data, the interpretation of written and graphical information
- k) pupil involvement is seen as important in fieldwork and pupils should learn to rely on personal observation in the field as the primary source of information collection (pp.2, 4-8)

The South African Council for the Environment's 1988 Report of the Committee for Environmental Education in a section on teaching strategies for environmental education, states the following:

Techniques for secondary education

In the secondary phase of education the provision of environmental knowledge, the development of positive environmental attitudes, and the encouragement of positive environmental behaviour are achieved through both structured and unstructured teaching. Various school subjects are used to develop environmental awareness in pupils.



Effective environmental education should place equal emphasis on both environmental structures and processes, with pupils being encouraged to understand those elements which affect the nature and quality of the environment. A knowledge of basic ecology is the basis of approach, with relationships between biotic and abiotic elements being stressed. Particular emphasis should be placed on the "balance of nature" within natural systems and pupils should examine the effects of human activities on this balance.

While it is obvious that geography and biology are good subjects for developing environmental knowledge and positive environmental attitudes, all high-school subjects should be used to do this. The languages offer unlimited opportunities during reading, oral and writing sessions. Art is an important vehicle in sharpening sensitivity to the colours and textures in the environment, as well as deepening awareness (through direct observation) of environmental problems. Technical subjects are wide open for use in creating environmental concern, while subjects such as history and economics are obvious vehicles for developing knowledge and awareness of the influence of historical events and economic processes on the environment.

#### Fieldwork and practical work

Fieldwork and practical work are essential parts of the environmental experience. Such experience should develop skills of observation and note-taking, and should encourage positive environmental attitudes and behaviour in the pupil.

One of the guiding principles for effective environmental education is that pupils should be involved in problem-solving situations. Whether you teach biology or geography, history or english, encourage your students to look at environmental issues objectively, to analyse problems, and to seek ways and means of achieving solutions (p.9).

When discussing the geography syllabus specifically it continues:

#### Junior secondary phase

In addition to the aims which are basic to the senior primary phase, the introduction to the junior secondary syllabus, specifically and by implication encourages environmental concern. The basic

objectives of the course are the development of knowledge, skills, perception and appraisal of the pupil's environment. Specifically included in the objective of appraisal is the objective that pupils should develop an environmental awareness. They need to feel a commitment to the environment by developing a "caring attitude". This means they are expected to:

- (a) recognise the need for conservation;
- (b) understand that the balance of nature is largely dependent on man's wise management of his environment.

In the teaching guide-lines, the inter-disciplinary approach is encouraged.

#### Senior secondary phase

The aims of this section of the course are as for the senior primary and junior secondary phases. Pupils are more mature, have a sound foundation of skills and knowledge and have a wider perspective; it is therefore possible to do some fairly advanced work. At this level, geography is an optional subject and a high standard should be maintained (p.16).

In conclusion, the report states:

From the above it is abundantly clear that teachers have, in the two courses which have been analysed, perfectly adequate vehicles for thorough environmental education. By the time pupils have completed these courses, they should have a full understanding of the environmental problems they will have to live with and help to solve. They will have enough knowledge, skill and perspective to understand the implication of the world and the South African Conservation Strategies and have developed attitudes and concerns which will motivate them to help in the implementation of these strategies.

1. Teachers must bear in mind that all pupils in the Republic are compelled to follow the general science and geography courses up to Standard 7. In the senior secondary phase, geography and biology are optional subjects, but biology is by far the most popular option and most of the pupils will take biology or geography and many will offer both subjects for the Senior Certificate. All pupils are therefore exposed to at least nine years of geography and general

science while a majority of school-leavers have geography and/or biology for their Senior Certificate course.

Teachers are encouraged to employ an inter- or cross-disciplinary approach to their teaching of environmental education. This is a simple matter in the primary phases where pupils generally have only one teacher, but it requires careful planning and co-ordination between the various subject teachers in the secondary phases. Principals are encouraged to assign a senior teacher for the task of ensuring such inter-disciplinary planning.

2. Teachers are reminded that all education departments encourage outdoor education in spirit and in practice.

Departments encourage teachers to use educational facilities such as museums and nature reserves. These facilities are available to all teachers and their pupils and resident teachers ensure high quality field-teaching. In some departments a financial subsidy is available to all senior primary pupils on a per capita basis for all approved field studies and outdoor education excursions.

The Land Service Youth Movement has very direct environmental conservation goals and schools are encouraged to form Land Service clubs and to avail themselves of this organisation's fine administrative and physical facilities and the financial support which is available.

Each year the Education Departments set aside a specific conservation day when all schools are urged to conduct a special environmental conservation programme, preferably out-of-doors (p.17).

The report finally remarks:

The Council is confident that all teachers will help to develop citizens who are aware of the total environment, concerned about it and its associated problems and who have the knowledge, attitudes, motivation, commitments and skills to work individually and collectively towards solutions of current problems and the prevention of new ones. "Such citizens will be aware that they are but temporary stewards of a portion of the earth and that

it is their obligation to leave their corner of it, as far as it lies within their capability, a better place than they found it."

A prominent South African environmentalist has said: "If you are not part of the solution, you are part of the problem" (p.18).

A detailed analysis of how the above recommendations have been implemented in the ecology section of the new syllabus, as undertaken through a fieldwork programme, will occur in Chapter 5 of this thesis. Prior reading of relevant and related material before the construction of the worksheets has ensured that the spirit and intent of the Council for the Environment's recommendations have been carried through in the worksheets used in the fieldwork.

Armed with the back-up provided above in the Natal Education Department syllabus guide, as well as the Council for the Environment report (1988), geographers are encouraged to become environmental educationists and to create in their pupils a level of Ecology - a minimum level of ecological understanding. An ecolate person will be in the position of being able to 'do something at an individual level to improve or maintain the balance between quality of life and quality of the environment' (Hurry, 1987, p.5). Hurry believes that one of the best ways to achieve this will be through pupils acquiring fieldwork and problem-solving skills, working where possible in the local environment which will help them

accept their environmental responsibilities of a more universal nature. An attempt has been made in this thesis to meet this challenge through the fieldwork programme conducted in Pigeon Valley.

### Conclusion

This chapter has examined the concept of environmentalism and the area of study termed environmental education. Various definitions of environmental education were presented, together covering a multitude of meanings and intentions. Reasons for the absence of a universally acceptable definition were also discussed. For the purposes of this study two definitions similar in most respects, were accepted. These were the definition incorporated in the United States Environmental Education Act of 1970 and that adopted by the South African Council for the Environment (1984).

The chapter continued with an analysis of the aims and objectives of environmental education and examined how these varied according to the values and interests of the parties involved. The lack of a unifying environmental philosophy was seen as being detrimental to the progress of the environmental education movement. The need for more research and the development of more effective teaching methods in environmental education was highlighted. The current position of environmental education in schools, both overseas and in South Africa

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was then examined. The disappointing position in this country became apparent when it was compared to what was being achieved elsewhere. Regarding the future, it was felt that environmental education should feature more prominently in both secondary and tertiary education.

## CHAPTER THREE

### LITERATURE REVIEW

#### Introduction

Various methodologies exist which can be used to teach environmental education. Three main approaches have been identified in the literature viz. the systematic approach, the problem/issue based approach and a fieldwork-based approach, and each will be discussed in turn. A case will be made for the fieldwork approach to be the preferred methodology, using some of the vast literature available on the merits of the fieldwork approach. The nature of fieldwork will be discussed, including an analysis of the history of fieldwork in geography, the aims, purposes and values of fieldwork, the place of fieldwork in the school syllabus, the assessment of fieldwork, fieldwork approaches and the formulation of a design for the fieldwork carried out in Pigeon Valley. Various methods/techniques which have been used in the fieldwork in Pigeon Valley, including observation, use of worksheets, questionnaires and interviews, will be referred to, leading to a fuller analysis of the role of these techniques in case study research in the next chapter viz. Research methodology.

### Approaches to the teaching of environmental education

Nightingale (1986) suggests three general approaches to the teaching of this section of the new high school geography syllabus, which he sees as not being mutually exclusive:

#### a) A systematic approach

This is the approach which Nightingale believes is implied in the Natal Education Department guide for geography teachers and which he suspects will be adopted by locally produced text-books. He believes that teachers using this approach will be in danger of adopting a 'teacher tell' style of teaching with information dispensed by means of typed handouts or lectures which must then be memorised by pupils. One big advantage of this method, especially to the over-burdened teacher of matric classes, is that much ground in the syllabus can be covered quickly and thoroughly.

Modern educationists have condemned this time-honoured approach with good reason: pupils are passive recipients of information; rote learning, often with little understanding, is encouraged; there is little opportunity for reasoning; critical analysis and the development of skills is neglected and the subject matter being dealt with is often made to appear bookish, unrelated to reality and irrelevant. The biggest criticism of this method is



that it ignores the increasing stress being placed in teaching on processes. These processes are seen as the elementary skills of scientific enquiry, that is, the way that scientists (and geographers) think and operate, while discovering the facts and laws of science. Most modern educators believe that these skills or processes are more important than the acquisition of scientific products (the facts and principles).

b) A problem/issue based approach

With this approach concepts are introduced as part of the scientific underpinning required for a serious analysis of the environmental issues which confront mankind today. Through a study of the ecological concepts the pupils are in this way prepared to tackle the analysis of various environmental problems and issues. Nightingale gives two examples to illustrate this approach:

First, the use of dieldrin spray to eradicate tsetse fly in Botswana. Concepts: ecosystem, food-chains, persistent pesticides, half-life trophic levels, interference in ecosystems, destruction of ecological processes. Ethical and management considerations, economic development and conservation of natural resources.

Second, the replacing of natural forest with gum and pine plantations in the St. Lucia area. Concepts: the dynamics of an ecosystem, distinction between open systems and cybernetic systems, energy flow and nutrient cycling. Biotic communities, biome, habitat, niche, stratification, ecological succession, productivity (gross and net productivity). Factors influencing the stability and instability of ecosystems. Production systems, young ecosystems, reasons for and dangers associated with the intensive manipulation of systems, irreversible biological impacts (pp.1-2).

These examples demonstrate how much of this section of the syllabus can be covered using this approach. Nightingale lists numerous advantages which can be advanced in favour of this approach:

1. The relevance of this section of the syllabus is apparent. Pupils are confronted with real and important issues.
2. Concepts and models are used in order to obtain a greater understanding of issues under study. They are not likely to be seen by the pupils as theoretical abstractions which are of only academic interest.
3. Pupils are encouraged to adopt a scientific approach to their investigations. Problem solving will often entail the formulating and testing of hypothesis. They are thus being encouraged to develop research techniques and skills and thus begin to think like scientists.
4. Enlightened educationists stress the need to move away from the rote learning of factual information. This problem solving approach is didactically sound.
5. In all probability the examination questions on this part of the syllabus will include a large element of problem solving.
6. Text books and other reference material would be used as a resource, rather than followed slavishly, if this approach were adopted.
7. Real understanding of the underlying principles is encouraged, rather than the memorisation of half-digested factual information (p.2).

Nightingale concedes that this approach is not as tidy as the systematic one, and that careful planning is required to ensure adequate covering of each of the concepts that are likely to be examined.

c) A fieldwork-based approach

The big advantage put forward for this approach is that much of the ecology course in the new syllabus could be based on fieldwork carried out either in the school grounds or at no great distance from the school (e.g. at a nearby natural area, like Pigeon Valley). A larger scale fieldtrip to an ecologically more diverse area such as St. Lucia on the Natal north coast would not be really necessary but could be undertaken as an optional excursion run by, for example, a school's geography or outdoor society.

A feature of the fieldwork approach is that it could be directed towards the resolution of environmental problems, and the investigation of environmental issues affecting a particular area eg. Pigeon Valley, thus many of the arguments advanced in favour of the problem solving approach could also apply to fieldwork.

Nightingale discusses the advantages of using the fieldwork approach:

a) Fieldwork is an integral part of all natural and social sciences, providing as it does a training in the methodology of the natural sciences and, indeed, in scientific method.

b) Fieldwork lends itself to discovery learning. Pupils are confronted with situations in which they suggest problems to be solved and propose methods of solution.

c) Field studies are an important means of developing the critical faculty of pupils. Very often pupils are spoon fed with ready made concepts, generalisations and conclusions which they accept unquestioningly. Pupils must be encouraged to formulate their own generalisations and conclusions based on a study of the environment as their primary information source.

Documentary material, statistical data, maps and photographs should provide a secondary information source.

Nightingale lists a number of important lessons which pupils will learn if they gain information at first hand:

- i. They will realise that for the natural scientist the field is a laboratory, and that fieldwork equates with laboratory work (Marker, 1970).

Pupils will learn how to obtain information for themselves, to go out into the field and observe, count, record and process data. Thus they will begin to develop the skills of the research workers who obtained the information which is now in their textbooks.

- ii. They will become aware of how easily inaccuracies creep into scientific work (a salutary lesson), that wrong conclusions may result from inaccurate or faulty 'factual' information. That the accuracy of a set of statistics may be effected by the expertise, prejudices or conscientiousness of enumerators. They will realise how approximate many statistics are and how quickly they date. Thus through fieldwork they develop that critical

attitude which is the hallmark of a mature educated person.

iii) Fieldwork also assists pupils in gaining a genuine understanding of terms and concepts which they may otherwise use with little understanding. Introducing them to concrete examples provides them with a ready frame of reference and assures common standards of comparison within a group. Terms like undulating or open woodland may mean different things to different pupils. Indeed some phenomena can only be appreciated when viewed at first hand. One of the tragedies of schooling is the barrier between the accumulation of facts in the classroom and their meaning in the field (p.3).

d) Field studies enable geography teachers to make their subject come alive for what is learnt rests upon the foundations of reality.

e) Training in intelligent observation of the environment, which fieldwork provides, is an important part of a child's education. In several other important respects fieldwork constitutes sound educational practice.

As Marker (1970) stated:

It has been established that learning is most efficient when the three faculties of hearing, seeing and doing (or experiencing) are brought into play, thus practical work is the most efficient teaching method, and it follows that time spent on fieldwork is time well spent (p.773).

f) Fieldwork gives the opportunity to begin with a particular observation and thus to retain a sense of adventure. It is sound educational technique to begin with the local and the familiar before going on to study

subjects outside the pupil's experience (Long and Roberson, 1966). Furthermore, in the field, children learn by actively doing things, an idea which epitomises much of what John Dewey believed in. The element of discovery and the opportunity to use their own initiative and ingenuity both add to the interest and value of fieldwork. Also, field studies lend themselves to group and project work allowing pupils to work at their own speed and to develop a sense of responsibility.

g) A number of other spin off benefits can also be claimed for fieldwork. Nightingale lists them:

It can lead to improved teacher pupil relationships, offer the occasion for healthy outdoor exercise, introduce pupils to new and worthwhile leisure activities, play a part in character building and be a means of introducing the town child to the countryside and the town to the plattelander. Some fieldwork can also have a vocational aspect as people are observed in various types of employment (p.4).

These spin off benefits on their own provide a justification for the use of a fieldwork based approach in geography.

Many writers who are concerned with the broader aims of environmental education consider fieldwork to be an important means of furthering their aims. Fieldwork is seen by them as playing an important role in producing in pupils a concerned interest in the environment in which they live, which hopefully will mature into a commitment

to conservation and a sense of responsible citizenship, this surely being the ultimate aim of any geographer in the field of environmental education.

With careful advanced planning geography teachers can incorporate a fieldwork programme into their lesson preparation so as to ensure that, due to time and work pressures, they do not lapse into the rut of the systematic approach to teaching this so vital, dynamic section of the new syllabus. Problem solving and the examining of local environmental issues must be incorporated into the fieldwork done, this providing a challenge to pupils and teachers alike.

#### A brief history of the fieldwork tradition in geography

The fieldwork element in geography has been present since the earliest days of teaching the subject. Wise (1948 in Goodson, 1983, p.70) uncovered a range of experiments in teaching geography through a fieldwork approach in early nineteenth-century English schools where the intention was to broaden out from detailed studies of the child's immediate environment into studies of more extended geographical areas. According to Goodson (1983) this pioneering work in English schools as well as later work in German schools influenced the Royal Geographical Society's Inspector of Geographical Education, Dr. J.S. Keltie, in the 1880s to record that the school boards in

London, Birmingham, Edinburgh and Glasgow employed and encouraged methods in geographical fieldwork.

From the late nineteenth century, school teaching of geography continued to employ local field studies and to extend their use. Often the approach has been most favoured among younger children, in elementary and primary schools. It was seen as important that young children study more and more out of doors and that there should be a concentration on the child's immediate environment and neighbourhood in these studies. Geography was seen as the key-subject offering pupils the chance of studying the local environment in all its details.

The establishment of fieldwork geography in the secondary school was closely allied with developments in the universities. According to Goodson, as early as 1896 Herbertson carried out experimental field classes with school children in Edinburgh. Later at Oxford, Herbertson and H.J. Mac Kinder organised field courses for teachers in the years 1906-14. These two pioneers of geography teaching derived much of their ideas and writing from Sir Patrick Geddes (1854-1933) who, in turn, owed much of his work to the early French sociologist, Frederic Le Play (1806-1882).

The other external influence which provided a stimulus to fieldwork in geography was the work of the university



field geologists at the turn of the century. Their efforts assisted fieldwork to become widely advocated by university geography departments in the period following the Second World War. This positive attitude to fieldwork rubbed off on the schools and in 1947 the Ministry of Education issued circular 140, revoking the regulation by which the consent of Her Majesty's Inspectors was necessary for all secular instruction given off the school premises, and expressed the hope that Local Education Authorities would make this extended freedom a reality. Educational visits were encouraged, and financial help, though never plentiful, became more readily available.

It was significant of the increasing emphasis placed upon fieldwork in universities, partly through the good work of people like Wooldridge and Hutchings, that in 1961 Hutchings' work in this sphere was recognised by his election to the Presidency of the Geographical Association. Progress in schools was slower for as the Department of Education and Science reported in 1972: 'In spite of constant advocacy by leading teachers for over 40 years, fieldwork held an uncertain foothold in school geography until the 1950's (cited in Goodson, 1983, p.72). However, from this date onwards, progress in school geography fieldwork was rapid and various professional bodies such as the Field Studies Council, Royal Geographical Society and the Geographical Association

worked to establish facilities for fieldwork.

By the 1960s the far greater support for fieldwork could be gauged from the increasing number of publications which provided the growing number of enthusiastic teachers with a wide range of ideas on how to carry out successful fieldwork. This study has utilised a fair number of these publications to provide information on geographical fieldwork and its conduct, and has applied where applicable what was read in these publications into the Pigeon Valley fieldwork exercise.

By 1969 fieldwork was clearly well established in many schools. John Everson (1969) confidently noted that: 'it is a truism to state that the campaign to put fieldwork in the mainstream of school geography is now over' (cited in Goodson, 1983, p.72). He went on to define the progress that had been made by fieldwork in teaching and examinations:

Since the war, increasingly, its place has been recognised and accepted by most students and teachers. There is now a large and growing body of literature describing field techniques and areas in Great Britain and abroad in which these techniques can be used. Examination authorities, such as Oxford and Cambridge, Cambridge and Associated Boards, put considerable emphasis on fieldwork at Advanced level. In these and other examinations questions are set which require from the student practical experience of work in the field if a satisfactory answer is to be written. The C.S.E. boards are even keener to promote this type of work and in some cases fieldwork is a compulsory part of the examination (cited in Goodson, 1983, p.72).

Fieldwork's progress at the time can be further gauged by the following quotation:

In 1972 the Department of Education and Science survey of schools found that only 8 percent of the schools did not carry out fieldwork, whereas 80 percent regarded it as important or very important (Goodson, 1983, p.72).

This growing interest in fieldwork was also found to be occurring in the universities.

In spite of these widespread indicators of acceptance in the academic sectors of the secondary schools and the universities, a number of fundamental problems regarding fieldwork arose and have remained unresolved. These include practical difficulties, as Everson concedes (1973):

The organiser has to find time to organise and prepare for the trip; to justify to himself and, more importantly, to others, the loss of actual school teaching time, especially for classes preparing for public examinations, to find suitable staff for the work, to keep the costs down ... The 1972 Department of Education and Science survey found that:

In 54 per cent of the schools visited the timetable created difficulties and the problems appeared to be more severe in the grammar than in other types of school. Put in another way, fewer than half of the schools possessed sufficient flexibility in timetabling to permit educational activities widely acclaimed to be valuable for pupils of all shades of ability ... many schools overcome their difficulties by conducting fieldwork at weekends or in school holidays.

The report adds, ominously with regard to the ensuing wave of cuts in educational expenditure, that about 42 per cent of the schools reported difficulties in financing fieldwork (cited in Goodson, 1983, p.73).

Problems such as these have also been experienced at university and college level. Other problems such as difficulties linked with the supposed generalisations present in fieldwork and a supposed lack of a scientific basis are seen by many as the main problems facing fieldwork. In recent years attempts have been made to counter these latter mentioned accusations by developing a model of 'field research' to be used by pupils in the field. This method focusses on the process of hypothesis formulation and testing, leading to the provision of theories. This more scientific approach is advocated later in this chapter for the more senior years of the secondary education phase. Schools, however, have been a bit slow to use this approach with most still using field teaching and traditional fieldwork methods. The unfamiliarity of many geography teachers with the use of the field research approach is seen as the reason for this situation.

As Boardman (1974 in Hall, 1976) has commented, in planning fieldwork teachers must begin by defining objectives from within the constraints imposed by the fieldwork to be conducted. In this way the teacher can then ensure the success of the planned fieldwork and assist the pupils under his/her care to experience the real world of geography outside the confines of the classroom.

The acceptance of fieldwork as an appropriate method of teaching geography, even though problems do exist, seems to be revealed in the discussion which has taken place so far. This study recommends the use of fieldwork in geography teaching and its full implementation by teachers in their teaching programmes.

#### The aims, purposes and values of fieldwork

The development of fieldwork as a major part of geographical study is probably the greatest change in the subject which has occurred in post-war years. Much, if not most, geographical research depends upon it or includes it. Fieldwork is seen as an important means to achieving the purpose of geography viz. the study of man in relation to his environment in its various aspects - physical, economic, social etc. Bailey (1987) argues that for pupils to understand the realities of their environment, there is no substitute for first-hand experience.

Many of the advantages of fieldwork were discussed earlier in this thesis but will be expanded on at this point. Webster (1981) reinforces the advantages of using the fieldwork approach, as discussed earlier by Nightingale by seeing the value of fieldwork as lying in:

1. teaching the pupils how to apply the theoretical knowledge they have learned in the classroom

2. teaching pupils the methods used by the research geographer so that the link with the advances at the forefront of the subject are maintained
3. allowing pupils to discover geographical principles for themselves, a process called 'experience-centred education'
4. motivating the pupils to further work in the classroom through the excitement of their own discoveries in the field (p.4)

Webster continues: 'The value of fieldwork lies in making the pupil think like a geographer through enabling him to experience the activities of a geographer. This requires a build-up of skills and techniques which can only be achieved through a programme of regular discovery experiences in the field' (p.5).

Webster warns that there is no point in studying something trivial in the field simply to say that a field study has been done. The field study must be sufficiently motivating to keep groups of pupils working without the constant attentions of the teacher. Webster believes that the best way to achieve this is to make the field study an investigation of a hypothesis. Two such exercises are contained in the senior worksheets prepared for the Pigeon Valley fieldwork case study. Such investigations give pupils an exciting sense of discovery, however, it must be borne in mind that the pupils must consider the investigation as relevant and worthwhile so as to motivate them to do the necessary work. Webster warns teachers that the last thing they must do is destroy pupil

enthusiasm which accompanies the pupil's own discovery. Teachers must beware of dominating the study outdoors in an effort to ensure that the pupils learn what it was intended that they learn, for this can create opposition to outdoor learning experiences.

Morton (1969) is another who favours the use of a fieldwork approach and urges more fieldwork to be done in South African schools, pointing to the much greater emphasis placed on it in British schools. He lists six main aims of fieldwork:

1. It gives reality to a subject that can only too easily become a list of specialised phrases, such as scarp, undercut slopes, thornveld, and so on.
2. It appeals to the children's sense of adventure and exploration and, in doing so, heightens their interest in other aspects of their study.
3. It is one of the fundamental geographical processes, used by most geographers engaged in research.
4. It strengthens and adds purpose to map reading, particularly the interpretation of contour maps and at the same time gives meaning to land-use maps by showing how generalised they can be.
5. It helps children appreciate relationships which are after all the essence of regional geography.
6. It develops the ability to view a landscape with the discerning eye of a geographer - a gift that could enrich travel in later life (p.519).

Nightingale (1981), as already referred to in his 1986 article earlier in this chapter, is another geographer who sees much value in field work. He states:

The main aim of such an exercise is to promote in pupils an awareness of their environment. Having had their eyes opened to the richness of a locality with which they are familiar, and which they may well have taken for granted, it is to be hoped that they will begin to look with new interest at other areas. It has been well said that 'sight is a faculty but seeing is an art'; one of the major objectives of geography teaching is, surely, to enrich our pupils' lives by encouraging them to be observant. So many are oblivious to the rich variety, and the inherent interest of their surroundings. Furthermore, it is to be hoped that, by interesting pupils in a part of the landscape that forms a backdrop for an important part of their lives, they will begin to cherish it, and to feel a measure of responsibility for it. This is character training. An obvious spin-off is pride in the school and a sense of belonging to a community. A deliberate attempt has been made in these exercises to include open-ended questions which raise issues that have wider implications (p.288).

Long and Roberson (1966) cite two pieces of research which contribute evidence to the value of fieldwork in geography viz. those by Oliver (1948) and Ware (1956) in Britain:

Oliver and Ware both investigated the relationship of fieldwork to geographical studies and found similar results. Oliver's test population were training college students, and Ware's third form grammar school boys. Both used control groups which were pursuing a similar course of studies without fieldwork. Oliver's excursion programmes were designed to promote the understanding of geographic concepts and principles and not merely to increase knowledge of the districts visited. The results of his tests show that the effect of outdoor work in geography upon attitude is more immediate than that on attainment. The effect of observational work on the youngest students was most noticeable. Ware, too, found no great improvement in academic performance, except in map work, but considerable improvement in attitude. The boys who were least favourably inclined towards geography at the outset derived most benefit from the excursions as far as attitude was concerned. The average boys made most advance in attainment. That fieldwork improves the



attitude of the average child towards the subject study is further evidenced in the biological field research of Pheasant. In these days, when the motivation of learning through emotional appeal is sought, a favourable attitude is seen to be the first requisite of learning (p.131).

Bailey (1987) is another geographer who advocates where possible the use of the local environment when doing fieldwork in order to:

- (i) familiarise pupils with the geography of their environment
- (ii) enable fieldwork to be undertaken fairly frequently
- (iii) to make the best use of time and financial resources available (p.1)

He continues by stating that fieldwork conducted at some distance from the pupil's school runs the risk of inadvertently teaching pupils that geography happens elsewhere. He concedes that some localities may be richer in terms of opportunities for fieldstudy, but that most geographical concepts can be adequately studied in one's local environment. This applies particularly to certain areas of the syllabus such as environmental/ecological studies.

To conclude this section attention should be given to Bennett, D.B. (1974) who stated that any environmental experience, like a fieldwork exercise, should include three broad categories of activity viz.:

1. Environmental discovery and inquiry

The students gather and compile data and facts about natural and man-made environmental components and their related social, political and economic aspects.

2. Environmental evaluation and problem identification

To evaluate the data and give meaning to it. Answering these questions:

How well are human and ecological needs being satisfied?

How can the environment be maintained/or improved?

3. Environmental problem solving

- selecting and defining an issue
- inquiring to become informed about the problem through investigation
- determining alternative solutions to the problem
- evaluating the consequences of solutions and choosing a solution
- developing a plan of action

(cited in Opie, 1979, pp.24-25)

Opie (1979) states that an environmental experience, like a fieldwork exercise should be seen as part of Bennett's Environmental Education Model (Figure 17) with its components of environment, values and behaviour interacting with each other so as to create an affective-type environmental encounter. The end result of all this is that pupils should, after experiencing environmental fieldwork in an area like Pigeon Valley, have been

involved in:

- a) discovery and inquiry
- b) evaluation and problem identification
- c) problem solving
- d) value clarification
- e) attitude formation
- f) moral responsibility, for such fieldwork to have been successful.

Bennett's work in this regard should be borne in mind as providing a theoretical framework within which environmental activities, such as fieldwork, constitute a valuable environmental experience.

#### The place of fieldwork in the school syllabus

Webster's (1979) comprehensive study of the position of fieldwork in Natal schools was prompted by the unsatisfactory nature of field study planning in Natal at that time. He found that whilst schools occasionally conducted geographical field study excursions, he was unable to discover one Natal school with a comprehensive field study programme which was integrated with the teaching of geography in the classroom. Based on the writer's personal knowledge of the present-day position in this regard in Natal high schools, it is felt that the position has probably not changed very much. This unsatisfactory situation exists even though the importance

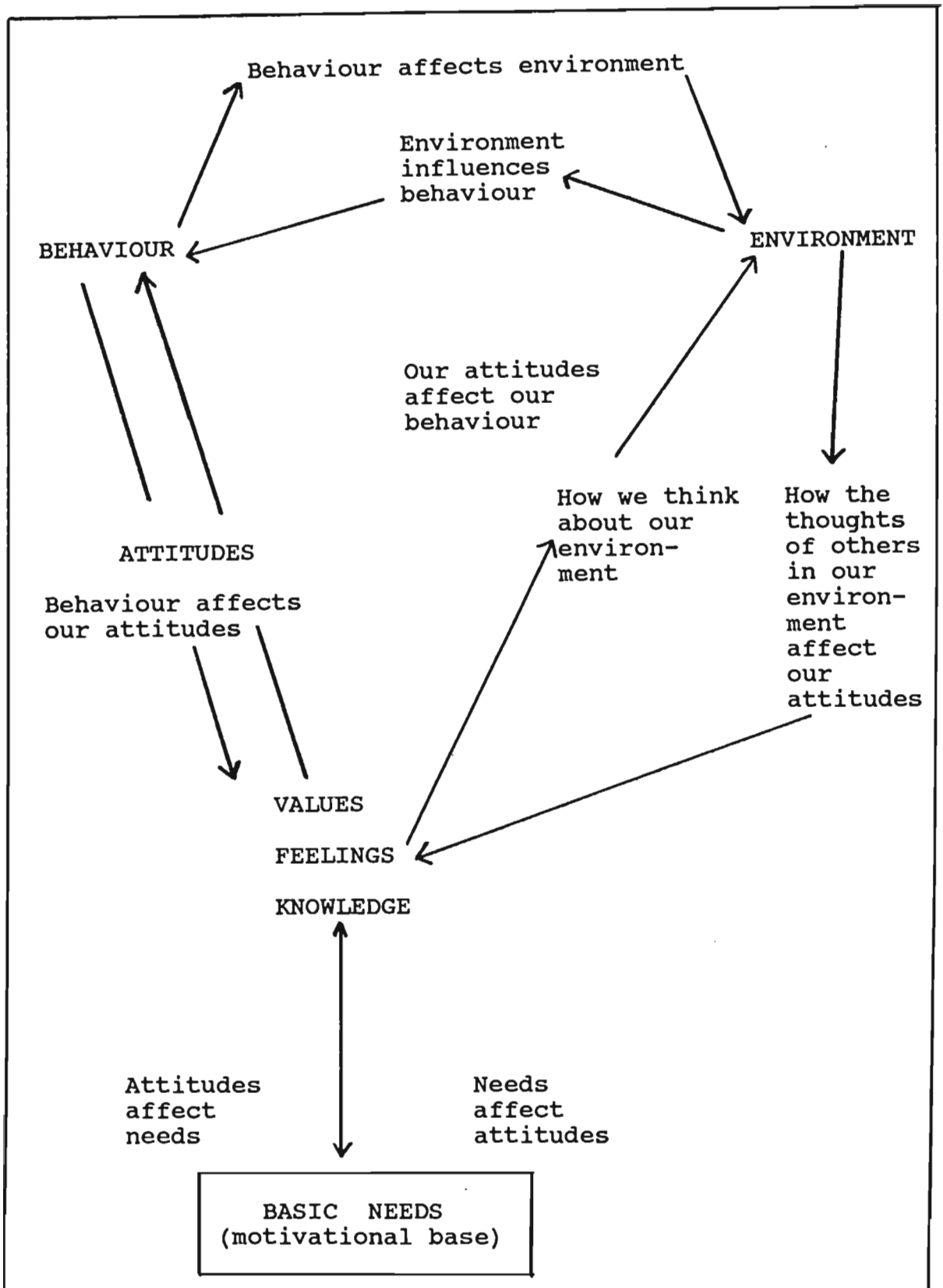


Figure 17: An environmental education model  
 Adapted from: Bennett D.B. (1974)  
Source : Opie, 1979, p.68

of fieldwork in teaching geography effectively is now widely acknowledged. Studies have revealed that active experience in the field is a more fruitful form of learning geography than the more passive methods of learning characteristic of the classroom. Webster continues by quoting the work of such respected writers in education and in geography as Skinner, Dewey, Peters and Everson in arguing that in geographical fieldwork, as in any other form of learning, intrinsic motivation is more effective than extrinsic motivation. Webster recommends the design of field study programmes, wherever possible, to test hypotheses which have been put forward, as the best form of intrinsic motivation for pupils. He sees this as providing the pupil with the satisfaction of solving a problem as well as the stimulation of possible error in the solutions arrived at. Also, problems and hypotheses being investigated must promote an understanding of the key concepts or what Bruner (1960) called the structure of the subject. He goes on to support Hutchings (1960) and Peters (1964) in their argument that until the pupil has mastered the skills and techniques required in a subject, and grasped the essential meaning of the subject, active instruction on the part of the teacher is required until, with greater pupil competence, teacher supervision can slowly recede.

Webster goes on to review in some detail the opportunities and limitations in geographical fieldwork created by curricula and syllabi in Natal, in particular at the secondary level. He examines the potential for fieldwork presented by various areas of the geography high school syllabus viz. map reading, geomorphology, settlement geography and meteorology. Nightingale (1977a) and Marker (1970) are other geographers who have identified different areas of the syllabus as having particular potential for fieldwork. The area of biogeography (including ecology) has been identified by all three writers cited above as having particular potential for fieldwork. Webster (1979) has provided a programme of biogeographical field studies and practical exercises for Natal schools while Nightingale (1981) has listed a series of ecological studies which could be incorporated into high school fieldwork programmes.

Marker (1970) also sees the area of biogeography as lending itself to fieldwork and makes a few practical suggestions which serve as examples of just how much of the syllabus content can be covered:

One of the most instructive exercises is to select a slope of variable relief and vegetation and to study it with three small groups, one to level the slope, one to record soil depth, colour, texture and pH and the last to record vegetation type and percentage cover. This information amalgamated on one profile can lead to very instructive discussions on the importance of gradient in governing soil depth and thus vegetation growth. The lack of botanical

knowledge is no reason for ignoring this aspect of geography. Plant communities can be described in general terms as grassland, forest or scrub. The life forms can be applied with no knowledge of technical terms. Simple concepts such as percentage cover (bareground susceptible to sheet wash estimated using a foot quadrat), can be introduced. The size of a tree canopy can be measured and its effect on light gauged with the aid of a light meter (p.774).

The tremendous potential for educational fieldwork has been demonstrated by various geographers in their development of local trails. Examples include Ballantyne and Attwell's (1985) Wynberg Village Trail and Nightingale's (1977a) trails in the Westerford School grounds in the Cape and in the vicinity of the Rondebosch Boys' High School in Cape Town. Nightingale's thesis (1977a) actually contains a suggested fieldwork syllabus for use by the latter mentioned school, as well as a proposed restructured standard eight syllabus to include an ecology/ecosystems component.

Work such as the above shows that fieldwork is an accepted teaching technique and has definite educational value. South African geography teachers now need to follow the lead given by their overseas colleagues or else they will find South African school geography lagging behind. Geography teachers in Natal can take the lead in this regard and should feel the need to do so. The pioneering work of Webster and Nightingale needs to be built on and developed.

### The assessment of field studies

Work by Nightingale and Webster (1981) has shown the importance of assessing fieldwork done by the pupils, for they warn that should it not be done, the field study component of the syllabus would risk becoming an optional extra, disregarded by the pupils and sometimes, especially when under pressure, omitted by the teacher. They state that in assessing fieldwork it is important that the teacher be clear about his objectives. They suggest a hierarchical list of objectives (based on Bloom's (1956) Taxonomy of Educational Objectives - Cognitive Domain) which provides a framework for the assessment of fieldwork and practical work. Bloom's taxonomy identifies six levels of cognitive operations viz.:

1. Knowledge (recall)
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

The suggested hierarchy of objectives for the assessment of geographical fieldwork (Table 3) showing the importance of a graded structure of assessment objectives is also partly based on the following hierarchy of assessment



science in the United Kingdom:

- (1) skill in observation and recording of observations;
- (2) ability to assess and interpret the results of practical work;
- (3) ability to plan practical procedures and techniques for solving particular problems;
- (4) manipulative skills;
- (5) attitudes towards practical work, including such attributes as persistence, enthusiasm, originality and enjoyment (cited in Nightingale and Webster, 1981, p.23).

Nightingale and Webster (1981) state that: 'it is important that the teacher relate the skills he expects his pupils to display with their developmental level as well as their intellectual level. As a pupil gains experience in fieldwork so his ability to attain higher objectives can be assessed' (p.27). They also put forward a suggested scheme of elements which should be included in fieldwork assessment. They argue: 'that the assessment should consist of examination and test questions as well as assessment of performance in the field. Examination and test questions should be as specific as possible and should be related to theoretical work which has been covered in class' (Nightingale and Webster, 1981, p.27).

1. Initial stage: The application of knowledge
  - 1.1 Recognition of apparatus, recall of terms, definitions and conventions
  - 1.2 Ability to use this apparatus in routine situations
2. Intermediate stage: The application of learned techniques
  - 2.1 Ability to select appropriate procedures to solve simple practical problems which have been defined for the pupil
  - 2.2 Ability to observe accurately and to record observations
  - 2.3 Ability to analyse these observations
3. Advanced stage: The ability to investigate
  - 3.1 Ability to devise techniques to meet the demands of a defined problem
  - 3.2 Ability to plan and carry out a practical field investigation
4. Final stage: The ability to evaluate
  - 4.1 Ability to pronounce judgement in terms of internal evidence such as logical accuracy and consistency.
  - 4.2 Ability to pronounce judgement in terms of external criteria.

Table 3: A suggested hierarchy of objectives for the assessment of geographical fieldwork

Source : Nightingale and Webster, 1981, p.24

Specific and thought provoking questions requiring a fair degree of interpretative skill must be set by teachers. They continue: 'Despite these advances in examining, the questions cannot assess the practical ability of the pupil in the field, and must be accompanied by an assessment of

the pupil's practical fieldwork by the teacher' (Nightingale and Webster, 1981, p.26).

In Table 3 they:

have proposed a scheme of assessment which will minimise dangers of subjectivity by requiring the analysis of the components of the field study. There is now a distinct opportunity for this form of assessment, for the system of internal assessment coupled to an external examination shortly to be implemented in Natal schools lends itself to the judicious use of the assessment of pupils' practical fieldwork. The progressive geography teacher will grasp this opportunity to include the assessment of fieldwork in his pupils' internal marks for geography (Nightingale and Webster, 1981, p.26).

Nightingale and Webster's schemes outlined above provide a working framework for geography teachers to use when involved in the essential task of assessing fieldwork done by their pupils. It will also be shown later in this thesis how the worksheets used in the Pigeon Valley fieldwork can be used by teachers as an assessment tool to help them ascertain how well pupils have grasped the essential concepts covered by the worksheets.

#### Various approaches to field studies

According to Nightingale and Webster (1981), many teachers, though convinced of the importance of fieldwork, have, due to deficiencies in their training, little idea as to how to conduct field studies. Teachers need a broad conceptual structure for fieldwork activities so as to be better equipped to decide how to undertake particular fieldwork activities.

Webster (1979) believes that it is logical to base the planning of a field study programme, as was the assessment of fieldwork discussed earlier, upon a hierarchy of cognitive processes, one of the best known of which is that designed by Bloom and his associates in 1956. Their hierarchy of cognitive processes from low to high order, on closer examination, shows that a field study involves at least five of the six processes they identified. Both simple field studies (for junior pupils) and advanced field studies (for senior pupils) presume levels of knowledge and comprehension from the pupils; both attempt to apply the pupils' knowledge to reality; in both cases analysis and synthesis skills are involved. Whether the final stage of evaluation is reached depends upon the design of the field study.

Webster however, believes that however useful Bloom's taxonomy may be as a possible foundation for a fieldwork programme, it still does not provide an adequate basis for the construction of a programme of field studies for schools. He suggests that the programme should rather be based upon:

- 1) the gradually evolving role of the teacher
- 2) the mode of enquiry pursued in the field

Basing a programme on the interaction of these two factors should deepen the pupil's awareness of the structure of

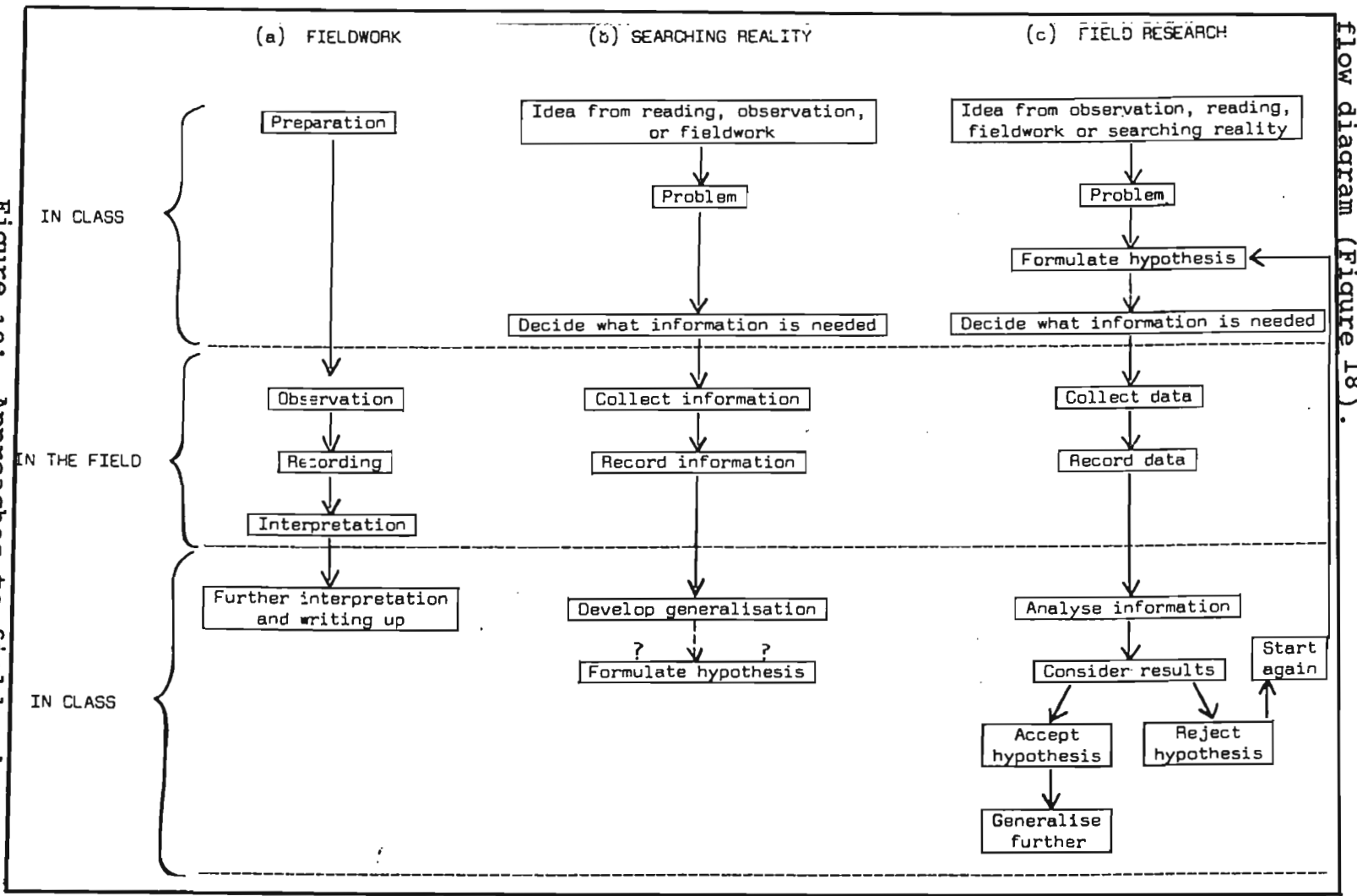
geographical knowledge as well as provide the necessary motivation to study the subject in the field. Webster continues by pointing out that the late G.F. Hutchings, who as Warden of Juniper Hall Field Centre in England for many years, was probably the most experienced field teacher in the country, identified two stages of pupil competence in fieldwork based on the two factors above viz. the role of the teacher and the method of enquiry. The first stage Hutchings called field teaching for very young pupils and fieldwork for slightly older children and the second stage a field research type stage.

These two main approaches to field studies as well as two other lesser used approaches will now be discussed. The two main approaches to field studies have been distinguished by Board (1965) and Everson (1973) (cited in Nightingale and Webster, 1981) - a traditional fieldwork approach and field research. A 'searching reality' approach put forward by Daugherty (1974) and the elaborate classification of fieldwork approaches put forward by Hall (1976) will also be discussed, the merits and demerits of each approach analysed, together with their appropriateness for use under varying circumstances.

a) The traditional fieldwork approach

This approach owes much to British geographers such as Wooldridge and Stamp. Everson (1973 in Nightingale and

Webster 1981) has represented this approach by means of a



flow diagram (Figure 18).

Figure 18: Approaches to fieldwork  
Source : Nightingale, 1980, p.82

The different levels in the flow diagram are examined by Nightingale and Webster (1981):

Preparation: to provide a background for studies in the field, resource material such as maps, aerial photographs and written publications can be consulted. Teachers may prepare questionnaires or assignment work cards for highly structured field studies, or on the other hand little attempt may be made to dictate to students, more opportunity being left for personal discovery.

Observation: Everson (1973) points out that this stage lies at the heart of this approach. Briault and Shave (1968) state that "good fieldwork is accurate observation accurately recorded". Teachers may guide observation verbally, by means of questionnaires or by planning for the performance of specific tasks.

Recording: this can be done in a variety of ways described in some detail by Long and Roberson (1966 pp. 134-148). Field sketches, tables, matrixes, graphs, transects and photographs may be utilised. This recording is an important step for it transforms what might otherwise be a holiday jaunt into a true field exercise, focusing attention on significant features and assisting both observation and interpretation.

Intérpretation: this is carried out in the field and in the classroom.

Follow-up procedures: these vary considerably, ranging from a mere tidying up of material recorded in the field to elaborate projects. With young children this stage should not be prolonged, for their interest span is limited. If pupils are instructed to use means other than writing for presenting the material, the work at this, the most tedious stage, is made more interesting and challenging (pp. 6-7).

Hall's classification (Table 4), to be discussed later, according to Nightingale and Webster (1981), makes the point that:

traditional fieldwork can be carried out either as a means of introducing material to the pupil (the

teacher confronts the pupil with a phenomenon which is new to him); or it may be used as a follow-up to classwork, reinforcing what the pupil has already learnt. In the first place the teacher is saying: this is the reality: we shall learn more about it in school; in the second: we have learned about this, now let us go and see it (p.7).

Nightingale and Webster believe that this traditional approach to fieldwork has some significant shortcomings:

It concentrates on what is readily observable in the field. Indeed it has been said that a feature of good field teaching is to restrict the discussion to that which is visible. Relationships may be sought and found but just how real they are is often open to question for no experiments are made to test the validity of the conclusions drawn (Everson, 1973). Usually it is the facts rather than processes that will be discerned in the field (Long and Roberson, 1966). This approach leads to a concentration on the simple and the obvious and to a neglect of the more complex phenomena and relationships. Thus in geography, rural areas were studied and more complex urban areas neglected. This lends force to the charge that this approach leads to a naive superficiality - for example to a neglect of such factors as the very considerable influence of planning, agricultural subsidies and freight charges on land use. Such fieldwork may be useful in giving the child an overall picture of the landscape or of the life in a stream, it may encourage a positive attitude towards conservation, and it will most certainly increase the motivation of pupils, but, as Powell (1975) points out:

whether a basic concept, an explanation, has been added to the cognitive structure of the pupil is much harder to assess. Common sense tells us that fieldwork should have a real sense of purpose.

It is this lack of a clearly defined aim - so often absent - that is provided by field research (p.7).

b) Field research

Everson (1969) questions the field teaching approach on the grounds that it lacks structure. He believes that it



often degenerates into an aimless discussion of any feature encountered on the excursion, and the major technique employed is simply verbal description, leading to results which are often inconclusive. Instead of field teaching, Everson proposed a hypothesis-testing approach to fieldwork which subsequent writers (eg. Hall, 1976) have termed 'field research'. Figure 18 summarises the main steps in field research. Nightingale and Webster (1981) have summarised these main steps as follows:

The idea generation stage could be traditional fieldwork, or an idea suggested by the textbook, general reading or chance observation. This leads to the identification of a problem - often thrown up as a result of discussion in the classroom. The next step is to provide a theory or model which will provide a theoretical explanation of the phenomenon. The theory may be derived from the accepted body of theory of one or other of the sciences, or be made up by the pupils (or teacher); Everson (1973) argues that the former is preferable for the results of the verification of hypotheses should be relevant to the main body of theory.

This is followed by the formulating of a hypothesis, based on theory, which can be considered as an answer to the problem. Decisions must be made as to what information is required in order to test the hypothesis, and how this information can best be obtained. So far most of the work has been done in the classroom with the pupils involved at every stage.

It is now time to take the pupils into the field. Recording is done in one or more of the variety of ways alluded to in the discussion of traditional fieldwork, but with this important difference: that the pupils now have a clearly defined aim for their activities - that of testing the validity of a particular hypothesis. If the hypothesis proves to be correct, it is accepted and then becomes the basis for further generalisation; if it proves to be wrong, this is recognised as an equally valid result and attempts are made to formulate new hypotheses, taking into account the knowledge gained (p.10).

Webster (1979) lists the following advantages of this approach, as identified by Everson (1969):

- (1) the fieldwork is structured towards the solution of a problem and thus irrelevant information the pupils may come across in the course of the investigation is ignored;
- (2) techniques, including statistical methods, are regarded in perspective as tools and are not studied in themselves;
- (3) the initial preparation and the processing of results afterwards in the classroom form an integral part of the fieldwork exercise; and
- (4) the study leads to a generalisation which may be applied elsewhere as it is based upon objective methods (p.56).

Nightingale and Webster (1981), based on work done by Everson (1973), consider the criticisms of this approach:

that many teachers are concerned that this approach places too much emphasis on problems and too little on observing phenomena; that children will become too bogged down in the minutia of testing and recording; and that as a result pupils will get less of a thrill and excitement from these studies and even, some contend, of understanding, than they would from the old approach. Children using the field research method are operating in the same way as research scientists and they are consequently providing general statements which in this form of the study are objective not subjective assessments of the answer. These conclusions are comparable with the results obtained elsewhere from similar studies. The techniques are firmly placed and are not studies for their own sake, as can happen in many less controlled pieces of work. Lastly, the fieldwork is structured towards a conclusion and is not represented by inert, factual information included just because it happens to occur in the area studied. It is also a method which thrives on so-called difficult areas and it concentrates interest on process (p.10).

Nightingale (1986) believes that there need be no conflict between the two approaches discussed as their objectives

differ and each is valid. The scale of the study, the age of the children, and the distinct objectives in view will all help to decide which method should be used. If a quick overview is required, and much of the relevant material is readily observable in the field, then the traditional method can be used as has been done for the junior secondary phase in the fieldwork worksheet (Appendix J and accompanying marking guide Appendix K) prepared for Pigeon Valley. It must be pointed out that these junior worksheets are not part of the actual case study which forms the basis of this thesis, as described in the following chapters, but forms, for reasons outlined later, a parallel exercise to the focus of the study. If there is a greater complexity of material, and the factors coming into play are less apparent, then the greater sophistication of field research may be needed in order to get to the heart of the problem. This has been done for the senior secondary phase in the fieldwork worksheets (Appendix E) prepared for Pigeon Valley.

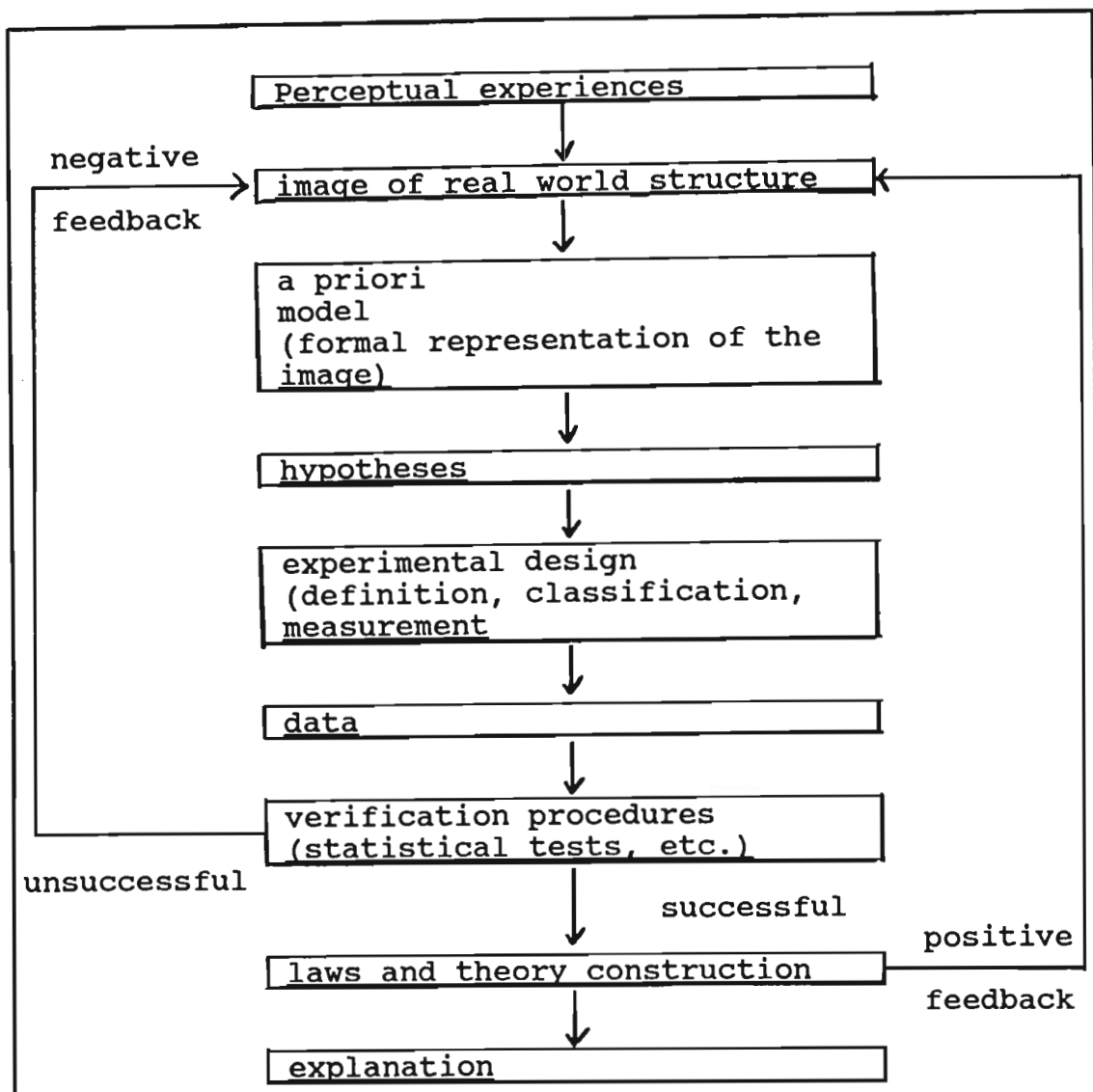
Nightingale continues by saying that both methods can be used at any stage in the child's career but that the first method is better suited to the earlier years and increasing emphasis should be given to field research as the pupil moves on to more advanced and exacting work, as has been done with the Pigeon Valley worksheets. Even here, the use of hypothesis testing has been tentatively

introduced in two exercises within the worksheet as pupils are not familiar with this approach and need much more practice in using it.

Walford (1973) asks whether the two approaches apparently so divergent could be ordered into a whole. He believes they can if one accepts the idea that geography must adopt scientific procedures and methods, and must try to develop theory of its own. Harvey (1969) suggests an extended and more generalised version of the field research flow diagram (Figure 18) in what he calls a route to scientific explanation (Figure 19).

Powell (1976) is one of many geographers who has reported on the effective use of field research in school geomorphology. Using a standard nine class of the Empangeni High School in Natal he investigated the relationship between channel width, stream flow and sediment size in the Umhlatuze River Valley in Zululand. Measurements taken by his pupils supported the hypothesis that where a river gets narrower, velocity increases, enabling the river to carry a heavier load as portrayed in pebble size.

This study represents a more ambitious hypothesis testing field research exercise when compared to the exercises included in the Pigeon Valley fieldwork, which should be viewed as tentative and introductory, for pupils who are not well versed in carrying out this type of fieldwork.



**Figure 19:** A route to scientific explanation  
 (from Explanation in Geography by  
 David Harvey, Edward Arnold)  
Source : Walford, 1973, p.113

Hall (1976) is one writer who is critical of the formally structured approach to fieldwork advocated by Everson. He wonders whether the geographic purpose of such an investigation can be obscured at school level by the over-rigorous analysis of results. He argues that the

scientific method used in field research is, in fact, an over-formalised version of a research technique used by scientists, and when rigidly used as a fieldwork method for school pupils, may inhibit the enjoyment of unexpected discovery which should accompany the move away from the classroom. In place of a single hypothesis-testing approach, Hall (1976) suggests a four-tier classification of geographical fieldwork in schools, which essentially broadens and deepens Hutchings' (1960) two-tier field teaching/field research classification to include Everson's (1969) highly structured hypothesis-testing approach (Table 4).

c) 'Searching reality'

Another form of the problem solving approach which is not as rigidly structured as the field research method has been suggested by Daugherty (1974) which he calls 'searching reality' (Figure 18). Nightingale and Webster (1981) see this procedure as follows:

Though the procedure is much the same as with field research, the significant difference is that instead of testing a definite theory or hypothesis, and anticipating a specific result, pupils are simply investigating a hunch about some geographical relationships. They are aware of some sort of order in the real world and are making a preliminary attempt to find reasons for it, but they may have little idea of what the outcome of their investigations will be. An example of this might be: the pupils become aware of a general pattern of residences in terms of the age of the buildings in the area around the school; they might set out to confirm that such a pattern exists, to determine the

Type	Teaching method	Process	Type of Structure	Teacher/Pupil	Result
FIELD DEMONSTRATION	(a) Teacher reinforces  (b) Teacher confronts	In (a) previous classwork is followed up including simulated fieldwork skills (i.e. orientation of map to ground, slope and contours, intervisibility)  In (b) new phenomena and new skills are introduced in the field for the first time. Students record what teacher observes for future classwork or exam study.	Tightly structured linear programme prepared by teacher; 'pause and move on' by foot or vehicle	Close supervision of class as a class: <i>teacher</i> busy leading and talking; <i>pupils</i> passive in (a) and imitative in (b)	Convergent and closed
FIELD STUDY	Directed exploration	Pupils highly circumscribed by directives but considerable autonomy of movement. What is discovered, measured, etc., is by teacher intention, but the process is pupil centred	Can be fairly tight (i.e. worksheet of questions) or more loosely phased around a series of guidelines  'Colonial elephant hunt' where pupils placed advantageously to fall over their own environment but shoot their own quarry	Open supervision with pupils working in groups or individually. Teacher control by effective preparation	Convergent and closed but room for a margin of personal influence and error
FIELD TESTING	Controlled inquiry	Research into a specific hypothesis or model along carefully controlled lines in accordance with the conventions of deductive science. Problem solving dominant	Operationally tight (accuracy essential in recording data). Degree of structure and amount of computation a function of hypothesis and techniques employed	Pupil as researcher and teacher as laboratory supervisor with duty to safeguard data from contamination by irregularities of conduct in research and miscalculations in computation	Open, unless previously worked out by teacher or the hypothesis overcontrived by him
FIELD DISCOVERY	Open inquiry	Journey into the unknown, where theme, guidelines, hypothesis, mode of working are the choice of the pupil. 'Discovery, Exploration, Creativity' possible in the widest sense	Loose, lightly constrained to random	Only responsibilities of pastoral care, subject consultant by pupil request. Main work is to provide the possibility and encourage inquiry	Divergent and unpredictable

**Table 4: A simple fieldwork classification in geography**  
**Source :** Hall, 1976, p.250

nature of the pattern more clearly; and then attempt to discover what factors have given rise to patterns which they have identified in the field.

In some cases 'searching reality' can be regarded merely as an earlier stage of research leading up to the formulating of a hypothesis which can then be tested using the procedure outlined under the heading 'field research'. In the example cited above, the hypothesis might be formulated that: "In the suburb of Rondebosch the first phase of residential development took place during the Victorian era and was in the form of ribbon development along major transport routes." This, however, need not be the objective. A 'searching reality' exercise may legitimately end with a broad generalisation .... or statement of some meaningful conclusions (p.11).

Daugherty (1974) goes on to attempt a fusing of his searching reality with the hypothesis testing approach to produce a flow diagram showing the relationship between hypothesis testing, generalisation and prediction in the scientific approach to geography (Figure 20).

Rawlings (1977) has successfully used both field research and 'searching reality' approaches in fieldwork in England and sees both approaches as having merit and believes that both should be utilised. However, as Daugherty (1974) points out:

the quality of an investigation does not lie in the label attached to the approach but first of all in the clear definition of the problem and secondly in the careful design of a procedure for solving it (p.9).

Rawlings sees this advice as applying particularly to the teacher planning school fieldwork.



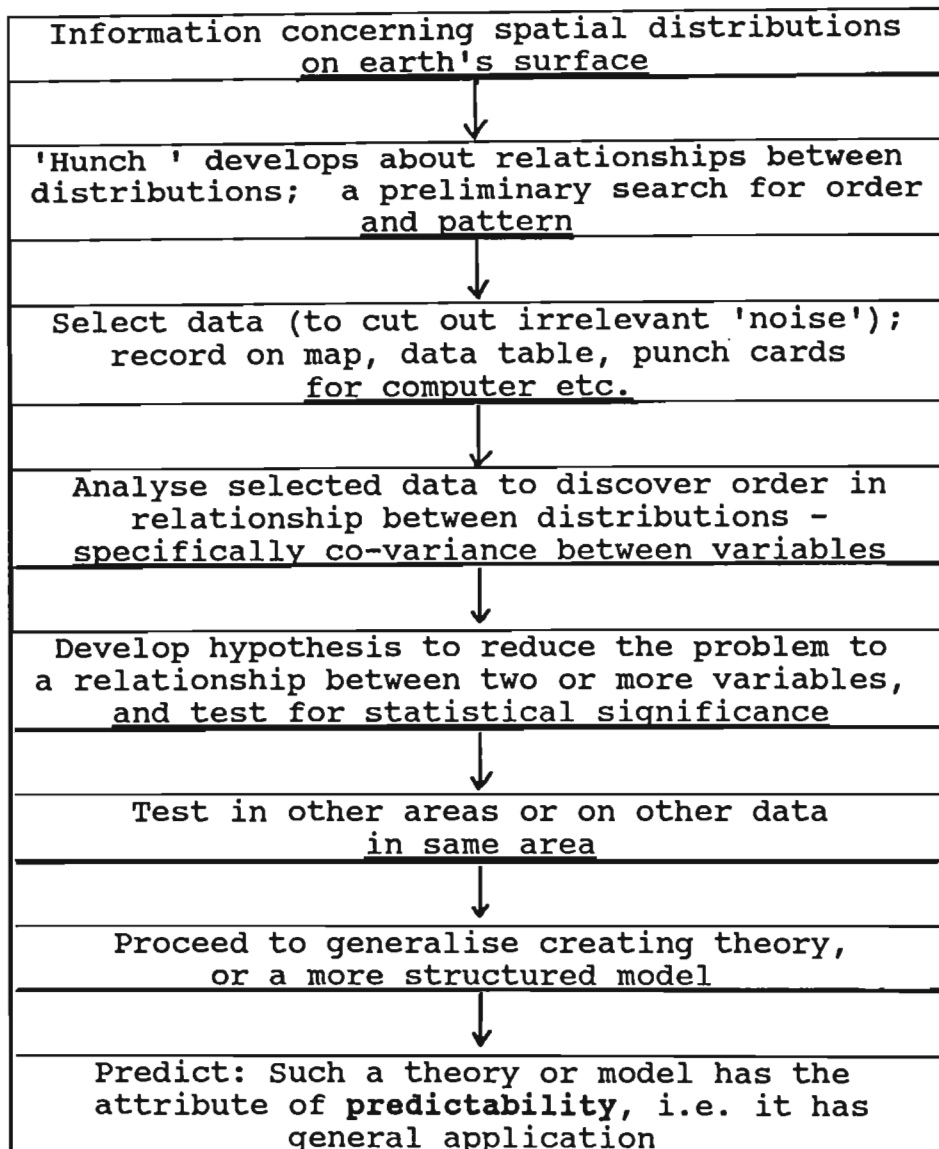


Figure 20: The relationship between hypothesis testing, generalisation, and prediction in the scientific approach to geography.

Source : Daugherty, 1974, p.8

The various approaches to field studies outlined above should serve as a theoretical framework for the teacher planning such activities. The classification given should not be regarded as prescriptive, simply suggesting,

in broad outline, different approaches to fieldwork which can be used. Nightingale and Webster (1981) analyse how on any one field trip more than one method may be used:

For example: while testing a hypothesis with regard to the flow characteristics of a river, a teacher may set his pupils the task of identifying and sketching certain landforms associated with river flow; then, stopping at a vantage point from which an interesting stretch of river can be viewed, he might attempt to explain the different stages in the development of that particular stretch of river, partly by means of questions and partly by direct exposition. He has then used several different methods during a single fieldwork exercise (p.11).

Webster (1979) suggests that whatever fieldwork method is eventually chosen, field study programmes used by schools in Natal should comprise the following three stages:

- (1) Stage of Observation - during the first few years of the pupil's school career he is taken on brief excursions during which the teacher draws the attention of the pupil to features, processes and activities that must be observed. No, or very little, collection of data takes place, for the intention during this stage is to promote observation and discussion in order to teach the pupil basic geographical terms. The teacher plays an important role in directing the pupil's observation.
- (2) Stage of Explanation - this is the stage during which formal field teaching takes place, and it includes Hutchings' (1962) stage of field teaching, and Hall's (1976) stages of field demonstration and field study. Before the pupil can analyse and interpret the landscape for himself, it is important that he is taught the basic methods of the geographer in the field. Peters (1964) argues that initial learning does not take place unless the teacher provides guidelines and examples. Once the momentum is established the teacher can stand back and allow the pupil to continue his investigations unaided, but at this important stage the help of the teacher is necessary in learning how to select and collect data, and to analyse and

present results. This is a crucial stage in establishing the groundwork of method in the field and a great deal of practice at data collection and analysis is required by the pupil before he is sufficiently proficient to proceed to the next level. It is likely that academically weaker pupils will not proceed beyond this stage for they will require the constant guidance of the teacher which characterises this stage.

- (3) Stage of Investigation - this final stage is reached when the pupil is sufficiently competent in fieldwork method to plan and conduct a field investigation along hypothesis-testing lines. The teacher remains in the background as an adviser, allowing the pupil to approach the material as directly as possible. At the same time the teacher retains control of the purpose of the investigation thus ensuring that it will contribute to the pupil's understanding of the structure of the subject (p.58).

Webster's three tier classification of geographical fieldwork is summarised in Table 5. The table shows how Webster's 3-tier system has been based on the work of Hutchings and Hall mentioned earlier.

Webster continues by identifying a further problem in designing a field study programme viz. the covering of the many strands in a subject like geography. The fieldwork programme must so arrange these various strands that the pupils knowledge of all the branches of geography is steadily deepened and, as his experience progresses, the interrelationship between the various branches of the subject becomes more fully understood. Figure 21 illustrates an arrangement of the various branches of geography, which aids the planning of a field study course at school level. As can be seen in the figure, many areas

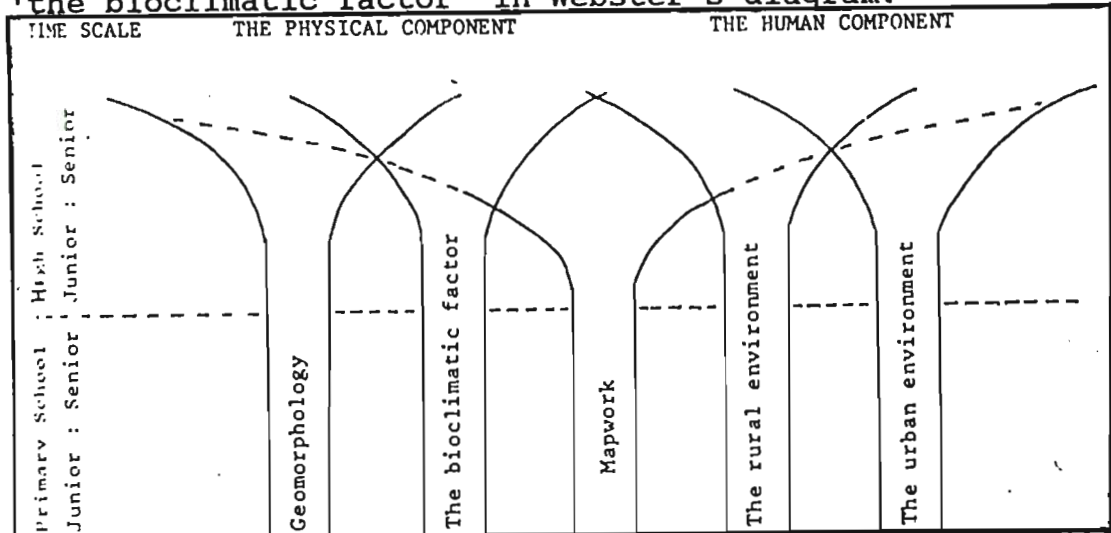
G.E. HUTCHINGS		D. HALL	A 3-TIER SYSTEM
			STAGE OF OBSERVATION  Simple observa- tion of features and processes by very junior pupils
FIELD TEACHING	FIELD DEMONSTRATION		STAGE OF EXPLANATION
Extension of classroom teach- ing to the field. Active demonstra- tion of fieldwork methods by teacher.	Teacher reinforces previous classwork and confronts pupils with new phenomena.  FIELD STUDY Exploration directed by the teacher.		Active teaching role played by the teacher in demonstrating and teaching field- work methods and in directing field studies made by the class
FIELD RESEARCH	FIELD TESTING		STAGE OF INVESTIGATION
Pupil investi- gates aspects of the environ- ment under supervision of the teacher	Research into a specific hypothesis or model along carefully con- trolled lines		Pupils investi- gate problems in the field along hypothesis-testing lines. Teacher plays a super- visory and advisory role.

Compiled from Hutchings (1962) and Hall (1976)

Table 5: A classification of geographical fieldwork at school level

Source : Webster, 1979, p.60

of a school geography syllabus can be covered using a fieldwork approach. This study concerns the area called 'the bioclimatic factor' in Webster's diagram.



**Figure 21:** An arrangement of the various branches of geography for field study purposes

Source : Webster, 1979, p.61

To conclude this section, much hard work remains to be done on the most appropriate approach to be used when implementing a programme of field studies. Teachers must take their courage in both hands and venture out to make full use of the resources of the environment. They must be clear in their own minds as to what they hope to achieve through the use of fieldwork but must remember not to be too prescriptive. Room must be allowed for pupil initiative e.g. if hypothesis testing is to be done, then the hypothesis to be tested should have been suggested by the pupils themselves. Only a knowledge of the various types of fieldwork available to teachers will make them competent and confident enough to set up a fieldwork programme in their schools.

Techniques, methodologies and exercises which should be incorporated into a fieldwork programme

According to Wheeler and Harding (1965) geography is primarily an observational study, concerned with the relationship of phenomena in space and is an environmental science in nature. The environment is used as the basis for geographical observations with the geographer's laboratory being the world outside the classroom. Geography is a discipline which teaches observation skills and an 'eye for country' (Wheeler and Harding, 1965, p.7). In doing so it looks for correlations between the various natural phenomena, attempting to see the environment as a unity. The child who makes a geographical study of his local area attempts to see that particular part of the world as a whole dependent on its many parts - an exercise in synthesis. Fieldwork is a method by which pupils undertake geographical studies of their local area.

To be able to carry out fieldwork correctly, as part of the study of a pupil's local area, various practical skills may be required of them, so as to enable the pupils to study more fully the area concerned. A wide variety of literature is available both locally and overseas on what skills should be incorporated into a school-based geography fieldwork programme. Nightingale (1981) is a local writer who has discussed in some detail the practical skills required of pupils in the field, while

examples of overseas writers in this field include Long and Roberson (1966), Wheeler and Harding (1965), Briault and Shave (1960) and Archer and Dalton (1970). A good fieldwork programme will include as many of these skills as possible. However, a review of available literature reveals that there are a few basic skills that should be incorporated into almost all fieldwork programmes. Some of these skills have been included in the Pigeon Valley fieldwork exercises, while those that have not either do not easily fit the particular area being studied or could form the basis for a possible improvement of the worksheets used. These practical skills will form a very important part of the actual fieldwork excursion and must therefore be taken cognisance of in the 'preparation for fieldwork' phase and the 'synthesis of observations' stage. They would include:

- 1) Drawing of large scale maps
- 2) Drawing of profiles or cross sections
- 3) Field sketching
- 4) Soil studies
- 5) Weather and climate studies
- 6) Ecological studies

These practical skills will now be briefly discussed:

- 1) Drawing of large scale maps

Pupils in the high school, even from the junior secondary phase (standard six) are well versed in the analysis and

interpretation of the 1:50000 series of large scale topographical maps of South Africa. The map of the relevant area of study should be examined in detail by the pupils in the classroom prior to actually embarking on the fieldwork and a simplified base map of the area should be constructed, with the teacher providing the pupils with the scale of the base map and what information it needs to show. Long and Roberson (1966) are among other writers who advocate the drawing of large scale base maps when conducting fieldwork. An example of a base map completed in detail is shown in Figure 22. Usually such a map would only consist of a basic outline of an area, onto which relevant information such as land use could be placed.

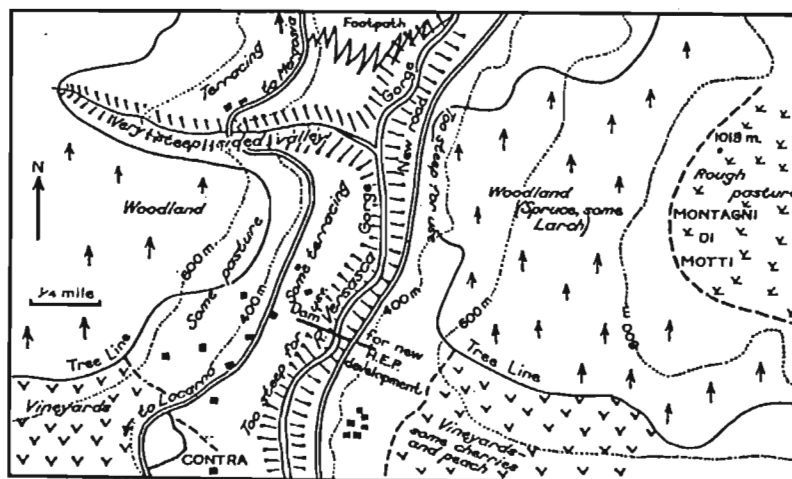


Figure 22: A completed base map

Source : Long and Roberson, 1966, p.136



Figure 23 gives an example of such a land use base map.

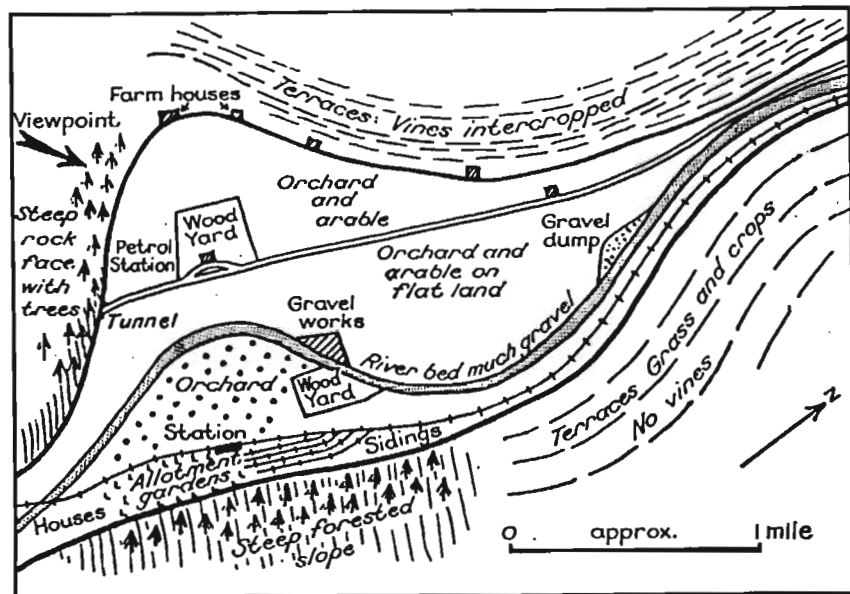


Figure 23: A land use map  
Source : Long and Roberson, 1966, p.136

Field sketching skills are involved in the construction of the above land use base map, as well as observational and mapping skills.

## 2) Drawing of profiles and cross sections

Pupils are conversant with the skills required to carry out the drawing of profiles and cross sections from the standard seven year of high school and continually practise the skill up to standard ten. Briault and Shave (1960) stress the importance of drawing profiles and cross sections in fieldwork and show examples of the kind of profiles and cross sections required for fieldwork purposes (Figures 24 and 25).

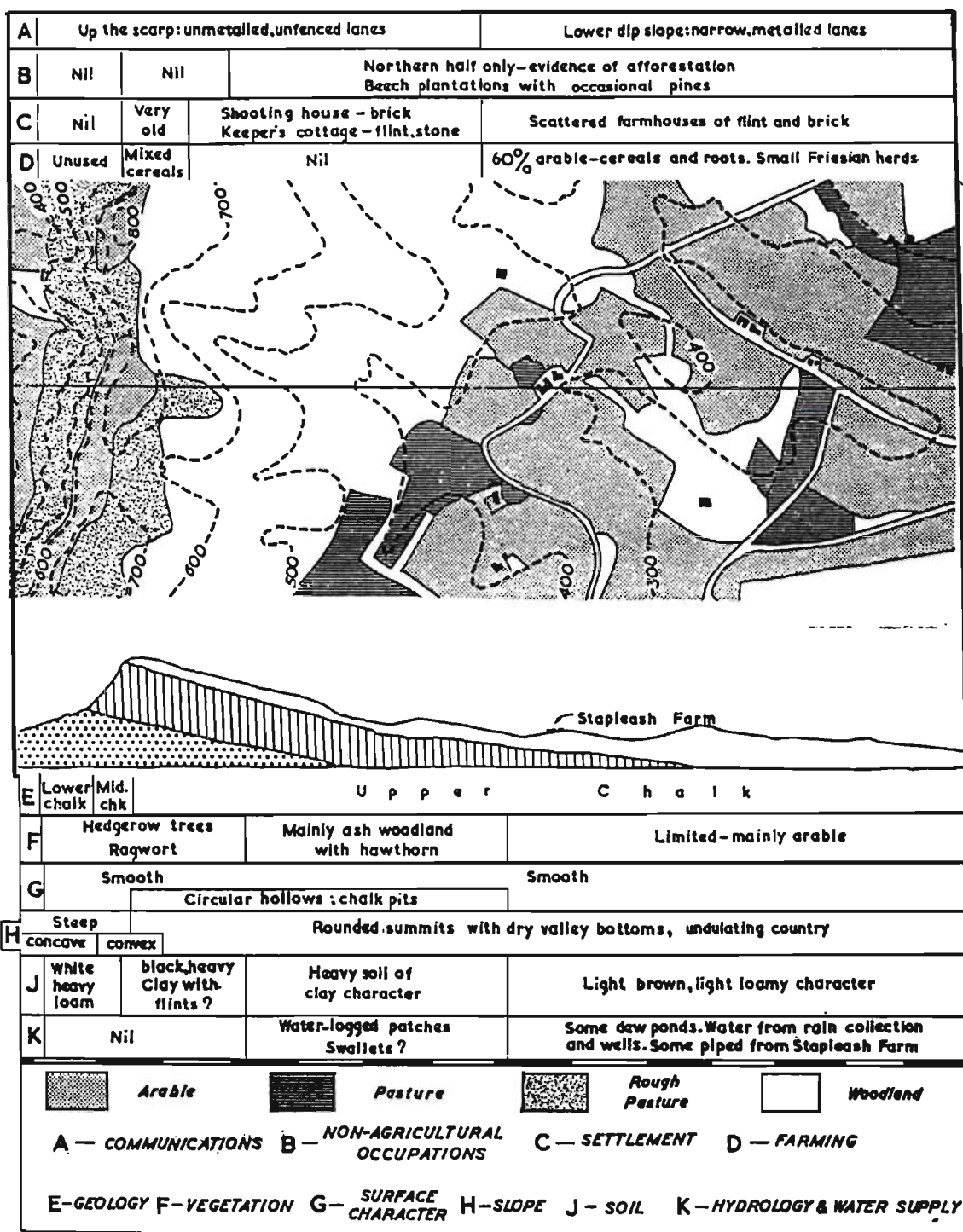
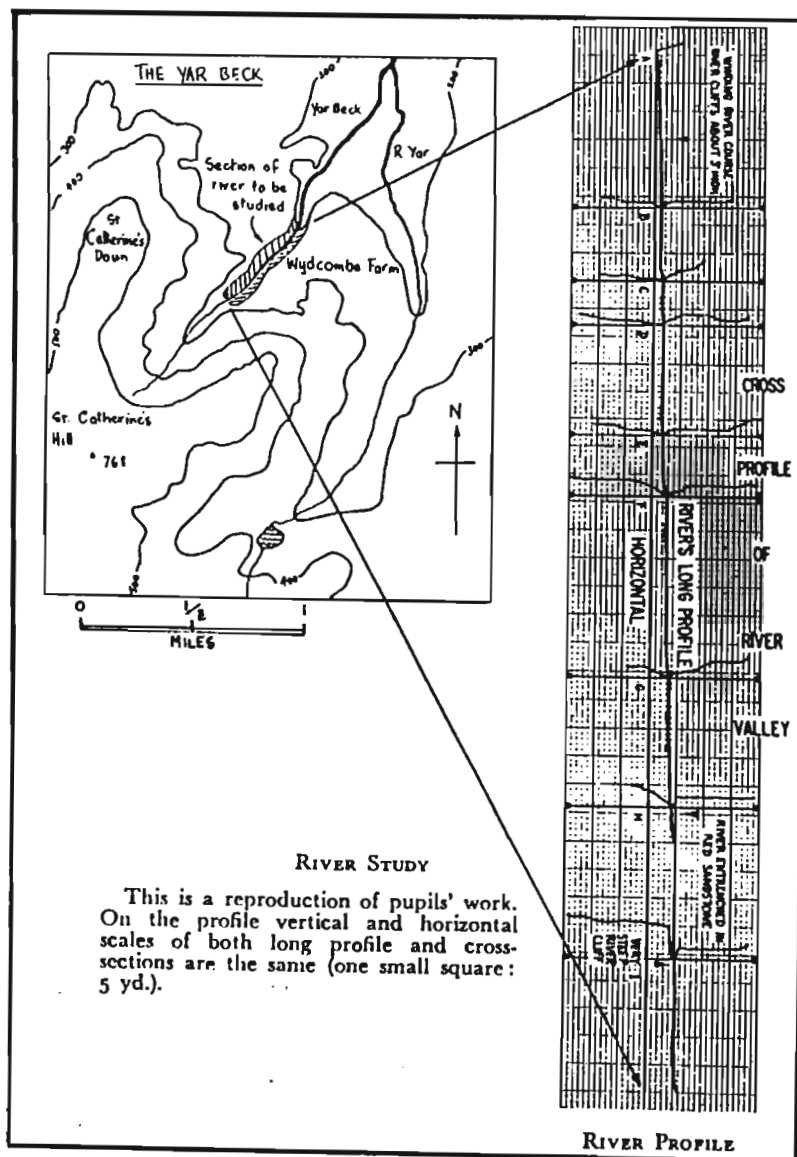


Figure 24: A transect across the South Downs in West Sussex

Source : Briault and Shave, 1960, p.47

Such a detailed transect might only be required of senior high school pupils, but provides an idea of the amount of information which can be plotted in such an exercise.

The profile in figure 25 provides a typical example of what a high school pupil in Natal would be required to produce as part of his fieldwork exercise.



**Figure 25:** A river profile  
**Source :** Briault and Shave, 1960, p.51

A vertical profile of buildings in an urban area, such as along a particular street, can also be drawn (Figure 26), especially if fieldwork in urban studies was being conducted.

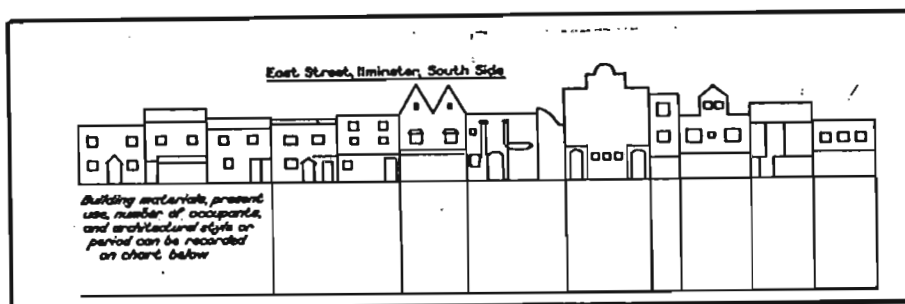


Figure 26: A prepared street profile: Ilminster, Somerset

Source: Long and Roberson, 1966, p.137

### 3) Field sketching

According to Archer and Dalton (1970) and Briault and Shave (1960), field sketching constitutes one of the most important of the practical skills required of pupils in the field. Unfortunately, pupils are not encouraged enough to employ this skill and hence when attempted, it is usually poorly presented. The field sketch attempts to capture the appreciation and understanding of the landscape - all too often a photograph is taken to replace it as part of the fieldwork geographer's equipment. Archer and Dalton (1970) show in simple diagrammatic form what is required in field sketching (Figure 27).

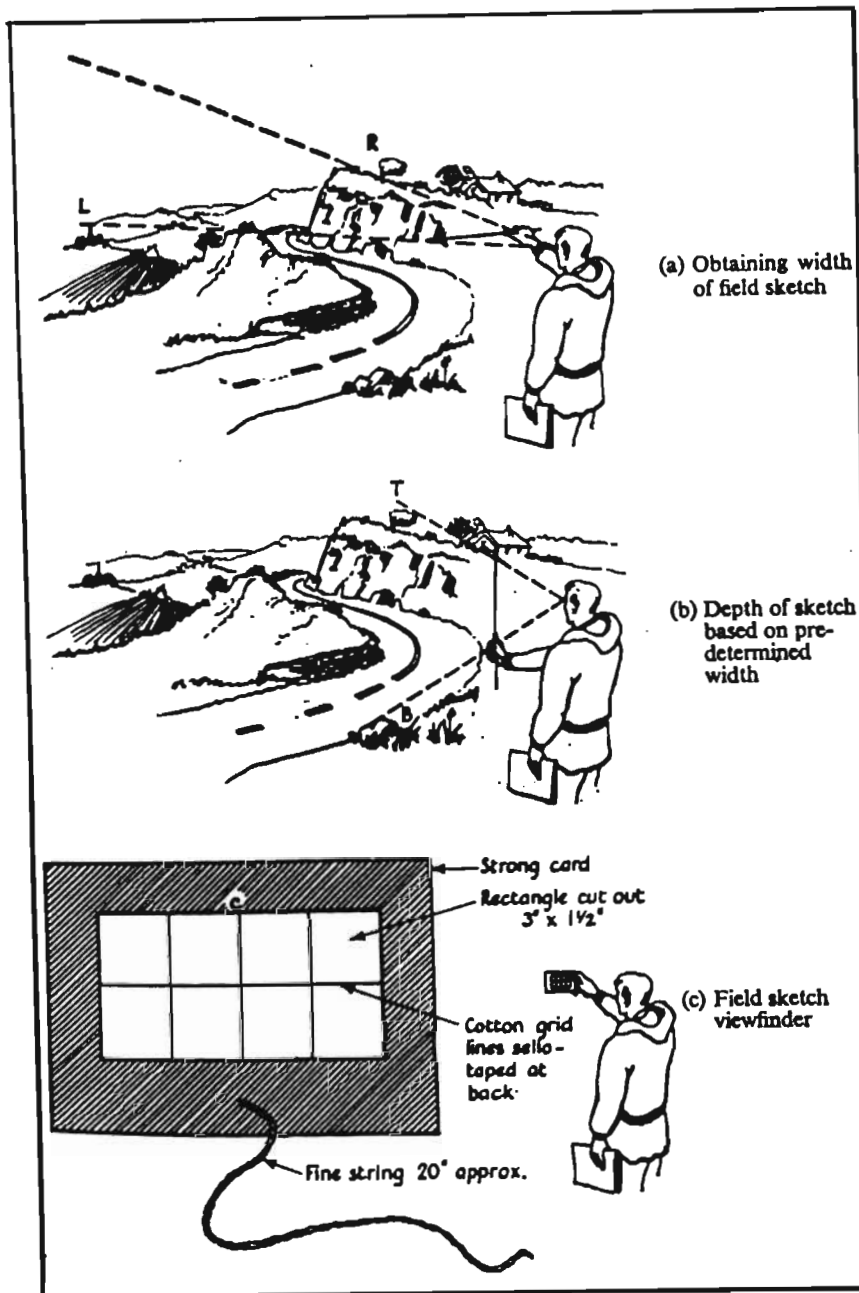


Figure 27: Making a sketch in the field  
Source : Archer and Dalton, 1970, p.41

The simple procedures used in doing field sketching need to be taught to pupils and practised by them so as to make them conversant with this important fieldwork technique.

Briault and Shave (1960) provide examples of simple field sketches (Figures 28 and 29).

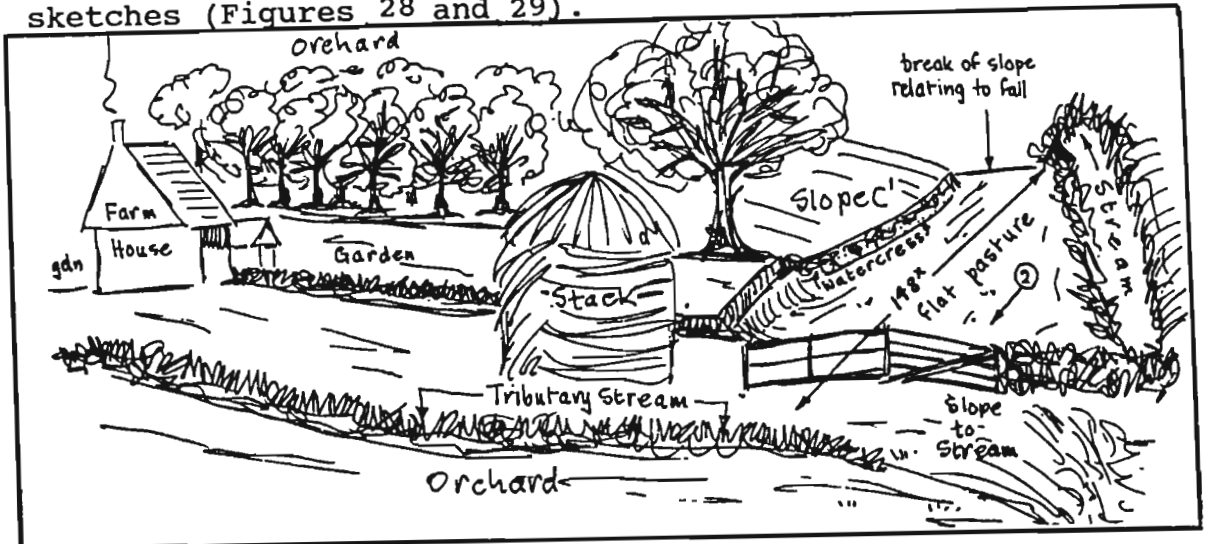


Figure 28: A simple field sketch  
Source : Briault and Shave, 1960, p.56

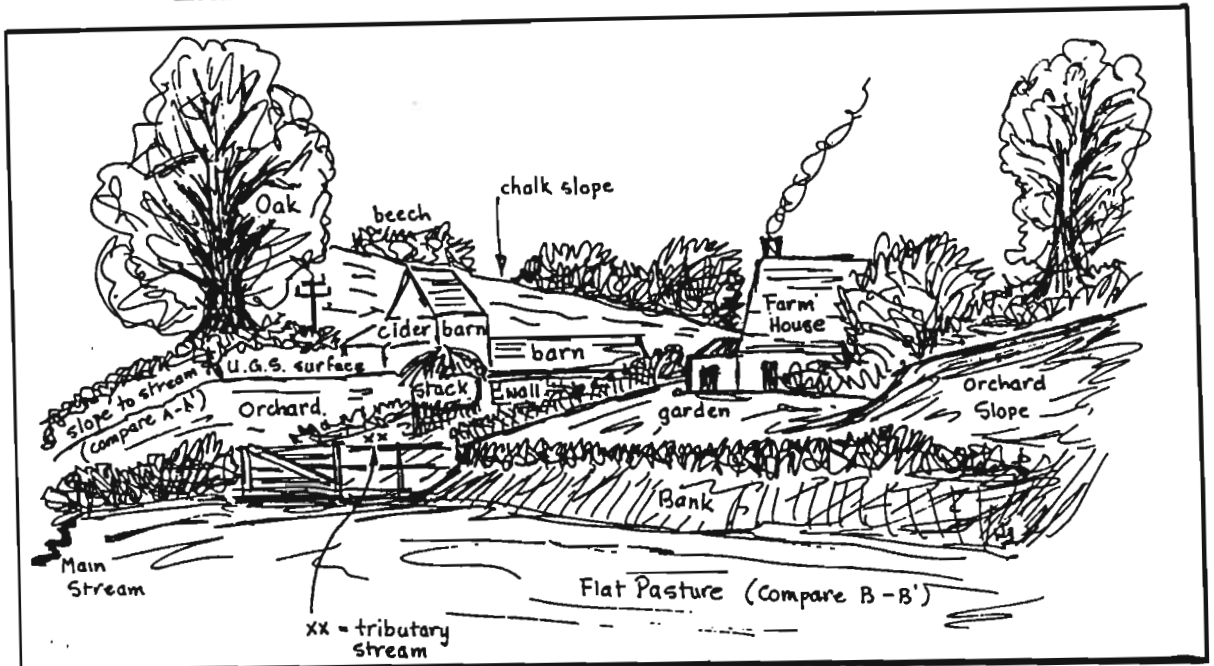
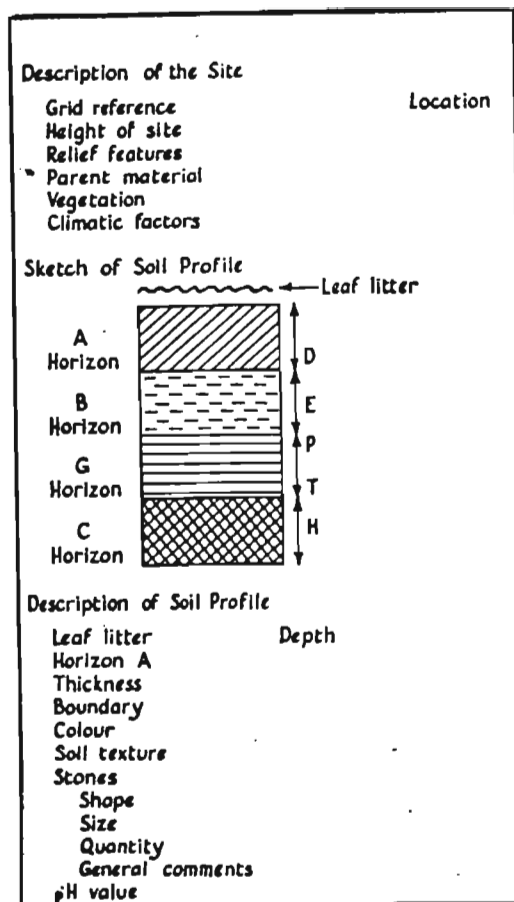


Figure 29: A simple field sketch  
Source : Briault and Shave, 1960, p.57

Simple field sketches can fairly easily be produced from an elevated point above a fairly open terrain but is not suitable in an area like Pigeon Valley with its dense climax stage vegetation cover.

#### 4) Soil studies

The new high school geography syllabus incorporates soil studies in the new ecology section and by doing so encourages the study of soils in ecological fieldwork. Much can be done in the field to examine the local soil types, with both the biotic and abiotic components of the soils to be studied. The various soil characteristics or properties can be examined viz. colour, texture, structure, acidity and depth while consideration should also be given to the main soil forming factors viz. climate, parent material, vegetation, topography, time and biotic factors. Practical activities which can be done by the pupils, and which are done in this study, include taking soil temperature and moisture readings, checking structure with field microscopes, determining soil texture, taking soil acidity readings, studying the soil's biotic component with magnifying glasses or field microscopes etc. One of the more practical exercises is to dig a soil pit (not permitted in Pigeon Valley for conservation reasons and therefore not done in this study) so as to study soil profiles and analyse profile characteristics. Archer and Dalton (1970) are among other geographers advocating soil studies in fieldwork and in Figure 30 demonstrate a typical soil profile and how it can be analysed.



**Figure 30: A typical soil profile analysis**  
**Source:** Archer and Dalton, 1970, p.65

Pupils should be aware that much can be deduced about the geological, geomorphological and climatic history of an area by studying its soil profile. Where, for whatever reason, it is not practical or permitted to study a soil profile in an area, then pupils need to contact the local municipality or university department for information on the probable soil profile in the area concerned.

A soil study provides a hypothesis testing exercise for pupils in the Pigeon Valley fieldwork programme, conducted for the purposes of this study.



Stenhouse. Central to this approach they see the case study researcher typically observing the characteristics of the study group. The purpose of such observation, as in this study, is to probe deeply and to analyse intensively the varied phenomena that constitute the group. They see the unstructured, ethnographic account of a teacher of his pupils as being the most typical method of observation in the natural surroundings of the school. This importance of observation in case study research supports the sentiments expressed earlier by Kenny and Grotebuschen on case study as 'intensive investigations'.

Cohen and Manion continue by discussing six different examples of educational case studies. They were chosen to illustrate the use of a particular style of observation within a particular observational setting and have obvious relevance to this study. Figure 31 sets out the typology of observation studies on the basis of which the six case study examples were selected.

The table reveals that there are two principal types of observation used in educational case studies viz. participant and non-participant. Frequently the type of observation undertaken by the researcher is associated with the type of setting in which the research takes place.

Figure 31 reveals a continuum of settings which are applied to the six selected studies used as examples.

These range from the artificial environments of the therapist's clinic (Cell 5) and the social psychological laboratory (Cell 6) to the natural environments of the community in which the professional life of a headteacher is embedded (Cell 1) and the academic, social and religious life associated with boarding school education (Cell 2). Because our continuum is crude and arbitrary, we are at liberty to locate a study of infant schools (Cell 3) somewhere between the artificial and natural poles' (Cohen and Manion, 1985, p.123).

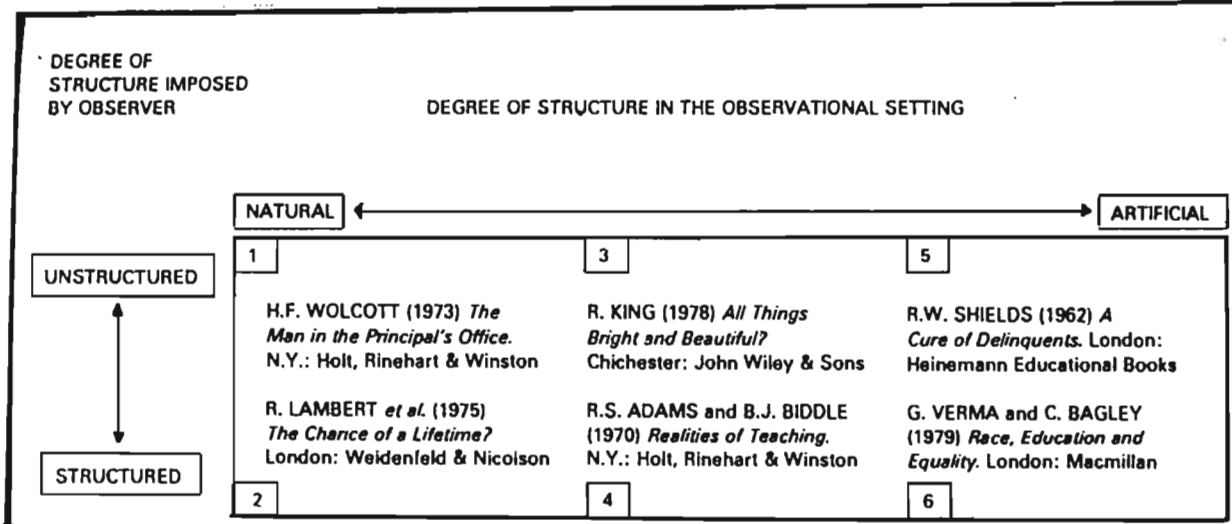


Figure 31: A Typology of Observation Studies  
Source: Cohen and Manion, 1985, p.121

Although in theory each of the six examples of case studies referred to above could have been undertaken either as a participant or as a non-participant observation study, a number of factors intrude to make one or the other of the observational strategies the dominant mode of enquiry in a particular type of setting. An

analysis of the figure reveals that this study can be seen to be an unstructured non-participant observation study in a natural environment.

Millar (1983) is another writer who has considered case study research. He sees case study research as: 'a) one form of social enquiry, b) an attempt to understand social processes and meanings in a restricted undertaking where c) undertakings and contexts are real and d) focus on educational processes as part of an evaluative study' (p.115). This definition supports Stenhouse's earlier discussion of the evaluative style in case study research which has been adopted for the purposes of this study.

Millar goes on to list the following characteristics of case study research which once again reveal the choice of case study as an appropriate method of research when the nature of this study is examined. These are:

- a) a concern with real events, in real contexts in real time
- b) a concern with the meanings of events for the actors in the situation as opposed to measuring behaviour and attitudes
- c) a concern for the social processes and wider social functions that provide the context for such personal meanings
- d) a concern with the intelligent grasp of engagements in specific contexts rather than with the generation of findings or rules that can be widely generalised.

This point links with Stenhouse's earlier reference to the uniqueness of each case study research.

- e) Toleration of and capacity to make use of the widest range of techniques for gaining information, including quantitative methods where possible and appropriate.
- f) very often, but not always, action research (participatory research) by the researcher in the social processes he is studying (pp.117-118).

Millar continues by stating that three key questions need to be asked which direct case study research viz. a) What is the case about? b) How does the case work and c) Why does the case work in this way? These questions should be seen as similar to the key questions asked by Yin when he discussed the importance of defining a study's research questions at the outset of the study. By answering these or similar questions, as has been attempted in this study, Miller believes the case study researcher will provide for himself a framework in which to operate. This will assist him in following the essential methodological principles that serve as guidelines and standards for case study research.

To summarize at this point, then, case study research should be seen as one of a range of research methodologies which are being utilised more and more in recent years, especially in educational research. It is eminently suited to particular research studies which occur in education, like the study constituting this thesis. The following discussion of the various strengths of case

study research should be seen to provide further evidence for the suitability of case study for the purposes of this study.

As far as the strengths of case study research are concerned, Walker (1980) sees what he calls the 'democratic mode' (p.35) as particularly appropriate in case study research, or in evaluation activities using case study techniques. He sees this as placing:

the case study worker in the position of having to negotiate his interpretations with those involved in the study rather than being free to impose them on the data. The shift involved is a shift in power, a move away from the researcher's concerns, descriptions and problems towards the practitioner's concerns, descriptions and problems (p.35).

This is seen as very important, especially in educational research.

Walker (1980) sees case study research as inherently a social process leading to a social product. He sees case studies as public documents about individuals and events with consequences for the lives of those portrayed as well as for the reader. Case studies create images of reality that become part of the reality itself. They transcend the boundaries between the arts and sciences, retaining both coherence and complexity in the process. This versatility is seen by Walker as a strength of case study, a view supported by this researcher.

As has been stated earlier, direct observation is one of the techniques which has been used in this study to evaluate the fieldwork activities that took place in Pigeon Valley. Cohen and Manion (1985) see the element of researcher observation (whether it be participant or not) as an advantage of case studies. They see this form of research as being eminently suitable to many of the problems that an educational researcher faces:

- a) Observation studies are superior to experiments and surveys when data are being collected on non-verbal behaviour, as is the case in this study.
- b) In the observation stage, as was done in this study, the researcher is able to discern ongoing behaviour as it occurs and is able to make appropriate notes about its salient features.
- c) Because case study observations can take place over an extended period of time, the researcher can often develop a more intimate and informal relationship with those he is observing, generally in more natural environments than those in which experiments and surveys are conducted. Even though condensed field work was conducted in this study, the researcher had an intimate and informal relationship with the study's target group, having taught them during the course of the year and having observed them both in the classroom and during previous outdoor activities.

- d) Case study observations are less reactive than other types of data - gathering methods eg. laboratory-based experiments and surveys that depend upon verbal responses to structured questions, where bias can easily be introduced in the very data that the researcher is attempting to study.

#### Possible advantages of case study

Case studies have a number of advantages that make them attractive to educational evaluators or researchers. Table 7 lists the possible advantages of case study research, as advocated by Cohen and Manion (1985):

1. Case study data, paradoxically, is 'strong in reality' but difficult to organise. In contrast, other research data is often 'weak in reality' but susceptible to ready organisation. This strength in reality is because case studies are down-to-earth and attention holding, in harmony with the reader's own experience, and thus provide a 'natural' basis for generalisation.
2. Case studies allow generalisations either about an instance or from an instance to a class. Their peculiar strength lies in their attention to the subtlety and complexity of the case in its own right.
3. Case studies recognise the complexity and 'embeddedness' of social truths. By carefully attending to social situations, case studies can represent something of the discrepancies or conflicts between the viewpoints held by participants. The best case studies are capable of offering some support to alternative interpretations.
4. Case studies, considered as products, may form an archive of descriptive material sufficiently rich to admit subsequent reinterpretation. Given the variety and complexity of educational purposes and environments, there is an obvious value in having a

data source for researchers and users whose purposes may be different from our own.

5. Case studies are 'a step to action'. They begin in a world of action and contribute to it. Their insights may be directly interpreted and put to use; for staff or individual self-development, for within-institutional feedback; for formative evaluation; and in educational policy making.
6. Case studies present research or evaluation data in a more publicly accessible form than other kinds of research report, although this virtue is to some extent bought at the expense of their length. The language and the form of the presentation is hopefully less esoteric and less dependent on specialised interpretation than conventional research reports. The case study is capable of serving multiple audiences. It reduces the dependence of the reader upon unstated implicit assumptions ... and makes the research process itself accessible. Case studies, therefore, may contribute towards the 'democratisation' of decision-making (and knowledge itself). At its best, they allow the reader to judge the implications of a study for himself.

Table 7: Possible advantages of case study  
Source: Cohen and Manion, 1985, p.146.

A close reading of the six advantages above show that they all have particular relevance to the study conducted for the purpose of this thesis.

Millar (1983) is another writer who has discussed the advantages of case study research:

a) It is often a case of personal involvement by the researcher. This provides a means to greater insight into both self and process which issues, hopefully into improved practice, clearer goals and better informed strategy.

b) Its starting point can often be an uncomfortable sense of complexity, ritual or routine, masking insight into what is really going on which is seen as



a real challenge to undisclosed meaning for the researcher.

c) The researcher must be both insider and outsider in the study which should in its own way problematise the taken for granted practices and rationales that sustain educational institutions. Doing this has the salutary effect of altering the terms in which educational practice can be comfortably engaged in (pp. 122-123).

It is hoped that the attempt to apply these points in this study will become clear in chapter five of this thesis viz. the case study report.

As far as the weaknesses of case study research are concerned, they are acknowledged to exist and should be borne in mind when considering the research conducted in this study. However, it is believed that careful, meticulous application of the procedures pertaining to case study research, as has been attempted in this study, can overcome many of the traditional criticisms of this method and reduce any adverse effect on the quality or value of the research.

Cohen and Manion (1985) see many, but not all, case studies as 'subjective, biased, impressionistic, idiosyncratic and lacking in the precise quantifiable measures of surveys or experiments' (p. 125). Also, the observer can lose his perspective as a result of becoming part of a group and can become blind to the peculiarities that he is supposed to be investigating. These criticisms as well as others will be answered later in this chapter

with an analysis of the writings of Yin (1984) and Millar (1983). The various weaknesses of case study research are now discussed.

Millar (1983) lists some problems which he sees facing case study research:

a) It does not provide a tidy and academically respectable procedure. This must be set, however, against the interest, flexibility and capacity to deliver a new grasp of reality that this approach holds.

b) Its 'false coherence' (p.121). Ralph Ruddock (1981) has stated:

In evaluation, as in other forms of enquiry, there is a danger of imposing a conceptual order upon an empirical chaos. If our evidence forces us to conclude that the field we are investigating is a confusion of conflicts and contradictions, how are we to transcend this confusion? Are we writing in bad faith if we attempt to give a coherent account of a process which is not coherent?

c) Its lack of objectivity. This means that the case researcher's perspective itself requires exposure and problematising as part of the presentation of the study (pp. 121-122).

Walker (1980) sees the most often raised objection to case study as the 'generalisation problem'. This is seen in terms of the supposed limited reliability and validity of the case study and is often framed in terms of two questions:

a) How can you justify studying only one instance?

b) Even if it is theoretically justifiable, what use can be made of the study by those who have to take action?

Besides the above, other difficulties which can be encountered by case study researchers include:

- a) problems of the researcher becoming involved in the issues, events or situations under study
- b) problems over confidentiality of data
- c) problems stemming from competition from different interest groups for access to, and control over, the data
- d) problems concerning publication, such as the need to preserve anonymity of subjects
- e) problems arising from the audience being unable to distinguish data from the researcher's interpretation of the data (p.35).

Walker sees problems of the kind listed above as methodological and isolated technical problems that can be overcome within existing frames of research. The problems above, with the exception of point a), are not seen as being relevant to the nature of the study conducted for the purpose of this thesis.

In a later paper Walker (1983) examines three reasons for being careful when conducting case-study research. He states that case-study research:

- a) can be an intervention, and often an uncontrolled intervention, in the lives of others
- b) can provide a biased, distorted view of the way things are
- c) is essentially conservative in nature. Case studies are seen to 'embalm what is established practice simply by describing it' (p.163).

Based on mistakes he made when conducting case study research, he lists four resolutions which he will carry through in the future and which he hopes his readers will carry through:

- (a) First, not to underestimate the interventive power of the case study and its methods. Where possible to make use of multiple observers to act to protect the lives of participants, and to hold to procedures which build in countervailing forces in order to strengthen the position of those who are subjects of, and to, such research.
- (b) Second, to take care not to neglect the fact that the conduct of research is a social process, a temporary system, which has to find space for itself and so to be accommodated by other interests. Case-study research is not simply interventive as a process, but as the presence of people and relationships impinging on existing patterns of authority and of social relations. In the academic world we tend to lay great stress on the value of information for understanding, and to stress democratic rights of free access to information. In the worlds we study, research information is often conceived as the currency of power, and right of access to it controlled by bureaucratic boundaries. The interaction of these two sets of conflicting assumptions is frequently a more significant part of the research process than we admit or allow. It is not simply noise in the system, or the consequence of poor designs, but marks a fundamental discontinuity between the worlds of the researcher and of the subject.
- (c) Third, where possible to design studies such that those with power over the lives of others included in the scope of the study are required by the design to see the nature of their responsibilities. In particular, to design studies that give those at different levels of the system equal access to, and control over, the resources that the research provides.
- (d) Fourth, we should constantly look for ways of underlining the fact that case studies tell a truth but not the truth. They may offer certain claims to truth, depending on the nature of the

evidence they provide, but they are always partial accounts; constructions of reality; representations. Though, as I have argued here, they may well become part of the culture they describe, in that they provide shared memories and perceptions for their subjects, and so are likely to become a part of institutional mythology (pp. 164-165).

Due to its applicability in this study it is important to take note particularly of point (d) above viz. that 'case studies tell a truth but not the truth ..... they are always partial accounts ..... constructions of reality, representations'.

Yin (1984) and Millar (1983) are two writers who have examined the criticisms of case study research. Yin lists, discusses and attempts to dispel three common prejudices against case study research:

a) On their supposed lack of rigour Yin states:

Too many times, the case study investigator has been sloppy, and has allowed equivocal evidence or biased views to influence the direction of the findings and conclusions. As a result, every case study investigator must work hard to avoid this situation (p.21).

He continues:

What is often forgotten is that bias can also enter into the conduct of experiments (see Rosenthal, 1966) and in using other research strategies, such as designing questionnaires for surveys (Sudman & Bradburn, 1982), or in conducting historical research (Gottschalk, 1968). The problems are not different, but in case study research, they have been less frequently documented and addressed (p.21).

b) They provide very little basis for scientific generalization. As Yin (1984) says:

"How can you generalise from a single case?" is a frequently heard question. The answer is not a simple one, and it has continually been attempted without success (see Guba & Lincoln, 1981). However, consider for the moment that the same question had been asked about an experiment: "How can you generalise from a single experiment?" In fact, scientific facts are rarely based on single experiments; they are usually based on a multiple set of experiments, which have replicated the same phenomenon under different conditions. The same approach can be used with multiple-case studies but requires a different concept of the appropriate research designs. The short answer is that case studies, like experiments, are generalisable to theoretical propositions and not to populations or universes. In this sense, the case study, like the experiment, does not represent a "sample", and the investigator's goal is to expand and generalise theories (analytic generalisation) and not to enumerate frequencies (statistical generalisation) (p.21).

c) They can take too long and result in massive, unreadable documents. Yin (1984) sees this complaint as being appropriate, given the way many case studies were done in the past, but this is not necessarily the way case studies are being done at present or must be done in the future. The traditional, lengthy narrative can be avoided altogether. Yin continues:

Nor need case studies take a long time. This incorrectly confuses the case-study strategy with a specific method of data collection, such as ethnography or participant-observation. Ethnographies usually require long periods of time in the "field" and emphasise detailed, observational evidence. Participant-observation, in contrast, may not require the same length of time but still assumes a hefty investment of field efforts. In contrast, case studies are a form of inquiry that does not depend solely on ethnographic or participant-observer data (pp.21-22).

Regarding the criticisms of case study research Yin (1984)

states that four tests are relevant for judging the quality of a research methodology. For case studies, he identifies several tactics for dealing with these tests. Table 8 lists the four tests and the case study tactics for dealing with them. The four tests have been summarised in numerous social science textbooks and are listed by Yin (1984) as follows:

**Construct validity:** establishing correct operational measures for the concepts being studied;

**Internal validity** (for explanatory or causal studies only, and not for descriptive or exploratory studies): establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships;

**External validity:** establishing the domain to which a study's findings can be generalised; and

**Reliability:** demonstrating that the operations of a study - such as the data collection procedures - can be repeated, with the same results (p.36).

a) Construct validity. According to Yin (1984) two steps must be covered to meet the test of construct validity: '1) select the specific types of changes that are to be studied (in relation to the original objectives of the study) and 2) demonstrate that the selected measures of these changes do indeed reflect the specific types of change that have been selected' (p.37). In this study these steps have been implemented in the following ways: (1) It is hoped that the use of the fieldwork approach to teach the ecology section of the syllabus will have brought about changes in the pupil's perceptions of the

Tests	Case-Study tactic	Phase of research in which tactic occurs
Construct validity	use multiple sources of evidence;	data collection
	establish chain of evidence; have key informants review draft case study report	data collection composition
Internal validity	do pattern matching;	data analysis
	do explanation-building;	data analysis
	do time-series analysis	data analysis
External validity	use replication logic in multiple-case studies	research design
Reliability	use case study protocol	data collection
	develop case study data base	data collection

Table 8: Case Study tactics for four design tests  
Source : Yin, 1984, p.36

As regards the study conducted for this thesis each of the four tests above will be discussed.



environment including how it operates and his role in its processes; (2) The questions in the worksheets, the questionnaires and interviews and, more particularly, the pupil's responses to these, hopefully will demonstrate the change of perception and attitude that has come about. The use of triangulation with direct observation combining with analysis of worksheets, questionnaires and interviews should assist in meeting the requirements of construct validity by providing multiple sources of evidence and establishing a chain of linking evidence between them. The review of the draft case study report by the study's supervisors is also seen as a tactic to meet the demands of construct validity.

b) Internal validity. According to Yin (1984) 'this is a concern only for causal or explanatory studies, where an investigator is trying to determine whether event X led to event Y' (p.38). Since this study is more of an evaluative type study, the problem of internal validity is not as relevant. Yin (1984) does point out though that 'concerns over internal validity, for case study research, may be extended to the broader problem of making inferences, with an inference seen as every time an event cannot be directly observed' (p.38).

c) External validity. This deals with the problem of knowing whether a study's findings are generalisable beyond the immediate case study - seen by some as a major

barrier to doing case studies. As was stated earlier in this chapter by Yin, case studies are generalisable to theoretical propositions only and not to populations. They do not represent a sample and the researcher's goal should be seen to attempt to expand and generalise theories (an analytic generalisation) and not to enumerate frequencies (statistical generalisation). The study which is of concern here should be seen as an 'exemplary' case study in this context.

d) Reliability. The objective here is to be sure that, if a later investigator followed exactly the same procedures as described by an earlier investigator and conducted the same case study all over again, the later investigator should arrive at the same findings and conclusions. The goal of reliability is to minimise the errors and biases in a study. To do this case study research procedures must be properly documented. Yin suggests this be done through the use of a case study protocol or plan of action which should have the following sections:

i) overview of the case study project (the project's objectives and auspices, the case study issues, relevant readings about the topic being investigated i.e. the literature review)

ii) field procedures (i.e. the research design and description of the case study methodology)

iii) case study questions (i.e. the questions in the worksheets, questionnaires and interviews which the investigator must keep in mind when collecting data as well as the potential sources of information for answering the questions)

iv) guide for the case study report (helps provide an outline or format for the later compilation of the case study report)

The study conducted for the purposes of this thesis employed a case study protocol as suggested by Yin and as a result attempted to achieve a satisfactory level of reliability.

The importance of reporting fully everything done in the case study is thus important to satisfy the test of reliability. This requires careful observation and reporting of the activities that took place while in the field. Cohen and Manion (1985) have cited a number of useful suggestions about collecting field notes which have been summarised in Table 9 and which were generally adhered to in this study, except for points 4 and 5 which were not seen as relevant in the context of the study.

1. Record the notes as quickly as possible after observation, since the quantity of information forgotten is very slight over a short period of time but accelerates quickly as more time passes.
2. Discipline yourself to write notes quickly and reconcile yourself to the fact that although it may

seem ironic, recording of field notes can be expected to take as long as is spent in actual observation.

3. Dictating rather than writing is acceptable if one can afford it, but writing has the advantage of stimulating thought.
4. Typing field notes is vastly preferable to handwriting because it is faster and easier to read, especially when making multiple copies.
5. It is advisable to make at least two copies of field notes and preferable to type on a master for reproduction. One original copy is retained for reference and other copies can be used as rough draft to be cut up, reorganised and rewritten.
6. The notes ought to be full enough adequately to summon up for one again, months later, a reasonably vivid picture of any described event. This probably means that one ought to be writing up, at the very minimum, at least a couple of single space typed pages for every hour of observation.

Table 9: Field notes in observation studies  
Source : Cohen and Manion, 1985, p.127

Regarding the criticism of a lack of objectivity in case study research referred to earlier in this chapter, Millar (1983) states that the case study 'addresses the critique of subjectivity by presenting findings, procedures, basic data, and its own frame of reference for public scrutiny and attack. It does not claim the status of "truth" or "last word"; it simply invites confrontation by a better analysis' (p.122). In his conclusion to a consideration of weaknesses of case study research, Millar (1983) believes 'that good faith is at the core of the matter. A case study can be a glib and manipulative document. Insurance against this lies not in research technique but

in research ethic, and here accountability is the key term' (p.122). He continues: 'To conduct a case study requires the cooperation of people; it also requires their frankness, which may constitute a risk for them. It is essential therefore to clarify, negotiate and have agreement on the terms of research cooperation' (p.122). It was the experience of this study that a cordial, co-operative relationship existed between the researcher and his target group of pupils, with both parties having a clear knowledge of what was expected of them in the study, which resulted in a sound and successful working relationship.

#### The use of triangulation in case studies

The case study undertaken for the purposes of this thesis used triangulation as an appropriate method of evaluating the ecological fieldwork undertaken by the target pupils in Pigeon Valley. A consideration of points raised by various writers in this field, as discussed below will substantiate the use of this method in this study.

Stenhouse (1982) points out that an important issue in all reports of case study is the conception of reality they reflect. In the case of this study the reality being reflected will consist of what occurred during the ecological fieldwork which took place in Pigeon Valley. Stenhouse continues: 'In order to establish what really

went on we use 'triangulation' taking bearings on the issue by using evidence from different sources to cross check' (p.269). The strength of a case study's conclusions can often lie with these multiple sources of evidence each contributing to what would hopefully constitute a description of what really did occur in the study. For the purposes of this study, triangulation was achieved by the use of personal observation, worksheets, questionnaires and interviews. A triangulation methods matrix was drawn up (Appendix A) showing what items of desired information required could be provided by one of the four techniques used in the study. Such a matrix was based on one which appeared in Cohen and Manion (1985). Cohen and Manion (1985) see triangulation as 'the use of two or more methods of data collection in the study of some aspect of human behaviour' (p.254). This multimethod approach is a technique of research which is being used more and more in the social sciences. They continue: 'Triangular techniques in the social sciences attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint and, in so doing, by making use of both quantitative and qualitative data' (p.254). It is the contention of this study that the use of triangular techniques constitute an appropriate way of studying the complexity of human behaviour as displayed by the pupils involved in ecological fieldwork in Pigeon Valley. The

advantages of this multimethod approach in social research are manifold and Cohen and Manion examine two of them.

First, whereas the single observation in fields such as medicine, chemistry and physics normally yields sufficient and unambiguous information on selected phenomena, it provides only a limited view of the complexity of human behaviour and of situations in which human beings interact. It has been observed that as research methods act as filters through which the environment is selectively experienced, they are never atheoretical or neutral in representing the world of experience. Exclusive reliance on one method, therefore, may bias or distort the researcher's picture of the particular slice of reality he is investigating. He needs to be confident that the data generated are not simply artefacts of one specific method of collection. And this confidence can only be achieved as far as normative research is concerned when different methods of data collection yield substantially the same results. (Where triangulation is used in interpretive research to investigate different actors' viewpoints, the same method, e.g. accounts, will naturally produce different sets of data.) Further, the more the methods contrast with each other, the greater the researcher's confidence. If, for example, the outcomes of a questionnaire survey correspond to those of an observational study of the same phenomena, the more the researcher will be confident about the findings (pp. 254-255).

Secondly, the use of triangular techniques, it is argued, will help to overcome the problem of 'method-boundedness', as it has been termed. For example, the problem of time-boundedness affects the vast majority of studies with most limited to one point in time and therefore not taking into consideration the fact of social change.

Cohen and Manion illustrate the principle of triangulation in a simple form by providing a list of ten items which make up an attitude scale measuring a teacher's view of his role.

They explain the attitude scale and the principle of triangulation in the following way:

One item, or 'locational marker', by itself will tell us very little about a teacher's attitude in this respect. But ten such related items, or 'locational markers', will give a much fuller picture. Imagine now a detailed study of a class of pupils in a secondary school which involves teachers' ratings of pupils, school records, psychometric data, sociometric data, case studies, questionnaires and observation. Add to this the findings of investigations of similar classes in ten other secondary schools and we then have an illustration of the principle of triangulation at a more complex level (p.256).

The greater representative picture of a situation provided by triangulation, as revealed above, seemed to indicate to this researcher its appropriate use in his study.

Denzin (1970 cited in Cohen and Manion, 1985, p.257) is another writer who has concerned himself with triangulation and has identified the principal types of triangulation used in research (Table 10).

According to Cohen and Manion at least four of these types have been used in education viz. time, space, investigator and methodological triangulation. Of the four, they see the methodological type as the one used most frequently and the one that has the most to offer.



1. **Time triangulation:** this type attempts to take into consideration the factors of change and process by utilising cross-sectional and longitudinal designs.
2. **Space triangulation:** this type attempts to overcome the parochialism of studies conducted in the same country or within the same subculture by making use of cross-cultural techniques.
3. **Combined levels of triangulation:** this type uses more than one level of analysis from the three principal levels used in the social sciences, namely, the individual level, the interactive level (groups), and the level of collectivities (organisational, cultural or societal).
4. **Theoretical triangulation:** this type draws upon alternative or competing theories in preference to utilising one viewpoint only.
5. **Investigator triangulation:** this type engages more than one observer.
6. **Methodological triangulation:** this type uses either (a) the same method on different occasions, or (b) different methods on the same object of study.

Table 10: The principal types of triangulation used in research

Source : Cohen and Manion, 1985, p.257.

This study concerns type 6(b) viz. methodological triangulation using different methods on the same object of study, referred to by Cohen and Manion as the between methods' type. The triangulation techniques used in this study each provide a differing and unique perspective on the fieldwork exercise undertaken, each providing its own information on the situation.

Cohen and Manion list the following instances where use of triangulation in education might be appropriate. Most of the points stated here provide justification for the use

of triangulation in this study.

1) Triangular techniques are suitable when a more holistic view of educational outcomes is sought, including very importantly the development of attitudes.

2) Triangulation has special relevance where a complex phenomenon requires elucidation eg. where a comparative study is carried out comparing formal and informal teaching.

3) Triangulation is also appropriate when different methods of teaching are to be evaluated eg. when different methods of teaching arithmetical subtraction are evaluated.

4) Multiple methods are suitable where a controversial aspect of education needs to be evaluated more fully eg. the comprehensive school system in England.

5) Triangulation is useful when an established approach yields a limited and frequently distorted picture eg. use of a normative approach only rather than a combined normative/interpretive approach.

6) Triangulation can be a useful technique where a researcher is engaged in case study, a particular example of the 'complex phenomena' mentioned under point 2) above.

In this connection, Adelman et al (1980) wrote:

The advantages of a particular technique for collecting witnesses' accounts of an event - triangulation - should be stressed. This is at the

heart of the intention of the case study worker to respond to the multiplicity of perspectives present in a social situation. All accounts are considered in part to be expressive of the social position of each informant. Case study needs to represent, and represent fairly, these differing and sometimes conflicting viewpoints (cited in Cohen and Manion, 1985, pp.262-263).

Cohen and Manion believe that a researcher is confronted with three broad questions when contemplating a multimethod approach to a problem: Which methods are to be selected? How are they to be combined? How are the data to be used? Consideration is given to these questions at this point.

1) As far as the first question is concerned, the first task of the researcher will be to decide what kinds of information the researcher wants and, further, what he is to do with it. This can be done, as was discussed earlier, by means of a matrix similar to that recommended by Cohen and Manion. He then decides the most appropriate methods (or sources) for providing this information. The researcher should combine those methods (or sources) that will, in complementing each other, build up as full a picture of the areas he is investigating as time and facilities permit.

2) The selection of methods will depend on the objectives of the study, the particular situation, and the relative weightings which the researcher considers desirable to assign to the methods providing him with data. The crucial factor, however, when it comes to

integrating or contrasting the data and drawing inferences from them is the researcher's own judgement.

3) The way the data is used will depend on the researcher's original objectives in undertaking the study, his choice of methods and the kinds of data he accumulates. It is the contention of this study that the three broad questions on the use of a multimethod approach discussed above were successfully answered in the pre-planning and initial formulation of the study, thus enabling the application of such an approach.

Given that the use of triangulation is appropriate in case study research and, therefore, for the purposes of this study, an examination will now be made of the various techniques which were used in this research study.

#### Triangulation techniques used in the study

Besides the use of direct observation, the following triangulation techniques were used in this study: worksheets, questionnaires and interviews. The nature of each technique will be discussed in turn through an examination of the writings of various authors in the field and will be linked with the requirements of this study. The appropriateness of the triangulation techniques chosen will hopefully become apparent through the fairly detailed discussion of each technique which follows.

## WORKSHEETS

As far as the worksheets were concerned, two separate ones were drawn up for reasons outlined in chapter three of this thesis. A shorter, less detailed version of the worksheet, which does not form part of this study, was constructed using the method of traditional fieldwork for use by junior high school pupils (standards 6-8) (Appendix J) and a longer, more detailed version, based in part on the junior worksheet, using the method of field research, was constructed for use by senior high school pupils (standards 9-10) (Appendix E). The use by the 24 target pupils of the senior worksheet while conducting ecological fieldwork in Pigeon Valley constituted the essence of the study. The junior worksheets were drawn up to provide the school's geography department with a fieldwork programme on ecology applicable to all standards. An attempt was made, in drawing up the worksheets, to try to avoid the seven main faults to be found in worksheet construction as identified by Lloyd-Jones (1985):

- . they do not cater for the full range of ability in the classroom
- . the language they use is too difficult
- . the visual quality and layout is poor
- . there is insufficient variety of stimulus
- . there is lack of clarity about objectives
- . there is mindless filling of blanks, and not enough processing of information
- . it is not possible to see the wood for the trees (p.5)

As far as the worksheets drawn up for this study are concerned, following the points raised above:

1) The full range of ability levels in the target group seemed to have been catered for, judging by the generally high standard of pupil response to the worksheet questions, as revealed in chapter five of this thesis. Only one pupil out of the randomly selected target group of 24 pupils failed the worksheet exercise.

2) The language used in the worksheets is the language used by ecologists and environmentalists when discussing their subject, terminology the pupils are expected to be familiar with.

3) Whereas the visual quality of the worksheets was good in the original typed version, some of this may have been lost in its multiple duplication for the pupils. No major problems, as revealed in chapter five of this thesis, were reported by the pupils on the worksheet layout.

4) Based on the responses of both pupils and staff, as will be reported in the following chapter, it is thought that the worksheets do contain a sufficient variety of stimulus material.

5) There seems to be no major lack of clarity about objectives, based on pupil and staff feedback and the generally high standard of pupil response to the worksheet questions.

6) A fair amount of processing of information is required in completing the worksheets, as revealed by pupil feedback, many of whom felt the worksheets were too lengthy for the amount of time available to them for the exercise.

7) As Lloyd-Jones states:

Every worksheet says something about your relationship with your pupils, about how you feel about them on a personal level, about what you think they should learn and how they should learn it. It is all too easy to plunge into production without first standing back and 'seeing the wood' as a whole.

What assumptions are you making about the overall purposes of education and of your subject? About the needs of the pupils? Is the material you are producing worthwhile? What criteria do you use to judge worthiness? Is the material better than what it is replacing? What is your definition of better?

What is your rationale for the decisions you have made concerning where you want to place your material? (Table 13). What degree of teacher control is implied in your material? What teaching methods and types of classroom organisation are assumed?

What policy regarding the deployment of resources are you using - open access, controlled access, limited access?

Much teaching, especially in subjects like English or the Social subjects, concerns specific value positions. Are you aware that values are being put across by your material? Are such values assumed or implied without actually being stated? Are they mentioned without comment? Are they put up for discussion?

Worksheets are a tangible expression of your aims, of your interpretation of the syllabus, of your feelings about the subject, of your general view of what teaching and learning are about. So it is not an airy-fairy waste of time to stand back and ask yourself these fundamental questions (p.8).

Following the above quotation it is felt that the tremendous amount of thought and time that went into the construction of the worksheets used in this study do reveal this researcher's aims, interpretation of the syllabus, his feelings for his subject and his general views on teaching and learning. The construction of these worksheets definitely did prompt the asking of a large number of fundamental questions relating to the researcher's position in education.

In his book, Lloyd-Jones supplies a detailed check list of questions which need to be considered by teachers drawing up worksheets. In addition, his very useful book provides guidelines for teachers. During the worksheet construction phase of the study use was made of Lloyd-Jones' suggested approach to evaluating worksheets (Table 11) which is included in the study as a guide for fellow teachers.



From	To
Classes treated as one homogeneous unit.	Recognition of individual differences.
Emphasis on content and didactic methods.	Emphasis on process and concepts and self-discovery methods.
2x4 teaching. (Two covers of the text-book, four walls of the classroom).	Multi-media materials, practical and oral work, links with the community.
Teacher as instructor in a role of authority.	Teacher as manager of resources and learning experiences.
Emphasis on factual knowledge and academic studies.	Increasing emphasis on social, emotional, moral and aesthetic development.
Transmission of past culture.	Transformation of present and future society.
Learning experiences determined by the requirements of the subject.	Learning experiences determined by individual needs, interests and viewpoint.

Table 11: Teacher evaluation of worksheets  
Source : Lloyd-Jones, 1985, p.8

### QUESTIONNAIRES

As far as the questionnaires were concerned, notice was taken of guidelines for questionnaire construction provided by Leedy (1980) and Steinberg (1983). Leedy sees the questionnaire as 'a commonplace instrument for observing data beyond the physical reach of the observer' (p.99). He sees it as a totally impersonal probe and because of this characteristic of questionnaires, he believes that we need to be governed by several practical

guidelines when using them. An attempt was made to take these guidelines into account when constructing the questionnaires used in this study.

1) The language must be unmistakably clear in soliciting precisely what the researcher wishes to learn. Leedy suggests that the first guideline for questionnaire construction should be to inspect the assumptions which underly the questionnaire asking whether they fit the realities of life. As a result, all questionnaires should be pretested on a small population in a pilot study. In this case the groups which were used in a pilot study of the first draft worksheets were also used to pretest the questionnaires. The object of the pilot study was to test whether there were any items that the pupils found difficult to understand or comprehend. As will be revealed in chapter five of this thesis no major problems were encountered in this area. Should ambiguity of any kind exist though, one of the major causes for such a situation says Leedy 'is that the researcher has not spent enough time and care in defining the purpose for each item in the questionnaire, nor have the questions been edited so that each question is phrased with that meticulous precision of language necessary to elicit the answers that the researcher is seeking' (p.100). Steinberg (1983) sees the issue of question wording as:

probably the most important aspect when designing a questionnaire and provides the following useful guidelines:

- . employ simple language and words familiar to all respondents
- . avoid ambiguous words or phrases
- . involved and complex questions should be reduced to a number of simply-stated, concisely worded questions
- . questions should be as specific as possible
- . avoid leading questions
- . only one aspect should be covered per question
- . phrase sensitive questions with care
- . avoid sensitive or emotional words
- . avoid phrases that state a deviation from an accepted norm or value bluntly
- . take the differences in frame of reference between researcher and respondent into consideration
- . define the period precisely in questions pertaining to past or periodic behaviour
- . take into account potential memory and recall failures when posing questions relating to past events
- . check questions (p.23).

2) Questionnaires should be designed to fulfil a specific research objective. As Leedy states:

Item by item, a questionnaire should be built and quality-tested again and again for precision of expression, objectivity, relevance, suitability to the problem situation, and probability of favourable reception and return. Have you concentrated upon the recipient of the questionnaire, putting yourself in the place of one who is asked to invest time on your behalf? If you received such a questionnaire from a stranger, what would your honest reaction be? These

questions are very important and should be answered impartially (p.100).

3) The writer of a questionnaire should never forget that he is asking of his respondents time and effort and the favour of a reply. This brings up several important considerations in questionnaire construction:

a) Be courteous. Use polite wording to develop a rapport with respondents.

b) Make it simple to complete.

c) Think of the respondent eg. avoid phrases that may antagonise respondents.

d) Concentrate on the universal rather than on specifics, to general problems and ideas rather than purely personal matters, local conditions or concerns unless the study specifically concerns local matters.

e) Make the questionnaire brief and should solicit only those data essential to the research project. Only pertinent questions should be incorporated.

f) Check for consistency. As Leedy states:

In questionnaires dealing with debatable or opinion-sensitive issues or in situations where you may suspect that the respondee may give answers that are deemed prudent in certain cases, rather than what represents the candid truth, you may wish to incorporate a countercheck question into your list of questions at some distance from the first question. This helps to verify the consistency with which the

g) Offer to reveal the results of the study to the respondents should they be interested.

h) Think ahead, even before constructing the questionnaire, precisely how the data will be processed after the results are received as they can determine the form the questionnaire should take.

i) The importance of the initial approach to the respondents, politely requesting their co-operation and briefly telling them the purpose of the study.

Appendix H represents the questionnaire used as part of this study.

#### INTERVIEWS

Regarding interviews, the guidelines of writers such as Leedy (1980), Steinberg (1983) and Cohen and Manion (1985) have been taken into account. Leedy states:

Closely allied to the questionnaire is the structured interview. The interview, as a data-gathering technique, is frequently misunderstood. Most students think of it as "simply asking a person some questions"; and, of course, it is that. But it is not asking just any questions in any way. The questions for the interview should be as carefully planned and as accurately worded as the items in a questionnaire. Interviews should be considered as strictly professional situations which demand equally professional planning and conduct on the part of the interviewer. We have seen how the questionnaire demands considerable thought and planning for its effective administration. Equally careful planning is no less necessary for the interview (p.104).

He goes on to describe in some detail how a researcher should proceed to arrange an interview, much of which is irrelevant in the situation of this study viz. with a teacher as the researcher and with ready-to-hand pupil respondents, which obviates steps like the writing of

letters setting up the interview, the sending out of written confirmations to respondents etc.

Steinberg (1983) sees interviews as being categorised according to the level of structure of the interview schedule used, ranging from the highly structured formal interview to a totally informal situation.

He lists the following advantages and disadvantages of interviews, which have been taken account of when conducting this research:

#### Advantages

- . the dialogue situation usually results in greater and more accurate detail being obtained
- . topics can be probed when necessary
- . facilitates high response rates
- . rapport can be established and maintained, thereby retaining interest until the end of the interview
- . the burden of writing responses can be alleviated
- . it is a very flexible technique
- . ambiguities can be clarified
- . non-verbal behaviour as well as verbal behaviour can be recorded
- . complex situations, employing intricate questions, can be investigated
- . the length of the question schedule is less critical than with mailed questionnaires
- . more open-ended questions can be employed
- . the interviewer can ensure that all questions are answered and in the correct sequence

- . environmental control can be exercised
- . the veracity and validity of responses can be assessed

#### Disadvantages

- . a very time-consuming method and, therefore, not suitable when questioning a large number of respondents who are, furthermore, scattered geographically
- . anonymity cannot be guaranteed
- . the respondent is restricted by the interviewer to a specific time and place for the interview
- . the situation is open to many forms of bias - both the interviewer and the respondent are involved in a process of social interaction and are governed by the rules and restrictions of such an interaction
- . different interviewers elicit different responses thereby introducing an element of inconsistency
- . an interviewer may react differently to various respondents and thereby possibly distort the results (pp.20-21).

Steinberg believes that many of these disadvantages may be counteracted, as has been attempted in this study, by:

employing a highly structured questioning schedule, which will elicit standardised responses during the interview. The interviewer should, furthermore, develop interview techniques that will minimise the effect of conscious and unconscious interviewer/respondent biases (p.21).

Cohen and Manion (1985) see the interview as a popular research technique in the range of methods used in social research. The purposes of the interview are many and varied and include testing and developing hypotheses, gathering data and sampling respondents' opinions.

Cannell and Khan (1968) define the research interview as 'a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information, and focused by him on content specified by research objectives of systematic description, prediction, or explanation' (cited in Cohen and Manion, 1985, p.291).

Cohen and Manion see it as an unusual method in that it involves the gathering of data through direct verbal interaction between individuals. In this sense it differs from the questionnaire where the respondent is required to record in some way his responses to set questions. The relative merits of the interview and questionnaire are given in Table 12 and need to be considered by all persons concerned with these research techniques.

Cohen and Manion have also, in descriptive terms, compared interviews with self-administered questionnaires:

Each has advantages over the other in certain respects. The advantages of the questionnaire, for instance, are: it tends to be more reliable; because it is anonymous, it encourages greater honesty; it is more economical than the interview in terms of time and money; and there is the possibility that it may be mailed. Its disadvantages, on the other hand, are: there is often too low a percentage of returns; the interviewer is able to answer questions concerning both the purpose of the interview and any misunderstandings experienced by the interviewee, for it sometimes happens in the case of the latter that the same questions have different meanings for different people; if only closed items are used, the questionnaire will be subject to the weaknesses already discussed; if only open items are used, respondents may be unwilling to write their answers for one reason or another; questionnaires present problems to people of limited literacy; and an



interview can be conducted at an appropriate speed whereas questionnaires are often filled in hurriedly (p.304).

The direct interaction of the interview compared to questionnaires has been seen as a source of both its advantages and disadvantages as a research technique. One advantage, for example, is that it allows for greater depth than is the case with other methods of data collection. A disadvantage, on the other hand, is that it can be prone to subjectivity and bias on the part of the interviewer.

According to Cohen and Manion, as a distinctive research technique, the interview may serve three purposes:

First, it may be used as the principal means of gathering information having direct bearing on the research objectives. As Tuckman (1972) describes it, 'By providing access to what is "inside a person's head", (it) makes it possible to measure what a person knows (knowledge or information), what a person likes or dislikes (values and preferences), and what a person thinks (attitudes and beliefs).' Second, it may be used to test hypotheses or to suggest new ones; or as an explanatory device to help identify variables and relationships. And third, the interview may be used in conjunction with other methods in a research undertaking (pp.292-293).

Cohen and Manion identify four kinds of interview that may be used specifically as research tools: the structured interview; the unstructured interview; the non-directive interview and the focused interview. The structured type is the one which has been used in this study (Appendix I).

Consideration	Interview	Questionnaire
1. Personal need to collect data	Requires interviewers	Requires a clerk
2. Major expense	Payment to interviewers	Postage and printing
3. Opportunities for response-keying (personalisation)	Extensive	Limited
4. Opportunities for asking	Extensive	Limited
5. Opportunities for probing	Possible	Difficult
6. Relative magnitude of data reduction	Great (because of coding)	Mainly limited to rostering
7. Typically, the number of respondents who can be reached	Limited	Extensive
8. Rate of return	Good	Poor
9. Sources of error	Interviewer, instrument, coding, sample	Limited to instrument and sample
10. Overall reliability	Quite limited	Fair
11. Emphasis on writing skill	Limited	Extensive

Table 12: Summary of relative merits of interviewing versus questionnaire  
Source : Cohen and Manion, 1985, p.292

They see the structured interview in the following way:

The structured interview is one in which the content and procedures are organised in advance. This means that the sequence and wording of the questions are determined by means of a schedule and the interviewer is left little freedom to make modifications (p.293).

Cohen and Manion's classification of kinds of interview is similar to Steinberg's (1983) categorisation of interviews according to the level of structure of the interview schedule used, as discussed earlier in this chapter.

Kitwood (1977) has identified three conceptions of the interview held by those who use it as a research tool. The first conception is that of a potential means of pure information transfer. He explains that:

If the interviewer does his job well (establishes rapport, asks questions in an acceptable manner, etc.), and if the respondent is sincere and well-motivated, accurate data may be obtained. Of course all kinds of bias are liable to creep in, but with skill these can largely be eliminated. In its fullest expression, this view accords closely with that of the psychometricians, who apparently believe that there is a relatively permanent, consistent, 'core' to the personality, about which a person will give information under certain conditions. Such features as lying, or the tendency to give a socially desirable response, are to be eliminated where possible (cited in Cohen and Manion, 1985, p.294).

A second conception of the interview is that of a transaction which inevitably has bias, which is to be recognised and controlled. According to this viewpoint, Kitwood explains that:

each participant in an interview will define the situation in a particular way. This fact can be best handled by building controls into the research design, for example by having a range of interviewers with different biases (cited in Cohen and Manion, 1985, p.295).

The interview is best understood in terms of a theory of motivation which recognises a range of non-rational factors governing human behaviour, like emotions, unconscious needs and interpersonal influences. These potential obstacles to sound research need to be controlled and harnessed in some way, an almost impossible task and one which Kitwood offers no explanation for.

The third conception of the interview sees it as an encounter necessarily sharing many of the features of everyday life. Kitwood suggests that what is required, according to this view, is not a technique for dealing with bias, but a theory of everyday life that takes account of the relevant features of interviews. These may include role-playing, stereotyping, perception and understanding. Cicourel (1964) lists five of the unavoidable features of the interview situation that would normally be regarded as problems. Briefly, these are that:

1. There are many factors which inevitably differ from one interview to another, such as mutual trust, social distance and the interviewer's control.

2. The respondent may well feel uneasy and adopt avoidance tactics if the questioning is too deep.
3. Both interviewer and respondent are bound to hold back part of what it is in their power to state.
4. Many of the meanings which are clear to one will be relatively opaque to the other, even when the intention is genuine communication.
5. It is impossible, just as in everyday life, to bring every aspect of the encounter within rational control (cited in Cohen and Manion, 1985, p.295).

The message that proponents of this view would express is that no matter how hard an interviewer may try to be systematic and objective, the constraints of everyday life will be a part of whatever interpersonal transactions he initiates. In this study the interview was used as a means of collecting information on the ecological fieldwork experiences of the target group pupils in Pigeon Valley. During this study cognisance was taken of these conceptions of the interview and researchers must be aware of them when conducting interviews.

Continuing with an analysis of the use of interviews as a research technique, where relevant for the purposes of this study, Cohen and Manion identify three kinds of items used in the construction of schedules used in structured research interviews: fixed-alternative items, scale items and open-ended items which constituted the questions used in the interview schedule. Cohen and Manion's identification at this point of items used in the

IDENTIFICATION of kinds of research interview and Steinberg's (1983) categorisation of interviews according to level of structure referred to earlier in this chapter.

Open-ended items have been defined by Kerlinger (1970) as:

those that supply a frame of reference for respondents' answers, but put a minimum of restraint on the answers and their expression (cited in Cohen and Manion, 1985, p.297).

With open-ended items, other than the subject of the question, which is determined by the nature of the problem under investigation, there are no other restrictions on either the content or the manner of the interviewee's reply.

Cohen and Manion see open-ended questions as having a number of advantages:

they are flexible; they allow the interviewer to probe so that he may go into more depth if he chooses, or clear up any misunderstandings; they enable the interviewer to test the limits of the respondent's knowledge; they encourage co-operation and help establish rapport; and they allow the interviewer to make a truer assessment of what the respondent really believes. Open-ended situations can also result in unexpected or unanticipated answers which may suggest hitherto unthought-of relationships or hypotheses (p.297).

However, on the other hand, according to Cohen and Manion:

One of the problems that has to be considered when open-ended questions are used in the interview is that of developing a satisfactory method of recording replies. One way is to summarise responses in the

course of the interview. This has the disadvantage of breaking the continuity of the interview and may result in bias because the interviewer may unconsciously emphasise responses that agree with his expectations and fail to note those that do not. It is sometimes possible to summarise an individual's responses at the end of the interview. Although this preserves the continuity of the interview, it is likely to induce greater bias because the delay may lead to the interviewer forgetting some of the details. It is these forgotten details that are most likely to be the ones that disagree with his own expectations (p.304).

The interview schedule used in this study (Appendix I) has concentrated on asking open-ended questions which Cohen and Manion have identified as: 1) indirect rather than direct, 2) general rather than specific, 3) eliciting opinions rather than factual answers, 4) questions have been asked rather than statements responded to. Unstructured responses rather than structured responses are required from interviewees in this study. According to Cohen and Manion:

Although the interviewer has little control over the unstructured response, it does insure that the respondent has the freedom to give his own answer as fully as he chooses rather than being constrained in some way by the nature of the question. The chief disadvantage of the unstructured response concerns the matter of quantification. Data yielded in the unstructured response is more difficult to code and quantify than data in the structured response (pp.299-300)

This difficulty in quantifying data has been found to be the case in this study and will be discussed in chapter five.

The disadvantages of the unstructured interviewee response discussed above must be acknowledged as possibly providing

these are likely to be overcome by the use of triangulation, with the other techniques employed providing information not obtained from the interview and contributing towards a fully rounded analysis of the situation.

Cohen and Manion consider some further problems which surround the use of the interview as a research tool which researchers need to be aware of. One of these is that of invalidity, caused by bias which has been defined by the writers as: 'a systematic or persistent tendency to make errors in the same direction, that is, to overstate or understate the true value of an attribute' (p.302). The most practical way of achieving greater validity is thus to minimise bias as much as possible. According to Cohen and Manion:

The sources of bias are the characteristics of the interviewer, the characteristics of the respondent, and the substantive content of the questions. More particularly, these will include: the attitudes and opinions of the interviewer; a tendency for the interviewer to see the respondent in his own image; a tendency for the interviewer to seek answers that support his preconceived notions; misperceptions on the part of the interviewer of what the respondent is saying; and misunderstandings on the part of the respondent of what is being asked. Studies have also shown that colour, religion, social class and age can in certain contexts be potent sources of bias. Various writers have suggested the following as means of reducing bias: careful formulation of questions so that the meaning is crystal clear; thorough training procedures so that an interviewer is more aware of the possible problems; probability sampling of respondents; and sometimes by matching interviewer characteristics with those of the sample being interviewed (p.302).



The problem of bias is an inevitable one facing a study of this nature but was hopefully minimised through the careful formulation of the questions posed (through discussion with supervisors and use of the pilot study pupils as sample respondents).

Another problem with the interview as a research tool is the conflict it generates between the traditional concepts of reliability and validity. Where increased reliability of the interview is brought about by greater control of its elements, this is achieved often at the cost of reduced validity. As Kitwood (1977) explains:

In proportion to the extent to which 'reliability' is enhanced by rationalisation, 'validity' would decrease. For the main purpose of using an interview in research is that it is believed that in an interpersonal encounter people are more likely to disclose aspects of themselves, their thoughts, their feelings and values, than they would in a less human situation. At least for some purposes, it is necessary to generate a kind of conversation in which the 'respondent' feels at ease. In other words, the distinctively human element in the interview is necessary to its 'validity'. The more the interviewer becomes rational, calculating, and detached, the less likely the interview is to be perceived as a friendly transaction, and the more calculated the response also is likely to be (cited in Cohen and Manion, 1985, p.303).

Cohen and Manion continue:

Where either of the first two conceptions of the interview outlined earlier is held, Kitwood suggests that a solution to the problem of reliability and validity might lie in the direction of a 'judicious compromise'; with the third conception, however, reliability and validity become 'redundant notions', for 'every interpersonal situation may be said to be valid, as such, whether or not it conforms to expectation, whether or not it involves a high degree of communication, and whether or not the participants

Further problems with interviews surround the person being interviewed:

A cluster of problems surround the person being interviewed. Tuckman (1972) for example, has observed that when formulating his questions an interviewer has to consider the extent to which a question might influence the respondent to show himself in a good light; or the extent to which a question might influence the respondent to be unduly helpful by attempting to anticipate what the interviewer wants to hear; or the extent to which a question might be asking for information about a respondent that he is not certain or likely to know himself. Further, interviewing procedures are based on the assumption that the person interviewed has insight into the cause of his behaviour. It has now come to be realised that insight of this kind is rarely achieved and that when it is, it is after long and difficult effort, usually in the context of repeated clinical interviews (pp.303-304).

Stenhouse (1982) considers the problem or dilemma of using observation or interview in case study research:

I lean towards interview rather than observation. This is partly because I feel that the conditions of condensed field work preclude classic participant observation. But that is not the whole story. The people I interview are participants and they are observers of themselves and others; my object is to provide in interview the conditions that help them to talk reflectively about their observations and experience. It is their observations I am after, not mine. There is, of course, the possibility that at some points the interviewee is out to deceive the interviewer, and we must take account of the truism that we are all self-deceiving. At the same time it must be recognised that interview is often dependent upon observation. In the end, perhaps the issue is: is observation used to test interview or interview used to test observation? The first position is likely to be taken by those who see themselves as trying to establish facts: the second by those who see themselves as trying to disclose meanings (p.266).

This study has used both interviews and observation within the application of triangulation in an effort to obtain as

Pigeon Valley fieldwork. Certainly in this context, following Stenhouse above, the interview could be viewed as in a sense being used to test observation in an effort to disclose meaning of what occurred.

Stenhouse continues by giving consideration to the various methods used in fieldwork and problems like those alluded to above which accompany them. He sees the problems of record keeping in case study research as very important. It is on them that the plans of many case study researchers are seen to be wrecked. A big problem is the great deal of information which has to be handled and how it should be recorded, how it can be organised for use and how to write up the case study record.

He offers the following advice to case study researchers which has been heeded in this study:

- 1) So far as interviews are concerned the choice is between tape recording and taking notes. I use a tape recorder if I can: it protects the interviewee against misrepresentation, it captures the vividness of speech, it preserves a full record (p.267).

- 2) Notes on observations (like interview records) should always be dated and a time record should be kept in a margin. Sketches or photographs may be useful. A considerable problem in observation is its relation to inference, and the observer should cultivate a considerable depth of insight as to the individual characteristics of his observation and the degree and style of inference involved.

My name for the total collection of information as organised for use - interview, observation and document - is the 'case record' (Stenhouse, 1977).

The good organisation of this record is crucial for writing up. It should be carefully indexed. Photocopies of the record can be used to cut up and sort under different topics (record the page number on each piece!). Another possibility is to colour code margins using a different colour for each section or chapter of the report. Meticulous attention to such detail makes an enormous difference when the job of writing up has to be faced (p.268).

3) There is not enough experience of the problem of writing up this kind of material in contemporary educational research. The examples to turn to are clearly historians. For present purposes a good starting point is to consider the use of narrative, vignette and analysis. Such styles as these can, of course, be blended (p.268).

In connection with point 1) above Yin (1984) states:

A common question about recording interviews has to do with the use of tape recorders. Whether to use such devices is in part a matter of personal preference. The tapes certainly provide a more accurate rendition of any interview than any other method. However, a tape recorder should not be used when (a) an interviewee refuses permission or appears uncomfortable in its presence, (b) there is no specific plan for transcribing or systematically listening to the contents of the tapes, (c) the investigator is clumsy enough with mechanical devices that the tape recorder creates a distraction during the interview itself, or (d) the investigator thinks that the tape recorder is a substitute for "listening" closely throughout the course of an interview (p.85).

Regarding point 3) above this is the case with this study which has used both the narrative and analysis styles in the case study report in the following chapter of this thesis. The descriptive nature of narrative has been discussed by Stenhouse:

Narrative, as a form of presentation, has two great strengths: it is simple and direct to read and it is subtle. Its simplicity and directness is partly due to its being within a convention of representing the natural world that is thoroughly established and that most readers meet in the nursery, but it is also

partly because, as compared with analysis, the narrative form constrains the author from presenting his own logic in the teeth of resistance from the story. He does not drag the reader on to the territory of his own mind, but rather goes out to meet him. The subtlety of narrative lies in its capacity to convey ambiguity concerning cause and effect. In telling a story the author does not need to ascribe clearly causes and effects. Rather he may select from the record an array of information which invites the reader to speculate about causes and effects by providing him with a basis for alternative interpretations (p.268).

On the other hand, the analysis style debates points explicitly, wherever possible reviewing evidence. Its conceptual framework is drawn from systematic theory in the social sciences. It favours the search for precision in terminology and in theory, with definitions becoming very important.

These descriptions of the narrative and analysis styles by Stenhouse provide a justification for the use of these styles in this particular study.

#### The conduct of a case study

As a prelude to the case study report, to be presented in detail in the following chapter where the actual ecological fieldwork experiences of the target group of pupils are discussed, this chapter will conclude with a brief analysis of the research methodology employed in the conduct of this case study, with the writings of Yin and Stenhouse providing the theoretical justification for the steps taken.

Yin (1984) gives a most detailed account of the design, procedures and methods of case study research. Starting with the initial design of the proposed research, he goes on to consider how the researcher should prepare for the data collection phase of his research, how the data should be collected, how the data should be analysed and how the case study report should be composed. Yin's guidelines have where possible been used in the research methodology used for this study. A brief description of this will be followed by a detailed step by step description and analysis of how this study was conducted.

Yin sees the research design as the logic that links the data to be collected (and the conclusions to be drawn) to the initial questions of a study. Every empirical study has a plan or research design, but its development is seen by Yin as the difficult part of doing case studies. He sees the research design as helping investigators to design more rigorous and methodologically sound case studies. He identifies five important components of a research design.

- 1) the study's questions - how is the study to be conducted? Why in the way chosen?
- 2) the study's propositions - which direct attention to points that should be examined within the scope of the study?

3) the study's units of analysis - defining what the case is eg. the study of an individual or the study of a particular group. For the purposes of this study 24 randomly selected standard ten higher grade geography pupils at Glenwood High School in Durban during 1987 were used to comprise the target group. The 24 randomly selected pupils represented an average class size group for a standard ten class and being randomly selected pupils from all six of the set streamed classes in the school were represented.

4) the logic linking the data collected to the study's propositions.

5) the criteria for interpreting a study's findings.

These have been applied to this study and will be discussed in the following chapter.

The case study researcher must then decide what type of case study design he is to use (Figure 32).

	Single-Case Designs	Multiple-Case Designs
Holistic (single unit of analysis)	TYPE 1	TYPE 3
Embedded (multiple units of analysis)	TYPE 2	TYPE 4

**Figure 32:** Basic types of design for case studies  
Source : Yin, 1984, p.41

A single-case (holistic) design was chosen for this study. As Yin states, a holistic single-case design is 'best chosen if the study is an exploratory or evaluative device examining the global nature of a problem' (p.44), which approximates well with the nature of this study.

Yin reminds the researcher that the case study design does not have to be completed at the outset of a study only. The design can be altered and revised after the initial stages of a study, but only under stringent circumstances. In particular, pilot case studies may reveal inadequacies in the initial design, causing the investigator to modify the design. Fortunately, this was not found to be necessary in this study. The checking of the research design is an appropriate and desirable use of pilot studies. Yin continues:

At the same time, an investigator must be careful not to shift the theoretical concerns or objectives. If these, rather than the cases themselves, are changed, the investigator can correctly be accused of exercising a bias in conducting the research and interpreting the findings. The point is, the flexibility of case study designs is in selecting cases different from those initially identified (with appropriate documentation of this shift) but not in changing the purpose or objectives of the study to suit the case(s) that were found. The former situation is much like changing experiments when it is obvious that an experimental procedure is infeasible; the latter is a more subtle but still illegitimate change (p.54).

The next step in conducting case study research according to Yin and which was followed in this study, is to prepare for data collection. He identifies four points of



relevance here:

1) Adequate skills on the part of the case study investigator are required. Yin writes:

In actuality, the demands of a case study on a person's intellect, ego, and emotions are far greater than those of any other research strategy. This is because the data collection procedures are not routinised. Also, the skills required for collecting case study data are much more demanding than in experiments and surveys. In case studies, there is little room for the traditional research assistant. Rather, a well-trained and experienced investigator is needed to conduct a high-quality case study because of the continuous interaction between the theoretical issues being studied and the data being collected. During data collection, only a more experienced investigator will be able to take advantage of unexpected opportunities rather than being trapped by them - and also to exercise sufficient care against potentially biased procedures (p.56).

Unfortunately, as Yin points out, there are no tests for determining which persons are likely to become good case study investigators and which persons are not. However, he identifies a basic list of commonly required skills which a case study investigator should possess:

- . A person should be able to ask good questions - and to interpret the answers.
- . A person should be a good "listener" and not be trapped by his or her own ideologies or preconceptions.
- . A person should be adaptive and flexible, so that newly encountered situations can be seen as opportunities, not threats.
- . A person must have a firm grasp of the issues being studied, whether this is a theoretical or policy orientation, even if in an exploratory mode. Such a grasp reduces the relevant events

and information to be sought to manageable proportions.

- . A person should be unbiased by preconceived notions, including those derived from theory. Thus, a person should be sensitive and responsive to contradictory evidence (pp.56-57).

These points were noted by this researcher and an attempt was made to apply them where applicable in this study.

2) Training and preparation are required for a specific case study. Yin writes:

The key to understanding the training needed for specific case studies is to understand that every case study investigator must be able to operate as a "senior" investigator. Thus, once in the field, each case study fieldworker is an independent investigator and cannot rely on a rigid formula to guide his or her behaviour. The investigator must be able to make intelligent decisions about the data being collected.

In this sense, training for a case study investigation actually begins with the definition of the problem being studied and the development of the case study design (p.60).

This was done for this study in the introductory chapters and in the case study design at the start of chapter five.

3) The case study protocol is more than an instrument. It contains the procedures and general rules that should be followed in using the instrument. Yin sees the protocol as a major tactic in increasing the reliability of case study research, as was discussed earlier in this chapter, and it is intended to guide the investigator in carrying out the case study. Yin believes the protocol should have the following sections:

- . overview of the case study project (project objectives and auspices, case study issues, and relevant readings about the topic being investigated);
- . field procedures (credentials and access to the case study "sites", general sources of information, and procedural reminders);
- . case study questions (the specific questions that the case study investigator must keep in mind in collecting data, "table shells" for specific arrays of data, and the potential sources of information for answering each question); and
- . guide for the case study report (outline, format for the narrative, and specification of any bibliographical information and other documentation) (p.64).

These sections were used in the drawing up of a protocol for this study during the pre-planning for the study. The protocol is seen as important because:

First, it reminds the investigator what the case study is about. Second, the preparation of the protocol forces an investigator to anticipate several problems, including that of how the case study reports might be completed. This means, for instance, that the audience for such reports will have to be identified, even before the case study has been conducted. Such forethought will help to avoid disastrous outcomes in the long run (pp.65-66).

4) The conduct of a pilot case study constitutes the final preparation for data collection. It helps investigators to refine their data collection plans with respect to both the content of the data and the procedures to be followed. The pilot study is not a pre-test. It is used more formatively, assisting an investigator to develop relevant lines of questions - possibly even

providing some conceptual clarification as well. In contrast, the pre-test is the occasion for a formal dress rehearsal, in which the intended data collection plan is used as faithfully as possible as a final test run.

The pilot case study can be so important that more resources may be devoted to this phase of the research than to the collection of data from any of the actual cases. Thus topics to be borne in mind include the selection of pilot cases, the nature of the inquiry for the pilot cases and the nature of the reports from the pilot cases. The pilot studies undertaken in this study (Appendix D) are seen as important components of the overall study and were undertaken with Yin's suggestions here in mind. Yin believes that every case study should follow the four steps above to varying degrees, depending on the case study.

The next step in conducting case study research, as was done in this study, is the collection of data or evidence. Yin identifies six sources of evidence which can form the focus of data collection for case studies:

- a) documentation (eg. letters, minutes, administrative documents, formal studies, news clippings);
- b) archival records (eg. service and organisational records, maps, charts, survey data)
- c) interviews are seen by Yin as one of the most important sources of case study information. Yin

states:

Overall, interviews are an essential source of case study evidence, because most case studies are about human affairs. These human affairs should be reported and interpreted through the eyes of specific interviewees, and well-informed respondents can provide important insights into a situation. They also can provide shortcuts to the prior history of the situation, so that the investigator can readily identify other relevant sources of evidence. However, the interviews should always be considered verbal reports only. As such, they are subject to the problems of bias, poor recall, and poor or inaccurate articulation. Again, a reasonable approach is to corroborate interview data with information from other sources (pp. 84-85).

d) direct observation is also seen by Yin as an important source of case study information. By making a field visit to the case study site, an investigator creates the opportunity for direct observations of relevant behaviour or environmental conditions. Such observations are seen as yet another source of evidence in a case study.

e) participant-observation

f) physical artifacts (eg. a technological device, tool or instrument, a work of art, or some other physical evidence)

As has been stated earlier, the use of triangulation in this study employed the following techniques to collect relevant information: direct observation, worksheet responses, questionnaires and interviews.

In addition to the above, some overriding principles are important, according to Yin, to any data collection effort in doing case studies and were borne in mind in this study. These include the use of 1) multiple sources of evidence converging on the same set of facts or findings 2) a case study data base - a formal assembly of evidence distinct from the final case study report and 3) a chain of evidence - explicit links between the questions asked, the data collected, and the conclusions drawn. These principles incorporated into a case study investigation will increase its quality substantially. They are relevant to all types of sources of evidence listed above and should be followed whenever possible. Although they are not intended to straitjacket the inventive and insightful investigator, they are intended to make the process as explicit as possible, so that the final results - the data that have been collected - reflect a concern for construct validity and for reliability thereby becoming worthy of further analysis.

The next step in the conduct of case study research is the analysing of the data or evidence collected in the research. This is seen by Yin as one of the least developed and most difficult aspects of doing case studies. Too often investigators start case studies without having a notion about how the data/evidence collected are to be analysed. This can cause the study to

become stalled at the analytic stage. One approach to successful analysis is to make the case study data conducive to some sort of statistical analysis, which proved difficult in this study due to the nature of the study. Such quantitative aspects of case study, according to Yin, may be possible when one has an embedded unit of analysis within the case study, which is not the case in this study. It was decided that the nature of the case study was such that a descriptive analysis of evidence collected would be most suitable. Yin continues by stating that data/evidence analysis consists of examining, categorising, tabulating, or otherwise recombining the evidence, to address the initial propositions of a study. Analysing case study evidence is especially difficult because the strategies and techniques have not been well defined in the past. Nevertheless, every investigation should start with a general analytic strategy - yielding priorities for what to analyse and why. The ultimate goal of the general analytic strategy is to treat the evidence fairly, to produce compelling analytic conclusions and to rule out alternative interpretations.

A general strategy which helps the researcher complete the analytic phase of the research and which applies in this study is to rely on theoretical propositions that led to the case study in the first place. In the case of this study these propositions would include the value of

fieldwork as an appropriate method of teaching the environmental component of the new high school geography syllabus. These propositions should, hopefully, have shaped the data collection plan and therefore would have given priority to the relevant analytic strategies. The chain of evidence mentioned earlier is relevant here viz. explicit links between the questions asked by the case study, the data collected and the study's conclusions drawn.

The final step in conducting case study research is what Yin refers to as composing the case study report which for this study appears in the next chapter. He continues by stating that as a general rule, the compositional phase puts the greatest demands on a case study investigator. The case study 'report' does not follow any stereotypical form. Moreover, the 'report' need not be in written form only (eg. it can be oral). Regardless of the form, however, similar steps need to be followed in the compositional process eg. identifying the audience of the report, developing the compositional structure etc.

Regarding the audiences for case study reports, Yin points out that such studies have a more diverse set of possible audiences than do most other types of research. These audiences include: '(a) colleagues in the same field; (b) policymakers, practitioners, community leaders, and other professionals who do not specialise in case study



methodology; (c) special groups such as a student's dissertation or thesis committee; and (d) funders of research' (pp.122-123).

Yin continues:

Because case studies have more potential audiences than other types of research, an essential task in designing the overall case study report is to identify the specific audiences for the report. Each audience has different needs and no single report will serve all audiences simultaneously. For a thesis committee, mastery of the methodology and the theoretical issues of a case study topic, an indication of the care with which the research was conducted, and evidence that the student has successfully negotiated all phases of the research process are important (pp.123-124).

Thus, Yin sees the presumed preferences of the potential audience as dictating the form of the case-study report. Thesis and dissertation students need to be reminded, says Yin, that the thesis or dissertation committee may be the only audience for the case-study report. Yin warns:

Whatever the audience, the greatest error an investigator can make is to compose a report from an egocentric perspective. This error will occur if a report is completed without identifying a specific audience or without understanding the specific needs of such an audience. To avoid this error, one suggestion is to identify the audience, as previously noted. A second and equally important suggestion is to examine previous case study reports that have successfully communicated with this audience. Such prior reports may offer helpful clues for composing a new report (p.126).

Yin then goes on to consider the different varieties of case study compositions by discussing written and non-written case study reports and varieties of written reports. This study constitutes a classic single-case

study of the written type. The specific type of case study composition, according to Yin, should be identified during the design stage of the case study. He then considers how the reports chapters, sections, subtopics etc. need to be organised in some way, to constitute the report's structure. Six structures are suggested, with the hope that they will reduce an investigator's compositional problems:

- (1) linear-analytic structures
- (2) comparative structures
- (3) chronological structures
- (4) theory-building structures
- (5) "suspense" structures, and
- (6) unsequenced structures (p.131)

The linear-analytic type is the standard approach for composing research reports and has been used in this study. The particular structural requirements expected of an academic thesis, however, may bring about modifications to a rigid application of the linear-analytic format, as is the case in this study. According to Yin when discussing the linear-analytic type:

The sequence of subtopics involves the issue or problem being studied, the methods used, the findings from the data collected and analysed, and the conclusions and implications from the findings.

Most journal articles in experimental science reflect this type of structure, as do many case studies. The structure is comfortable to most investigators and probably is the most advantageous when research colleagues or a thesis or dissertation committee comprises the main audience for a case study. Note that the structure is applicable to explanatory, descriptive, or exploratory case studies. For example, an exploratory case may cover the issue or problem being explored, the methods of exploration, the findings from the exploration, and the conclusions (for further research) (p.132).

Yin goes on to discuss the procedures which should be followed when doing the case study report, which have been taken cognisance of by this researcher:

i) When and how to start composing the report

ii) Case identities: whether the identities of individual persons involved in the case should be revealed or not - a point not constituting a problem in this study. As Yin states: ' The most desirable option is to disclose the identities of both the case and the participating individuals' (p.136).

iii) Reviewing the draft case study - a validating procedure. Here the overall quality of the study is of relevance. The procedure is to have the draft case study report reviewed, not only by thesis supervisors and academic peers but also by participants and informants in the case, depending on the nature of the case study. In the case of this study, the draft case study report was reviewed by the study's supervisors but not by the study's participants and informants. It was felt that the informal relationship which existed between the researcher and the respondents negated the need for them to review the case study report and informal discussions which had been held with them revealed an agreement with the points made in the report.

## Conclusion

This chapter has examined the nature and characteristics of case-study research. A case has been made for the use of case study in educational research; its use in this study has been justified and the use of triangulation, as it has been used in this study, explained in some detail. The chapter ended with a step by step description of the research methodology used in the conduct of this case study, which leads to a full account of the case study report presented in the following chapter.

## CHAPTER FIVE

### CASE STUDY REPORT

#### Introduction

In this chapter a step by step description and analysis will be given of how the case study evaluation of ecological fieldwork in Pigeon Valley was conducted. This will be followed by a discussion of the study's findings including a detailed analysis and interpretation of what was revealed.

Due to the evaluative nature of this case study and as a result of the open-ended type questions posed in the worksheets, questionnaires and interview, with the resulting unstructured responses elicited from respondents, it seemed inappropriate to treat the responses in any statistical way. Likewise, even though correlation between different responses seemed to exist, it seemed inappropriate to attempt to demonstrate these statistically in any formal quantitative way. The qualitative nature of this case study should be viewed as part of the tradition of case study research in the social sciences with its focus on observation and interpretation of human behaviour rather than on the more formal measurement of it.

The conduct of the case study evaluation of ecological fieldwork in Pigeon Valley

In October 1984 the Natal Education Department released to high school geography teachers in Natal a new syllabus and syllabus guide to be implemented for standard eight pupils in 1985, for standard nine pupils in 1986 and for standard ten pupils in 1987. A syllabus and syllabus guide for standard six and standard seven was released at about the same time. The syllabus guide recommended that teachers teach the new syllabus in such a way that wherever possible stress be placed on a concern for the environment and the careful conservation and management of the earth's dwindling resources. During 1987 the syllabus stated that the section 'Ecosystems, Environmental Balance and Conservation' (Appendix B) be taught as part of the matric syllabus and that it would be examined in the year-end public examination.

A fairly comprehensive in-service course was held in September 1986 for senior geography teachers in Natal, to brief them on the requirements of the new syllabus, particularly as it applied to the standard ten group in 1987. Despite this, many teachers felt ill-prepared to implement the new syllabus and faced the year-end public examination with some anxiety. As one of the many geography teachers in Natal facing the new syllabus with

some trepidation, it seemed that there was a need for a study of the type undertaken in this thesis, not only to clarify the researcher's own position in relation to the new syllabus, but also to attempt in this way to assist fellow teachers in their preparations. It was felt that an appropriate way to achieve this goal would be an evaluative type case study on the use of geographical fieldwork to teach ecology. Numerous persons and organisations involved in various ways with ecology, environmental education and geographical fieldwork were consulted for advice and direction.

As a first step, after a study of Yin's (1984) five important components of a case study research design, discussed earlier in Chapter four, the following was decided:

- 1) the study's questions would basically be of the 'what' type viz. a study of what happened during the ecological fieldwork in Pigeon Valley, with the study concentrating on gathering information on the fieldwork activities which occurred so as to be able to undertake an evaluation of those activities. Questions of the 'how' and 'why' type so often associated with case study research were dealt with in Chapter three viz. How can the new ecology section most appropriately be taught to high school geography pupils and why should it be taught in this way? The answering of the 'what' questions by the

case study report provides information on the 'how' and 'why' questions. The 'what' question provides information which enables decisions of an evaluative nature to be made which in turn provides an answer to the 'how' and 'why' questions.

2) Regarding the study's propositions, each directing attention to something that should be examined within the scope of the study, it was decided that the following areas would have to be examined: a study of the nature of environmentalism, environmental education, ecology, ecosystems, biogeography, geographical fieldwork, case study research and triangulation techniques.

3) the study's unit of analysis within a holistic single-case study framework would comprise 24 randomly selected standard 10 higher grade geography pupils from Glenwood High School and the fieldwork in ecology undertaken by them in August, 1987 in the Pigeon Valley nature reserve in Durban, the object being to try and evaluate the use of a fieldwork approach to teaching ecology.

4) the study would, where possible, endeavour at all times to link the data collected to the study's propositions. This will become more apparent later on in this chapter when the study's findings are discussed.



5) the criteria to be used to interpret the study's findings would be the criteria used to direct why observation, worksheets, questionnaires and interviews were used in the study i.e. to provide an analysis of observation and responses to what occurred in Pigeon Valley.

The period October 1986 (when the study was registered) to April 1987 was spent collecting material through library sources, meeting with various persons and organisations connected to the area of study and regular meetings with supervisors. From the reading done, various guiding principles, aims, objectives, important concepts and skills which the relevant literature seemed to indicate should be included in a school-based ecological study of any kind were noted, for use in the construction of the worksheets used by the pupils.

The research was conducted part-time during this period as the researcher was employed as a senior geography teacher at Glenwood High School in Durban at the time. During the April school vacation in 1987 a series of meetings was held in the Pigeon Valley nature reserve in Glenwood, Durban, with Professor J.C. Poynton of the Department of Biology at the University of Natal (Durban) and Mr G. Nicholls of the Durban Municipality Parks, Recreation and Beaches Department, which controls and manages the municipal natural areas in Durban. The purpose of these

school based ecological fieldwork. The close proximity of Pigeon Valley to the school (a ten minute leisurely walk for the pupils), plus the fact that the geography department at the school had already frequently used this area for geographical fieldwork, seemed to indicate the potential suitability of the area for ecological study through fieldwork.

A worksheet was constructed by the researcher as early as April 1983, which was used by junior high school classes in Pigeon Valley to revise certain sections of the old syllabus. Some of the questions posed at that time seemed already to have an ecological bias. It was decided, therefore, to incorporate, where possible, some parts of this worksheet into the worksheets constructed for this study.

The next step in the research procedure was the development of suitable worksheets to be used by pupils in the Pigeon Valley area to learn ecology. Much time was spent during the 1987 April school vacation in Pigeon Valley becoming acquainted with the area. Information on Pigeon Valley was also obtained from two excellent publications entitled Self-guided trails in Durban and Small mammals of the Durban area as well as copies of Durban Focus (March 1986 and February 1987) all published by the Durban Municipality Parks, Recreation and Beaches Department. In addition, use was made of a B.Sc. (Hons)

study by a student S.J.G. Gordon, on the small mammal population in Pigeon Valley, an article by Nicholls (1982) in Veld and Flora as well as various Department of Environment Affairs publications. A meeting was also held with Mr C. Quickelberge of the Durban Natural History Museum on butterfly identification in Pigeon Valley.

The next step in the study was to have a fairly detailed look at the components of the matric syllabus section on ecology and ecosystems. A listing was made of these components. The intention at this point was to be aware of these component sections so that, when constructing the first draft of the worksheet, they would be comprehensive in covering as many of the component sections as was possible.

The early part of the study should be seen as attempting to answer the 'how' and 'why' questions, which often relate to case study research referred to earlier; while the later part of the study (i.e. the actual fieldwork being conducted) should be seen as attempting to answer the 'what' question.

For the reasons outlined in Chapter three of this thesis, a worksheet based on the field research approach was produced for use by the target group of standard ten pupils involved in this study. The worksheet formed one of the component techniques of the triangulation method in this case study research. The worksheet and more

specifically the pupils' responses to the questions contained in it was expected to supply useful information on the nature of the fieldwork activities which took place in Pigeon Valley. It was also decided to produce, not for the purposes of this study per se, but for the benefit of fellow geography teachers and the author, a junior worksheet based on the traditional fieldwork approach. It must be stressed at this point that the junior worksheets only formed a marginal part of this study (the case-study conducted in this study concentrating only on the standard ten group, as stated in the thesis title) but constituted a parallel study conducted for personal reasons. It was felt that the incorporation of a junior worksheet would assist in a better understanding of the overall implementation of environmental education throughout the high school syllabus. As has been pointed out already in Chapter two of this thesis, it is only the standard ten syllabus that actually contains a section on ecology and ecosystems but syllabus guides recommend the teaching of environmental education in geography at all levels in the high school. A reference booklet of diagrams to be consulted before, during and after the fieldwork by senior as well as junior pupils was also produced at this time (Appendix F).

When constructing the senior worksheet to be used in this study, cognisance was taken of the demands of the school syllabus as well as points raised by Lloyd-Jones (1985) on

worksheet design and methods. Diagrams used in the worksheet came from various sources but predominantly from Pillay and Seaton (eds)(1986) in their book on the ecology of the Seychelles. The senior worksheet was constructed to incorporate aspects of the junior worksheet. This was done for reinforcement, believing that what was required was a fieldwork programme stretching through all levels of the high school and introducing pupils at an early age to the concepts of ecology. It was also expected that the questions and exercises contained in the worksheets would assist in the achievement of the specific requirements of the ecology section of the Natal Education Department syllabus. The later analysis in this chapter of pupil worksheet responses indicates a measure of success in this connection. Once the worksheet had been approved by the study supervisors an analysis was done on a question by question basis (Appendix C), which revealed that the worksheet and reference booklet covered fairly comprehensively the subject material contained in this section of the syllabus. It was found that all areas of the syllabus were not covered in the same degree of depth as others, but this may be explained in terms of differing degrees of importance, with the main sections being covered in the required depth.

A teacher's guide was also prepared for the worksheet, giving teachers advice on how best to conduct the exercise, especially if they were not conversant with field research methods of conducting geographical fieldwork.

Following Yin's (1984) recommendation, discussed in Chapter four of this thesis, that a pilot case study be carried out as the final preparation before the data-collection phase of the study, a volunteer group of ten standard nine pupils taught by the researcher in 1987 at Glenwood High School were utilised, to test the use of the worksheet which had been produced and the conduct of the actual fieldwork. This work on the pilot study was conducted during the second school term in 1987.

The standard nine group spent two afternoons after school (3 - 5 p.m.) working through the worksheet in Pigeon Valley. It must be pointed out that the senior worksheet was designed to be at least a six school-period fieldwork study (approx. 4 hours time length), hence the equal total length of time spent by the pilot group in Pigeon Valley. The pilot group had received a two-hour briefing on an afternoon prior to conducting the fieldwork, where a detailed description was provided on what was expected of them while engaging in the fieldwork, and a basic lesson on ecology was provided. It should be stated at this point that because none of the pilot study participants

had ever been formally taught ecology. With the matrices only doing the courses in 1987, volunteers were invited from boys who had been or were still members of school outdoor clubs, wildlife societies, the Boy Scouts movement etc., and so had some feel for environmental conservation. Most of the pilot study participants had also done some ecology as part of their standard eight biology syllabus. No major problem (besides the time factor, always a problem when conducting fieldwork) emerged as a result of the pilot studies, which was greatly encouraging. Reports were written based on the pilot study and were presented to and discussed with the study's supervisors (Appendix D). Included here was a formal listing of equipment which the pilot study group found was needed to successfully conduct the fieldwork required. It was decided that this list should be incorporated with the teachers' guide which accompanied the worksheet.

During the period of the July school vacation in 1987 the final handwritten copies of the worksheet and reference booklet were finalised, as well as a mark allocation and marking guide for the worksheet, for use by teachers when assessing how well the worksheet had been completed. All the procedures outlined above pertaining to the construction of the senior study group's worksheets were applied in the construction of the accompanying junior worksheet.

Appendix E shows the teacher's guide and worksheet for the senior group (Field Research), and Appendix F, the reference booklet which applies to the worksheet. Appendix G gives the teacher's marking guide for the worksheet.

The worksheet and reference booklet was then prepared so as to be ready for the fieldwork, to be conducted during August 1987. The fieldwork was to be a means of teaching the ecology section of the syllabus prior to the writing of the Trials examination during September. This would constitute the first formal test after the fieldwork evaluation of how well the pupils understood the ecology section. The first public examination for the standard ten group on the new ecology section, as has already been stated, was scheduled for November, 1987. It was decided that the junior groups would also do ecological fieldwork during August for the sake of convenience, as much of the equipment to be used had to be borrowed from the school's biology department, and by conducting the fieldwork at the same time there would be minimal disruption to that department.

Prior to commencing the fieldwork, just as with the pilot study group, the target group spent an hour one afternoon being briefed on how the fieldwork was to be conducted. The group of 24 were divided up into six groups of four pupils each because of constraints imposed by a shortage



of some of the equipment required. It was stressed that although they were operating in groups, a full individual effort was required and all pupils would have their worksheets assessed for class mark purposes.

Full pupil involvement was required especially in the two hypothesis testing (field research) exercises involving a microclimatic study and a soils study, where various pieces of equipment had to be utilised. The aim was that each member of the group should have the opportunity of physically using each piece of equipment required to conduct the experiments.

During the actual fieldwork, the writer adopted the role of an observer. The plan was to move around from group to group, spending a few minutes with the group asking them questions about what they were doing, what their observations were, assisting where necessary, guiding, prompting, encouraging and clarifying problems. When moving from group to group observations of the behaviours present were recorded in brief point form, as unobtrusively as possible, in a pocket notebook for later analysis. Questions asked by pupils as well as comments made by them were carefully recorded. Since all the groups conducted their fieldwork in the demarcated area explained to them in the pre-excursion briefing, it was possible to monitor what was happening as they were all fully visible. As far as the use of the groupwork approach was concerned, the different responses and

behaviours observed between groups as well as the differing cohesiveness of the groups provided valuable insights into the use of a groupwork approach in ecological fieldwork. The information obtained through the use of observation is discussed later in this chapter.

Observation is acknowledged in the literature as a very important technique in case study research. The subjectivity of observation, however, must be acknowledged and for this reason triangulation was used in this study to give differing perspectives on what occurred during the fieldwork exercise.

As will also be revealed later in this chapter, particularly by the pupils in their questionnaire and interview responses, a lack of time created the major constraint when conducting the fieldwork exercise. A structured timetable of a 9 x 35 minute period school day, with at the very most 3 periods being allocated to any one subject on a day, does not easily allow for fieldwork to be done. Periods have to be borrowed by the geography teacher from other subject teachers so as to allow pupils sufficient time in the field. This hardly represents an ideal arrangement with other subject teachers also facing over-loaded syllabi and approaching examinations. As a result of this problem, pupils had been instructed not to spend too much time while in Pigeon Valley filling in the worksheets, but rather to use the opportunity for

observation and study of the environment, making notes in point form as they went along. The detailed completion of the worksheet could be done in homework periods subsequent to the field study.

This work would constitute the follow-up phase of the case study. Included here was the completion of the very important problem-solving questions appearing at the end of the worksheet.

The collection and marking of the worksheets and the initial drawing up of the questionnaire and interview schedules then took place. When constructing the questionnaire and interview schedules reference was made to the points raised earlier in Chapter four on how such data gathering techniques should be utilised. The triangulation matrix (Appendix A) was also consulted to recheck exactly what information was being sought by the data gathering methods. The questionnaire and interview schedules were purposefully drawn up after the fieldwork had been completed so as to probe more deeply issues and problems which arose in the fieldwork and in the pupils' completion of the worksheets. The questionnaire and interview schedules were also drawn up to obtain information on the fieldwork activities in Pigeon Valley which might not have been revealed as a result of the observation and worksheet techniques. The use and nature of triangulation in case study research is revealed here

the situation being studied.

The month of September 1987 was used for the marking of the worksheets and the preparation of the questionnaire and interview schedules. They were then given to the pilot study group as sample respondents in an effort to reduce interview and questionnaire bias; changes were made and the final drafts were then typed by the school secretary. Appendix H shows the finalised questionnaire given to pupils and Appendix I the interview schedule used for the pupils. The questionnaires were administered and the interviews were conducted during the month of October 1987, much of September having been taken up with matric trials examinations and marking. The questionnaires were completed by the target group in a one-hour session after school one day, and the interviews were conducted over a period of two weeks with sessions held during the school lunch break and after school. The interviews were tape recorded for later analysis.

It should be stated at this point that the use of triangulation in this case study should be seen to have two main purposes. The first of these is that the strength of the study's conclusions would lie with the multiple sources of evidence utilised (i.e. the triangulation techniques used), all providing a focus on the study. Secondly and probably more importantly, to provide insights which would not be obtained but for the

use of these multiple sources of evidence, each highlighting differing aspects of what was being studied, as a result of the differing perspectives of their observations.

It should also be noted at this point that, in order to obtain greater insight and knowledge of the fieldwork experiences taking place in Pigeon Valley, five other colleagues in the school's geography department who were involved in taking their respective classes to Pigeon Valley to undertake ecological fieldwork using the researcher's worksheets, were involved in the questionnaire and interview phase of this study. However, the information obtained does not constitute part of the study.

The conduct of the questionnaire and interview phase of the case study was then completed and the responses analysed. This left 1988 clear for last minute collection of relevant information, analysis of data and writing up of the case study. At this point, just prior to the discussion of evidence provided by the study, it should be pointed out that the four techniques used to obtain information provided data of a qualitative kind and as a result the study's conclusions and recommendations, as they appear in Chapter six, should be viewed as tentative in nature.

Discussions of evidence arising from the case study  
evaluation of ecological fieldwork in Pigeon Valley

Yin (1984) has stated that analysing case study data is especially difficult because strategies and techniques used for achieving these ends have not been well defined in the past. He has recommended that every case study investigation should start with 'a general analytic strategy to yield priorities for what to analyse and why, the ultimate goal being to treat the evidence fairly, to produce compelling analytic conclusions, and to rule out alternative interpretations' (p.100). According to Yin, one of the general strategies to help an investigator complete the analytic phase of his research is to rely on theoretical propositions that led to the case study in the first place. The main proposition which has been put forward for this study, as discussed in Chapter three, is that fieldwork in geography is both of importance and value and constitutes an appropriate method of teaching the ecology section of the new high school geography syllabus. Yin sees the proposition underlying a study as 'shaping the data collection plan and therefore would have given priority to the relevant analytic strategies' (p.100). It is hoped to show that a discussion of responses obtained from the application of the various research instruments constituting this study viz. the worksheets, questionnaires and interviews, will provide what Yin has described as a chain of evidence which may

support the main proposition of the study as stated above. A discussion of these responses now follows and represents a discussion of the case study's findings.

The overall impression gained of the fieldwork undertaken, from observations, feedback received from pupils and teachers and from an analysis of responses to the worksheets, questionnaires and interviews is that the Pigeon Valley fieldwork exercise was an academically acceptable and educationally sound experience for the pupils.

The opportunity to learn new work outside of the classroom seemed to present a challenge to the participants. This challenge was almost unanimously accepted, as is shown later in Table 14, with 18 of the 24 target group pupils indicating a positive response to the fieldwork exercise. To many of the participating pupils the ecological fieldwork exercises represented their first real taste of structured fieldwork. The educational value of the exercise can be gauged from the generally very well answered worksheet questions and the depth of response given in the questionnaires and the interviews. Obvious thought and application were present during the completion of the worksheets and questionnaire and when responding during the interview. The positive response obtained from colleagues in the geography department to the fieldwork carried out in Pigeon Valley, although not forming a part

researcher, for surely the sternest test of something is the one administered by one's peers. Based on the generally favourable response to the fieldwork done in Pigeon Valley, it is hoped that other high school geography teachers in Natal will use, adapt and modify the prepared worksheets so as to utilise them in ecological fieldwork in natural areas close to their schools.

#### Analysis of observation of fieldwork

As was stated earlier in this chapter, the role of observer was adopted during the conduct of the actual fieldwork. Notes were made on the observations of both the individual groups in action, as well as the class group as a whole. Approximately ten minutes was spent as unobtrusively as possible observing each group in turn from a distance, noting the behaviours present. About ten minutes were then spent with each group in turn, asking them questions about what they were doing, what their observations were, assisting where necessary, guiding, prompting, encouraging and clarifying problems. Questions asked by pupils as well as comments made by them were carefully recorded. This information provided useful insight into the use of the groupwork approach, the different responses and behaviours observed between groups and the differing cohesiveness of the groups.

An analysis of the general observations recorded revealed that learning was taking place, but that enjoyment was also



present. With only one or two exceptions the pupils seemed to respond to the challenge presented by the worksheet questions, as well as the two field research exercises, by keeping themselves busy completing the worksheets, measuring or quantifying an aspect of the environment or merely busying themselves observing the environment. The groupwork approach seemed to work very well with close co-operation and team-work in evidence at all times. No major problems emerged during the fieldwork exercise due, it is felt, to the thorough pre-excursion briefing given the participants beforehand. One or two minor questions, mainly to do with the use of equipment when conducting the field research exercises, were asked. Very few questions were forthcoming since most questions of a purely ecological nature could be answered by checking in the comprehensive reference booklet provided to each pupil. The self-discovery nature of the worksheets with their stress on observation and experimentation assisted in keeping the pupils busy and allowed circulation around the study area observing the groups in action.

The use of observation yielded an amount of useful information on the nature of the fieldwork activities which took place in Pigeon Valley, as is revealed below. Observations made by the researcher's colleagues when taking their classes to Pigeon Valley to do the fieldwork revealed similar responses which would seem to increase

the reliability of this researcher's observational evidence. Procedures and guidelines for these teachers had been outlined so that the fieldwork done by their classes would approximate as closely as possible that conducted with the target group.

Some more specific points noticed as a result of the observation of pupils doing fieldwork were: a) the importance of having an appointed group leader to coordinate the activities of the persons in his group, especially when doing experiments; b) the pupils seemed to become enthusiastically involved in what they were doing and this prompted a common response from the pupils that they should have been allowed to wear civilian clothes rather than school uniform when doing the fieldwork in order to facilitate greater comfort and ease of movement; c) the importance of demarcating the area of study to be used by the pupils, so as to allow the teacher optimal control of pupil activities. This demarcation of area would also facilitate the teacher's movement from group to group, assisting when required and observing pupil activity; d) questions raised by the pupils mainly revolved around minor misunderstandings concerning the instructions, questions and tasks required by the worksheets or the use of equipment in the fieldwork tasks and exercises required. As will be revealed later in the questionnaire responses (Table 15) only a few pupils misunderstood what was required of them in the fieldwork

exercise; e) The pupils' unfamiliarity with fieldwork, especially the conduct of scientific-type experiments when not in a laboratory, became evident. This fact supports the need for pupils to undertake a much greater amount of fieldwork, not only in geography; f) The varied cohesiveness of the different groups revealed the importance of teachers getting to know their pupils as well as possible prior to taking them out in the field, so as to be in a position to correctly allocate them in groups which display a level of cohesiveness when conducting fieldwork exercises. As a result of this observation, it is recommended that during the early part of the year teachers should conduct fieldwork based on an individual effort rather than use the groupwork approach, while they get to know their pupils better.

#### Analysis of Worksheet Exercise

An analysis of the responses by pupils to the worksheet questions, as shown in tabulated form (Table 13), revealed an encouraging grasp of the main concepts in the ecology section of the new syllabus. As the list of marks obtained by the pupils seems to indicate, the ecological fieldwork carried out in Pigeon Valley helped in understanding this new section of the syllabus. A group average of 120 marks out of 200 (i.e. 60%) was achieved, an encouraging result considering the random selection of the pupils involved, as described earlier in this chapter. Only one pupil failed the worksheet exercise and he turned

out to be a very weak pupil in the bottom higher grade geography class in the school. Some encouragingly good marks were also recorded, given that for all the pupils involved this was their first experience of being tested or assessed in this section. The worksheets contained different types of questions, ranging from short structured questions to longer open-ended evaluative questions and these were assessed by the researcher at the standard expected of the pupils in the year-end public examination, based on the researcher's four years experience as a sub-examiner and marker of the higher grade geography examination paper in Natal.

The writer's fortuitous experience as a marker of the ecology question in the Natal Education Department geography higher grade examination paper in November 1987, a matter of three months after the Pigeon Valley fieldwork was conducted, revealed to him the benefit obtained by pupils at Glenwood High School in doing the fieldwork. The question which appeared in the examination paper definitely seemed to be more straightforward than those in the worksheets and so afforded the Glenwood pupils a better opportunity of tackling them with confidence. A discussion with the paper's examiner, held at the conclusion of the marking period, revealed that pupils at Glenwood High School had achieved better than average results on the ecology section when compared to the rest of the province. It is relevant to note at this point

that in the questionnaires and the interviews, certain pupils raised the possibility that the worksheet questions were too difficult. It is believed that, while this may be the case at the moment, the standard of question set on ecology in the public year-end examination paper will rise in the near future as teachers and pupils become more familiar with the content of this new section of the syllabus.

A few more specific points which arose from an analysis of the worksheets were:

a) Pupils found the worksheets to be informative, providing them with additional information on the ecology section and assisting them in the answering of the worksheet questions. Table 14 which is based on an analysis of pupil responses to Question 28 of the worksheet also reveals that the accompanying reference booklet was a useful and informative supplement to the actual worksheet.

<u>Pupil number</u>	<u>Mark out of possible 200</u>	<u>Mark as a percentage</u>
1	120	60
2	132	66
3	103	53
4	148	74
5	131	66
6	60	30
7	106	53
8	109	54
9	113	57
10	140	70
11	82	41
12	105	53
13	101	51
14	100	50
15	120	60
16	141	71
17	130	65
18	110	55
19	127	64
20	148	74
21	144	72
22	131	66
23	146	73
24	122	61
	<u>Average</u>	<u>Average</u>
	120	60

Table 13: Worksheet Mark Analysis

b) The two field research (hypothesis testing) exercises contained in the worksheet required a fairly detailed knowledge of the sections on urban microclimate and soils, fortunately sections which had been covered in depth earlier in the year. It is felt that the two exercises

cannot be adequately completed prior to the teaching of these two important components of the syllabus.

c) Sections in the ecology syllabus which, in the light of the subsequent final matric examination question on the ecology section, required a greater in-depth treatment by the worksheet included i) Azonal and Zonal soil types, ii) Seral stages in ecosystems iii) Energy conversion, degradation and dispersal in ecosystems iv) Self regulation in ecosystems including negative and positive feedback loops and the concept of niche v) The concept of eutrophication and vi) Nutrient cycling.

Appendix C indicates by means of an asterisk those sections (above) which were touched on in the worksheet but could possibly have been expanded into full questions on their own.

d) Those pupils in the target group who were biology pupils, as was to be expected, did better in completing the worksheet than those pupils whose subject choice did not include biology, since they were more familiar with the work being covered, having done it in detail in the standard eight biology course. Their answers to the questions posed revealed a greater depth of understanding and comprehension of the concepts inherent in the ecology section.

e) The questions in the worksheet which related to the human impact on the ecosystem, which constitutes a geographer's focus on the ecology section in contrast to a biologist's one, were generally well answered and provided great encouragement to the researcher. Questions of a purely abstract type generally were not answered as well. This may reveal that as soon as pupils were able to identify in a personal way with the environment, they generally did better in answering the questions posed.

Table 14 summarises pupil response to the open-ended question posed by question 28 of the worksheet on whether the fieldwork approach had been helpful in the study of the new ecology section of the syllabus. The table indicates a generally positive response by pupils to the fieldwork exercise and the worksheet used, which supports the study's main proposition stated earlier. Time available for the fieldwork exercise emerged as the one major problem, a point which is elaborated on later in this chapter.



	N	R		N	R
	U	E		U	E
	M	S		M	S
POSITIVE RESPONSES TO THE FIELDWORK EXERCISE AND WORKSHEET USED	B	O	P	N	O
	E	F	O	E	F
	R	N		R	N
		S			S
		E			E
		S			S
1. Worksheet and reference booklet comprehensive.			20	1. Time shortage for	
				a. Observation	
2. Fieldwork provided a wider perspective and deeper insight into ecology. Exercise was informative from a practical point of view.			18	b. Discussion	
				c. Exploration	
3. Good learning/revision exercise			19	d. Appreciation	
				e. Accumulation of background knowledge	22
4. Provided a good summary of ecology section			17	2. Inappropriate clothing.	15
5. Provided opportunity to do fieldwork.			18		

**TABLE 14 :**  
**SUMMARY OF PUPIL RESPONSES TO QUESTION 28 OF THE WORKSHEET**

An analysis of the responses to the closed questions in the questionnaire also indicates that pupils enjoyed conducting the fieldwork. In most cases there was an overwhelming affirmative and positive response to the questions posed, and a belief was expressed that fieldwork represented an appropriate method of teaching ecology as part of the process of environmental education being encouraged by the geography syllabus.

The variety of responses, given in the questionnaire to the open-ended questions asked of respondents, was analysed in such a way that overall trends and points

which were raised by more than one respondent were looked for. These have been presented in an analysis of each individual question in the discussion below. A general agreement on points made by teachers and pupils is apparent. An analysis of responses given in the interviews reveals a similarity of response once again between teacher and pupil and a correlation between these responses and those given in the questionnaire. The interview responses are also presented later in this chapter in the form of an analysis of each individual question.

A detailed discussion of the questionnaire and interview responses will now take place. Where relevant, any significant points which arose as a result of the teachers' responses to their questionnaire and interview will be included. As has already been stated, the study of teachers' responses in the questionnaires and interviews constituted a parallel study not constituting part of this study but having obvious relevance from time to time.

#### Analysis of Questionnaire Responses

Table 15 provides a summary of the pupils responses to the closed questionnaire items. These responses, as well as those to the unstructured, open-ended questions which accompanied each closed item, will now be discussed question by question.

Question one of the questionnaire revealed an overwhelming 'yes' response, with 23 out of the 24 respondents answering in the affirmative. One of the pupils was unsure of a couple of methodological points concerning the hypothesis testing exercises which had been explained to the pupils beforehand in the classroom pre-excursion briefing. The pupils did point out the importance of the teacher being at hand to clarify any problems as they might arise. This showed once again the importance of the fieldwork groups working within a demarcated area with the teacher circulating around in it, a point stated earlier in the analysis of teacher observation of pupils engaged in the fieldwork. The teacher's ability to control the fieldwork operation was seen as important to successful fieldwork. Also, the generally satisfactory way that the worksheets were answered, as discussed earlier in this chapter, provides additional evidence which shows that the majority of pupils did clearly understand the instructions, questions and tasks required of them in the worksheets.

Question two revealed that only 2 pupils felt that additional information should have been provided for them to successfully complete the worksheet questions, but unfortunately did not specify what information was required. A general concern revealed by the pupils was that of the clarity of diagrams of birds and butterflies

original booklet from which the diagrams of birds and butterflies was extracted contained black and white pictures of the birds which made them difficult to identify, and the colour pictures of the butterflies also

Q. No.	Question	'Yes' response	Only partly/ not sure response*	'No' response
1.	Did you clearly understand the instructions, questions and tasks required of you in the worksheets?	23	1	0
2.	Did the worksheets supply sufficient information (by way of diagrams, data, written instructions etc.) for you to successfully complete the questions and tasks set?	22	2	0
3.	Do you feel that the fieldwork exercise enabled you to acquire the ability to conduct the experiments required in Ecology?	19	5	0
4.	Did you achieve a greater understanding of Ecological Terminology as a result of the fieldwork undertaken?	16	7	1
5.	Did the fieldwork exercises make you more aware of the importance of the environment	23	0	1
6.	Do you think that the purposes of the Ecology Syllabus (as stated by your teacher at the beginning of the course) were achieved as a result of the fieldwork undertaken?	22	2	0

Q. No.	Question	'Yes' response	Only partly/ not sure response*	'No' response
7.	Did you find you were kept fully occupied by the fieldwork exercise?	17	4	3
8.	Were the field-work exercises enjoyable?	22	2	0
9.	How successful do you think the worksheets used during the field-work exercises were in developing your understanding of the new Ecology section of the syllabus?	19	5	0

\* whichever is appropriate - refer appendix

Table 15: Pupil response to structured questionnaire items

appeared as black and white, when reproduced by the school's duplication centre. The problem of duplication of colour pictures for the use of pupils will be one facing every high school in Natal due to the expense involved and the fact that schools do not possess the necessary equipment. The only solution seems to be to obtain a set of thirty of the original booklets to lend to pupils for the duration of the excursion, and to then have these returned to the teacher for use by the next class. The problem of a lack of colour pictures of the birds needs to be addressed by the producers of the booklet, the Durban Municipality Parks, Recreation and Beaches Department.

Pupils also have access to Roberts' Birds of South Africa where colour photographs do appear for identification purposes.

The generally satisfactory way in which the worksheets were answered, as discussed earlier in this chapter, provides additional evidence which shows that the majority of pupils found that sufficient information had been provided for them to successfully complete the questions and tasks set.

Regarding question three, five of the respondents felt that they were unprepared to conduct the experiments required of them in the fieldwork exercise. The importance of the pre-excursion briefing to clarify just how the experiments were required to be undertaken is demonstrated here. It was interesting to note that some pupils wanted more experiments included in the fieldwork. It was observed that these tended to be some of the academically brighter pupils who were leading science pupils in the school. On the other hand, the whole concept of doing experiments seemed alien to some of the pupils who had not done anything along these lines before in geography. It is believed that greater use should be made of scientific experimentation in geography, especially when aspects of physical geography are being studied. An important point worth mentioning at this juncture is the earlier discussion of the observation

undertaken as part of the case study which also revealed that the pupils were able to conduct the fieldwork exercises required without major problems. This point also applies to the analysis of questions four and seven of the questionnaire.

Question four revealed a total of seven respondents who were unsure whether the fieldwork undertaken assisted them to achieve a greater understanding of ecological terminology. They all felt that terminology was best taught in the classroom and then reinforced by a fieldwork exercise rather than learning the terminology while in the field. They did acknowledge the assistance rendered them in this regard by a page in the reference booklet provided to each pupil which contained a glossary of ecological terminology. The majority of the respondents saw terminology and concepts as coming alive in the field and becoming more real to them.

Question five revealed that only one respondent felt the fieldwork exercise did not make him more aware of the environment, stating that it had certainly taught him more about its workings but not somehow about its importance. Twenty-three respondents revealed how the fieldwork done in Pigeon Valley had made them more aware of the importance of the environment as a result of a greater understanding of the threat posed by the interference of man's activities, a point also highlighted by the



teachers. The Glenwood pupils seemed to suddenly realise the importance and value of this small six hectare natural area in the middle of Durban suburbia and how many of them living in the local area had taken the area for granted for too long.

The teachers suggested the need for some form of measurement of the effect of human activity on the ecosystem (eg. the monitoring of noise levels and their effect on the area's fauna) and this would represent a possible improvement to the original worksheet. It is believed however, that their suggestions would be difficult for school pupils, who lack the necessary expertise, to do in any really scientific, quantitative way.

Question six revealed that only two respondents were not sure whether the purposes of the ecology syllabus had been achieved as a result of the fieldwork undertaken. Further responses to this question revealed some interesting points. Pupils did not seem to know what the purposes of the ecology course were, and wondered whether their teacher had specified them at the beginning of the course. The teachers on the other hand felt that, as is required, they had at the outset listed a series of behavioural objectives for the course. They felt that the problem was that the pupils had not remembered these objectives and had not seen them as terribly relevant. The importance

of teachers stressing the objectives of a course to pupils at the outset and reinforcing them during the course is seen as crucial to its success.

Question seven revealed that four respondents felt only partly occupied by the fieldwork exercise with three respondents saying that they were not fully occupied. It was significant that five of these pupils came from two groups where top science pupils in the school took a leading role in the conduct of the experiments. The responses to this question revealed that the structured nature of the groupwork approach used was an appropriate way of conducting ecological fieldwork provided that the pre-excursion briefing had specified to each group member what was required of him in the field, that each group had a responsible pupil leader and that there was good teacher control while in the field. The importance of teacher selection of group members, so as to keep potential trouble-makers apart, was stressed by the teachers.

Question eight revealed that two respondents only partly enjoyed the fieldwork exercises undertaken. Due to the lack of a question requiring elaboration by the pupils on their response made, further analysis of their attitudes is not possible.

Question nine revealed five respondents who felt that the worksheets used during the fieldwork exercise had only

partly helped to develop their understanding of the new ecology section of the syllabus citing the length and difficulty of the worksheet as their reasons. An analysis of pupil responses, in general, revealed that both pupils and teachers thought the worksheet was a bit long and a bit difficult but that it had been constructed with much care and thought. It is believed that, as has been stated earlier, the worksheets are not lengthy if pupils make point notes in pencil while in the field and then answer the question neatly in pen for homework as part of the study follow-up. Many of the questions are also 'theoretical' in nature and could be completed without even visiting Pigeon Valley - these could be filled in either before or after the fieldwork excursion. It must also be remembered that the worksheets were drawn up and used by pupils and staff prior to the first public examination of this section at year end. Thus the pupils' unfamiliarity with the work made it appear difficult. The same teaching staff who completed the questionnaire in 1987 have, during the 1988 year, reviewed the worksheets and with hindsight have stated that they are not overly difficult for the average pupil.

Question ten like question 28 of the worksheet was a general concluding question inviting the respondents to elaborate or comment on any matter relating to the fieldwork exercise or worksheets used. The question posed was as follows:

10. Are there any further points you wish to make relating to the fieldwork exercises and/or the worksheets used?

An analysis of responses revealed a demand by pupils and teachers for more time to be spent in areas like Pigeon Valley, thus allowing for greater exploration of the area and more observation of its component parts. Pupils revealed a dislike for conducting fieldwork in school uniform. This suggestion appears to be a reasonable one but it is believed that an acceptable minimum standard of dress be laid down after consultation with the school's principal.

Some of the pupils revealed the possible need to visit other larger natural areas where a greater diversity in the biotic component of the ecosystem could be observed and studied. It is believed that this could best be achieved through a weekend excursion run by the school's geography club or outdoor society, with teacher supervision, to an ecologically diverse area like Lake St. Lucia on the Natal North Coast, the Umgeni Valley Ranch near Howick in the Natal Midlands or to the Drakensberg mountains. Pupils made the point about avoiding doing fieldwork during the midday heat. This is seen as a valid comment depending on what kind of fieldwork is being done and in what location. The Pigeon Valley fieldwork was conducted during the morning and had been more or less completed by midday. Also, because of the forested nature

of the vegetation in Pigeon Valley, which provides a large amount of shade, this point was not seen as so important in the context of this particular field study.

A final point that should be mentioned is the generally satisfactory way that the worksheets were answered, as discussed earlier in the chapter, which provides additional evidence to support the mainly positive responses to questions posed in both the questionnaires and the interviews on whether pupils found the fieldwork exercise beneficial to them.

#### Analysis of Interview responses

As has been stated by Yin (1984) the major purpose of a focussed type interview, as was used in this study, is to corroborate or probe more deeply certain facts that the investigator already thinks have been established through the use of other research techniques which he has employed. In such a situation, the specific questions need to be carefully worded, so that the investigator appears naive about the topic and allows the respondent to provide a fresh commentary on it.

At all times, the interviewer must remember that his interview is a data collection instrument and he must prevent the respondent from rambling away from the essence of a question. The procedures to be adopted by an interviewer when conducting a successful interview can

present problems to someone inexperienced in this field, as can the analysis of the data collected. The use of a tape-recorder to record in detail the responses to the questions posed assisted in the following analysis of the interview responses.

A similarity of response with those in the questionnaire was obtained, with the interviews not only corroborating points raised but also providing a deeper analysis of these points. It must be noted at this point that ten out of the twenty-four pupils in the study group were randomly selected to participate in the interview phase of the research. A time constraint represented the main reason why the whole study group were not interviewed.

Due to the open-ended nature of the questions posed in the interviews, a descriptive analysis of the responses obtained will now be presented for each individual question. The tabulation which appears with each question was obtained from an analysis of the tape-recorded interview responses and provides a summary of the open-ended responses obtained.

#### Question One

Did you have any problems with the worksheets and reference booklets used in the Pigeon Valley fieldwork?

Positive response	Undecided/non committal	Negative response
4	0	6

This question, like questions one and two of the

questionnaire, revealed that most of the pupils interviewed (i.e. six out of ten) experienced no major problems with the worksheets and reference booklets. Minor problems which emerged as raised by two pupils were the black and white diagrams of bird and butterfly types, alluded to earlier, which made identification difficult in the field, and two pupils found the worksheets a little difficult. Some of the brighter pupils also felt that not enough space had been allowed in the worksheets for the answers. It is believed that the amount of space provided was adequate in encouraging concise pupil answers, something expected of pupils when answering examination questions.

Question two

- a) Did you have any problems working as a group in Pigeon Valley?
- b) Would you have preferred working individually?

	Positive response	Undecided/non committal	Negative response
a)	2	1	7
b)	6	1	3

An analysis of the responses to this question revealed that some of the brighter pupils indicated a willingness to work individually rather than in groups, whereas the weaker pupils all preferred the groupwork approach. The teachers saw copying as a potential problem among weaker pupils working in groups. The pupils felt that the size of the group was important and should not be too large as this would tend to encourage misbehaviour as a result of a

shortage of component tasks to be done. There should also be sufficient work available to keep all members of the group sufficiently busy.

Question three

Did you have any problems with the equipment used in the experiments/tasks/exercises?

Positive response	Undecided/non committal	Negative response
2	0	8

An analysis of the responses to this question revealed the need for a pre-excursion briefing on how the experimentation should be done while on the excursion. Two pupils had problems with the particular type of field microscope used and felt that an ordinary magnifying glass would have been adequate. The field microscopes used relied on sunlight to assist with magnification and problems could be experienced if it was an overcast day. The field microscopes were also found to be cumbersome to carry around while doing the fieldwork. The teachers indicated a keenness to follow-up experimentation done in the field with further experimentation in the classroom, especially on soils. A soil practical exercise, designed for use in a science laboratory or classroom using equipment borrowed from a science laboratory was subsequently drawn up for use by matric geography classes.



Question four

- a) Should more problem solving/experiments/tasks have been set?
- b) Should more time be allocated for observation and exploration?

Positive response	Undecided/non-committal	Negative response
a) 2	1	7
b) 8	1	1

An analysis of the responses to question four revealed that time spent on observation of the environment is an important aspect of fieldwork and should not be reduced in relation to that spent on completing the exercises required by the worksheet. Amongst the pupils, it was shown that brighter pupils welcomed more experimentation and problem solving tasks while weaker pupils wanted more time for observation and exploration.

Question five

Was too much time spent filling in the worksheets while you were in the Valley instead of more time being spent on observation or experimentation?

Positive response	Undecided/non-committal	Negative response
7	1	2

This question revealed that time spent filling in the worksheets was seen as a major problem facing the fieldwork exercise. It has already been stated though that the completion of the worksheets should be seen as part of the excursion follow-up for homework, allowing time for observation and exploration of the ecosystem being studied while in the field.

### Question six

How important is a preliminary 'acquaintance' visit to the area, using the reference booklet, before a more detailed worksheet based visit?

Very Important	Less Important	Not Important
9	1	0

An analysis of the responses to this question revealed, as suggested by nine pupils, that the time problem could be eliminated if two visits were made to the study area, the first an acquaintance visit to allow for observation and exploration and the second for experimentation and study of the area. Pupils indicated that a prior studying of the worksheet and reference booklet would assist in focussing their observation and exploration of the area during the acquaintance visit. Teachers, however, felt that although an acquaintance visit was essential in their case, so as to familiarise themselves with the area, such a visit was not necessary for the pupils who they thought would be unmotivated for the second work-orientated visit, after the excitement of exploration and observation of their first visit.

### Question seven

How much of a problem was the time available to you while you were doing the fieldwork?

Big problem	Minor problem	No problem
7	0	3

The time problem once again becomes the focus, as revealed by seven pupils, in an analysis of responses to question

seven of the interview. Whereas brighter pupils generally found they had sufficient time to complete the worksheet exercises, particularly if an acquaintance visit had taken place, weaker pupils still expressed a time-pressure problem. The teachers highlighted the importance of the pre-excursion briefing as a mechanism to reduce the time problem of the fieldwork. As has been stated earlier in this study, at least four hours (approximately a full school morning) is needed to successfully complete the fieldwork required. This would include the observation/exploration component as well as the actual experimentation.

The points raised by pupils in question eight of the interview viz. Are there any other points you wish to make relating to the fieldwork exercises and the worksheets used? revealed similar responses to those elicited in question ten of the questionnaire and question 28 of the worksheet. These included the pupils' desire to wear civilian clothes while conducting the fieldwork and to avoid doing fieldwork during the midday heat. The teachers once again reiterated the importance of assessing human impact on the ecosystem through, for example, the study of the effect of traffic noise and air pollution on the ecosystem.

### Conclusion

The internal similarities which are suggested between questionnaire and interview responses, as revealed above,

indicate the appropriateness of the fieldwork exercises devised as part of the study for the purpose of teaching the ecology section of the new matric syllabus. Observation of pupils while engaged in fieldwork and the analysis of worksheet responses provides further evidence of their suitability. These findings substantiate the recommendation made in the syllabus preamble that the fieldwork approach be used to teach the new section.

The analysis of the Pigeon Valley fieldwork exercise also indicated a measure of enjoyment by the pupils and an acceptance of this approach by the teachers. The importance of fieldwork as a replacement for systematic teaching of the ecology section is also revealed by these findings and this substantiates the study's main proposition. Various general, as well as more specific points arising out of an analysis of the observation of fieldwork, the worksheet exercises, questionnaire and interview responses have been presented in support of these statements.

An attempt has been made in this chapter to locate the analysis of the study in a structure so as to make the evidence collected as intelligible as possible. This was attempted through the use of tabulation and the establishment of links between evidence acquired from different sources. The evaluative nature of the study must not be overlooked, with the evidence gathered by the techniques used in triangulation assisting in the

formulation of the study's conclusions and recommendations.

In conclusion, the very nature of case study research must once again be borne in mind at this point. This case study has described and analysed an ecological fieldwork exercise conducted by a target group of matric pupils as part of their geography syllabus. It must be remembered that the very nature of case study research is not to attempt to generalise from one particular study to another study which may outwardly appear similar. Be this as it may, it is hoped that the points raised in this analysis will have some bearing on ecological fieldwork carried out by geography teachers not only in Natal but also throughout South Africa. These points will be elaborated on in the concluding chapter.

## CHAPTER SIX

### CONCLUSIONS AND RECOMMENDATIONS

#### Introduction

When American astronauts Bormann, Lovell and Anders made their historic flight around the moon and back to earth in December 1968, they became the first people to see the earth for what it really is - a small planet suspended in the blackness of space. They realised then that the earth was similar in many respects to the spaceship in which they travelled. As a spaceship the earth has limited supplies of living space, food and water; and as with a spaceship the life-support capability of the earth is dependant on the captain and crew. Since 1968 many ecologists have used the term 'spaceship earth', as was shown diagrammatically in Chapter one of this thesis (Figure 2), to bring home to people the fact that the earth has a limited life-support capability, and to stress that each and every one on earth has some role to play in protecting the total earth environment. Whatever we do to ensure the health of the environment locally contributes in some way to the well-being of the environment on a global scale. Whether we like it or not, we are all inextricably part of spaceship earth and our actions should reflect our concern for our mother planet.

The new high school geography syllabus encourages pupils to adopt this 'spaceship earth' view of our environment with man seen as living in harmony with his environment rather than man against it as has been the case in the past. The concepts of environmental conservation and management are encouraged, with ecological principles being applied, to the management of all natural resources. Man needs to move away from his current 'throwaway' society, shown diagrammatically in chapter one of this thesis (Figure 1), towards an 'earthmanship' society. Pupils are urged to live by the priorities of the World Conservation Strategy (W.C.S.), launched on 5 March 1980, which aims to keep our world a clean, healthy, productive and beautiful place in which to live. The three main priorities of the Strategy are:

- 1) to maintain the earth's ability to support life, that is, make sure that new developments do not reduce the capacity of the earth to support life;
- 2) to preserve genetic diversity by preventing the extinction of species, that is, to conserve wild plants and animals so that we can continue to develop new strains of seeds, livestock and micro-organisms to benefit mankind;
- 3) to make sure resources are used in a careful and sustainable manner, which means that we should not overexploit our natural resources.

The World Conservation Strategy uses an ecological approach towards conservation and management of the earth's resources. The new high school geography syllabus urges a study of the ecological approach through the study of ecosystems, ecological processes like energy flows, nutrient cycling and ecological self-regulating mechanisms as well as human impact on ecosystems.

Attempts at environmental education as part of the geography syllabus need to be conducted using the ecological approach. In addition to the famous three Rs of reading, writing and arithmetic, schools should be teaching resource utilisation, conservation and management. The World Wildlife Fund (W.W.F.) and its local branch, the South African Nature Foundation, are among many other organisations concerned about the growth in world population and the severe stress this is placing on the natural environment. Organisations like the World Wildlife Fund believe that the knowledge and will required to live in harmony with the environment need to be an essential part of the education of every child. By educating pupils we are preparing them for life as adults, with basic skills, information and values. These organisations believe that there can surely be no more important education than teaching the child how to live without destroying the environment that supports life. Schools and their teachers, particularly geography



teachers, have a very important, if not crucial, role to play in this regard.

### Conclusions and Recommendations

This study has attempted to show by means of a case study that fieldwork is an appropriate method for the teacher to use when teaching the section 'Ecosystems, Environmental Balance and Conservation' in the new standard ten geography syllabus.

The many advantages of fieldwork as a teaching method in geography as outlined in chapter three of this study as well as the apparent enjoyment and success of the ecological fieldwork carried out in Pigeon Valley, as revealed by observation, worksheets, questionnaire and interview responses in chapter five, seem to substantiate this view. The analysis undertaken in chapter five revealed not only that the target group of pupils seemed to enjoy the fieldwork exercise, but also that they learned about ecology and ecosystems at the same time. The fact that the study's conclusions cannot easily be generalised to other situations should not in any way detract from the study's value and importance as a piece of educational research in the field of geography teaching.

It is recommended that a problem/issue based component be built into any ecological fieldwork undertaken, particularly for senior pupils. The use of a traditional

fieldwork format with a built-in field research component is recommended for the use of senior pupils who need to become conversant with the use of the scientific approach (hypothesis testing) in fieldwork as a preparation for study at the tertiary level. This study also recommends that schools implement a fieldwork programme in ecology and environmental education so that the important basic concepts inherent in this section of the standard ten syllabus can be introduced and developed in pupils at the junior level to inculcate in them at an early age a concern and caring attitude towards the environment. This should be done , as revealed in chapter three, using the traditional fieldwork format, with its emphasis on observation and exploration of the environment.

The case study which forms the focus of this thesis investigated how a fieldwork exercise could be conducted with a group of standard ten pupils using the ecological approach. The case study investigated how the fieldwork exercise conducted in Pigeon Valley could be used to teach the ecology section of the syllabus. It is recommended that if time constraints force the use of a more systematic teaching approach, that fieldwork could be used to revise the section and reinforce concepts and terminology learnt earlier in the classroom.

As was pointed out in chapter two of this thesis, an environmental education ethic and bias is recommended by

the new syllabus for implementation by teachers at all levels. Teachers need to become ecocentric in their teaching approach and more influenced by environmental concerns in their outlook.

The choice of case study as the research method adopted by this study seems to have been an appropriate one when the essential characteristics of the case are identified viz. a study of a particular set of circumstances which prevailed and which allowed the researcher an insight into the use of geographical fieldwork to teach or revise the new ecology section of the syllabus. Case study seemed to provide an appropriate method to study the ecological fieldwork undertaken by the group of pupils selected in Pigeon Valley.

More specifically, the evaluation which arises out of chapter five reveals the importance of a number of points which it is recommended should be taken into consideration by persons intending to set up geographical fieldwork programmes in ecology. These points should not be seen to be listed in any order of importance.

1. The importance of the teacher acquiring a degree of knowledge in the area of ecology before attempting to devise a series of worksheets on the section. This can be achieved by a thorough reading of relevant literature and by consulting various persons and

references provided by this study should prove of assistance in this connection as well as the persons and organisations listed in the study's Acknowledgements.

2. The importance of teachers becoming conversant with the nature of fieldwork in general, but more particularly the use of different types of fieldwork suitable for both junior and senior pupils, as described in chapter 3 of this study. It is the study's contention that the average geography teacher in Natal needs to become more conversant with the use of fieldwork and fieldwork methods in geography.
3. It is recommended that when teachers attempt to draw up worksheets for use in geographical fieldwork, that they take cognisance of the points raised by Lloyd-Jones (1985) on worksheet design, referred to in chapter four of this study.
4. Teachers need to ensure that the material contained in their worksheets adequately covers the main points listed in the syllabus for that section. This can be achieved by the drawing up of a matrix similar to that shown in Appendix C.
5. It is very important to the success of a fieldwork programme if the teacher drawing up the worksheets provides an accompanying teachers' guide informing

colleagues exactly what is required and how the fieldwork should be conducted, as has been done for this study in Appendices E and J.

6. If time permits, a pilot study, as described in chapter four of this study, should be undertaken so as to iron out any problems which may occur with the worksheet or in the actual fieldwork. A pre-excursion briefing to the participants of the pilot study as well as any subsequent participants in fieldwork excursions is essential to facilitate the smooth running of the fieldwork.
7. Regarding worksheet construction, this study has revealed that teachers should guard against worksheets being too long and/or too difficult as pupil enjoyment of doing fieldwork must not be hampered in any way. Teachers must be careful to ensure that questions asked of the pupils are unambiguous, that tasks and experiments required are clearly stated, that diagrams and sketches provided in the worksheets have been duplicated clearly and that adequate space has been allowed for answers to the questions and tasks expected of the pupils.
8. In an effort to overcome the problem of time shortage often experienced in fieldwork, the teacher must ensure that pupils have an opportunity to study the worksheets beforehand and that pupils have been

instructed to fill in the worksheets for homework, so allowing maximum time for observation and experimentation while in the field. These points need to form an important component of the pre-excursion briefing session which of necessity must be held prior to the conduct of the actual fieldwork.

9. The importance of a follow-up phase to the fieldwork undertaken is stressed, during which worksheets are completed by pupils, discussed in class, marked by teachers and the mark used for assessment purposes. This will indicate to the pupils that fieldwork does have a more serious academic side and that the fieldwork excursion was not a one-off fun trip.
10. The importance of teachers thoroughly preparing themselves beforehand so as to ensure a successful session in the field e.g. nomination of group leaders, careful selection of group members, allocation of tasks to ensure pupil productivity, demarcation of the study area and ensuring that all equipment required is available, among other tasks. This information must then be clearly relayed to the pupils prior to their conduct of the fieldwork.
11. Most important of all, teachers need to provide pupils with a list of behavioural objectives as well as a generalised aim which they hope will be achieved as a result of the fieldwork undertaken. It is

important that pupils are made aware of these at the outset of the fieldwork exercise.

12. Teachers need to be careful to avoid subjecting pupils to strenuous fieldwork during midday heat in summer.
13. Teachers should, after consultation with the school's principal, allow pupils to wear civilian clothes during fieldwork activities.

### Conclusion

What has been learnt in this study has proved invaluable to the researcher in terms of his knowledge of what the new syllabus expects, how this knowledge can be learnt by pupils and methods used to convey the knowledge. Hopefully, what has been learnt through this study will be utilised by colleagues teaching geography in Natal high school and that the study has made some contribution towards the development of geography teaching in Natal.

The study's strength as an evaluation offers evidence which suggests that the fieldwork conducted and the worksheets used can be easily adapted by fellow teachers to natural areas near to their respective schools, with the Metropolitan Open Space System (M.O.S.S.) concept being applied in urban areas throughout South Africa facilitating the situation in this regard. The questionnaire and interview schedules could be used as is

or adapted by fellow teachers as a means of assessing the success or otherwise of the fieldwork they have conducted. Also, the detailed description of the steps followed by this study when setting up the fieldwork programme, as described in chapter four of this thesis, should provide a guide to fellow teachers wanting to institute a similar plan of action. Obviously, modifications and changes may need to be undertaken to suit the particular circumstances applicable. It may well be, though, that a different set of findings could result from that achieved in this study, a point which has been made before in this study when referring to the nature of case study as a research method. This study's limitation on generalising outcomes, as stated in the study abstract, should not detract from its value as a piece of educational research.

It is also felt that if this study encourages fellow teachers to conduct ecological fieldwork, a measure of success will have been achieved. As chapter two and three of this study have revealed, much scope is available for geographical fieldwork even though a disappointing quantity of fieldwork is at present being undertaken in our schools. It is the contention of this study that fellow teachers of geography have a responsibility to meet the challenges posed by geographical fieldwork in ecology and environmental education.



Finally, consideration is given to a quotation by R. Thomas Tanner included in a recent South African Council for the Environment publication (1988). The sentiments expressed in the quotation are fully endorsed by this study which should be viewed in the context of teaching our pupils more about 'Spaceship Earth', through the use of ecological fieldwork.

The quotation is as follows:

Our little Spaceship Earth whirls on through  
the fleeting stars of night. Except for sun-  
light, her fuel and supplies are all on board.  
There's no going back for more,  
and there's no getting off to go some better  
place.  
Spaceship Earth is off the pad,  
and we're the crew,  
The only crew she's got. (p.1).

Certainly, time is not on the side of the crew of Spaceship Earth, with the environmental crises referred to at the beginning of this thesis ready to engulf mankind.

APPENDIX A

CASE STUDY RESEARCH

TRIANGULATION METHODS MATRIX: INFO OBTAINED FROM MORE THAN ONE SOURCE MORE LIKELY TO BE VALID.

METHODS OF OBTAINING INFORMATION

INFORMATION REQUIRED	OBSERVATION	INTERVIEW	QUESTIONNAIRE	WORKSHEET
Kinds of information sought				
1. Success of field work approach to teaching ecology	X	XX	X	X
2. Success of the worksheets used	X	X	X	XX
3. Pupil/teacher enjoyment of the whole exercise	X	XX	X	
4. Pupil/teacher attitude formation (environmental awareness)	X	XX	X	
5. Syllabus objectives realised		X	X	XX

INFORMATION REQUIRED	OBSERVATION	INTERVIEW	QUESTIONNAIRE	WORKSHEET
Kinds of Information Sought				
6. Pupil concept development		X	X	XX
7. Pupil skill development	XX		X	X
8. Pupil Productivity/ involvement	XX			X
NOTE: THE FACE TO FACE PERSONAL 'REAL' NATURE OF THE INTERVIEW METHOD GIVES IT AN OVERALL ADVANTAGE OVER THE QUESTIONNAIRE AS AN INFORMATION/DATA COLLECTION METHOD (TUCKMAN, 1972, IN COHEN AND MANION, 1985)				

XX MOST EFFICIENT MEANS  
X SUPPORTIVE MEANS

AFTER: COHEN AND MANION, (1985), p.264.

## APPENDIX B

### THE ECOLOGY SECTION IN THE NEW STANDARD TEN

#### HIGHER GRADE GEOGRAPHY SYLLABUS

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
4. ECOSYSTEMS, ENVIRON- MENTAL BALANCE AND CON- SERVATION					
4.1 Soils					
4.1.1 The character- istics of soil	biotic - abiotic system edaphic factor weathering	- state the properties of soil - evaluate the role soil plays in the link between the biotic and abiotic subsystems of the man- environment system	- soils can be defined in several different ways. Whichever approach is used, it is important to stress that soil is a dynamic system. - emphasis must be placed on soil's importance to man.  - Field trips are import- ant.	- soil must be seen as the link between biotic and abiotic elements.	

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
4.1.1 continued				- Man's mis-management of this vital resource should be highlighted in a problem-orientated approach.	
4.1.2 Soil profile	profile horizon azonal zonal	- define the soil profile/horizon - identify the several master horizons in the soil profile - draw a diagram to represent a hypothetical soil profile	- The development of zonal type soil should be linked to soil forming processes and soil-forming factors. - Stress the inter-action between man and the development of soil profiles and the various elements within the profile		
4.1.3 Soil-forming factors	soil-forming factors soil-forming processes soil horizon soil type	- identify the soil-forming processes - list the factors influencing the formulation of soil	- Practical work should be encouraged		

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
4.1.3 continued		- describe the influence each factor has on soil formation			
		Pupils should:			
4.2	Concept of ecosystem an eco-system biotic and abiotic components	- define an ecosystem - identify the elements of a simple ecosystem - list examples of eco-systems - appreciate the inter-dependence of living organisms (including man) and their relationship to the abiotic elements of their environment	- Slides can be shown of different types of eco-systems e.g. lake, forest, sugar cane. - A field study of a selected ecosystem should be undertaken. Biotic and abiotic elements should be identified. Tentative inferences about the distribution and inter-relationship of the components could be made.		Murdock, W.M. (1971) <u>Environment. Resources. Population. Society</u> Massachusetts Sinava  Haggett, P. (1975) <u>Geography a modern synthesis</u> N.Y. Harper  Whittaker, R. <u>Communities and Eco-systems</u> - McMillan  Strahler A.N. (1973) <u>Environmental Geoscience</u> Hamilton

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
4.2 continued			<ul style="list-style-type: none"> <li>- A hardware model by Mr R O'Donoghue of NPB could be used to demonstrate the interdependence of the components of an ecosystem.</li> </ul>	<ul style="list-style-type: none"> <li>- The main aim of this section is to promote the realization of the interrelationships among organisms, including man, and their environment and of their interdependence.</li> <li>- In a field study a natural ecosystem could be contrasted with man-made ecosystems e.g. a playing field.</li> </ul>	Tyler Miller: <u>Living in the Environment</u> Wadsworth

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
4.2 continued				<ul style="list-style-type: none"> <li>- Abiotic components which may be investigated include: soil, light, temperature, water atmospheric gases, aspect, slope and altitude. Biotic components could include vegetation, insects, animals and man.</li> <li>- The inter-relationships between and inter-dependence of these various components should become apparent</li> </ul>	



SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES	
4.3	Ecological processes	producers consumers	- identify and draw simple food chains and food webs	- The concept of degrading and dispersal of energy as it moves through the trophic levels in a food chain should be related to the problem of providing food for a rapidly increasing human population.	- The processes are listed separately. However, pupils should understand that they are integral parts of an interacting system.	
4.3.1	Energy flow	decomposers food chain food web energy flow energy conversion degrading and dispersal of energy trophic level trophic pyramid	- draw and interpret trophic pyramids - describe the flow of energy through ecosystems, food chains, food webs and ecological pyramids - appreciate the unique role of plants as producers - explain why there is a decrease in usable energy available at each succeeding level in the food chain - describe how energy is degraded and dispersed in an ecosystem - explain why energy cannot be	- Concepts learned in this section can be used to explain why big animals are rare - Some consider that the purchase of red meat by the rich, deprives the poor of food. - The first and second laws of thermodynamics, the laws of concentration of energy and the energy degradation,		

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
4.3.1 continued				used as a theoretical underpinning for the section on the flow of energy through an ecosystem.	
4.3.2 Nutrient cycling	chemical cycle natural cycling through-put system	<ul style="list-style-type: none"> <li>- explain the dependence of life on energy flows and nutrient cycling</li> <li>- explain the need for and the consequences of nutrient cycling</li> <li>- draw simplified diagrams of the carbon and nitrogen cycles.</li> </ul>	<ul style="list-style-type: none"> <li>- The natural recycling of nutrients e.g. in forests or the grazing of grasslands by animals, should be contrasted with through-put-systems e.g. the harvesting of sugar cane and timber.</li> </ul>	Note. Nutrients cycle, energy does not.	

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
Pupils should:					
4.3.3	Ecological factors self-regulation the cycling of nutrients negative or positive feedback loop steady-state stable-ecosystem unstable-ecosystem population-explosion cycling vs through-put systems adaptation leading to a share of resources in the ecosystem niche	<ul style="list-style-type: none"> <li>- explain the effects of feedback loops</li> <li>- explain how animals in a natural ecosystem are so adapted to share rather than compete for resources</li> <li>- explain how different animals obtain their food from different parts of an ecosystem, thus sharing rather than competing for limited resources.</li> </ul>	<ul style="list-style-type: none"> <li>- An example of ecological self-regulation is the crocodile population of lake St. Lucia which is governed by supply</li> <li>- A real-life problem illustrating the breakdown of self-regulating systems is the need for the culling of antelope in nature reserves.</li> <li>- Flow diagrams should be used to illustrate how feedback loops operate.</li> </ul>	<ul style="list-style-type: none"> <li>- Note: sections 4.3.3 and 4.4 could be effectively integrated</li> <li>- Factors influencing the stability and instability of ecosystems should be examined</li> <li>- Explain why exotics often become problem weeds</li> <li>- Game ranching where a variety of animals utilize different parts of the veld, can be shown to be a more efficient use of the veld than cattle ranching.</li> </ul>	

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
Pupils should:					
4.4	Human impact on eco-systems	environmental degradation pollution eutrophication	- describe examples of man's impacts on eco-systems	- The ecological implications of feed-lots (a through-put-system) and of free range grazing (a cycling system) should be assessed	
4.4.1	Imbalance of the ecosystem	super pest persistent-pesticide population-pressure	- identify factors which have resulted in a change from stable to unstable conditions - explain the cause and consequences of eutrophication	- Explain how super-pests results from the use of insecticides - The pros and cons of the use of persistent pesticides such as D.D.T. should be debated.	- The concepts of trophic pyramids, natural cycling and persistent pesticides should be used to explain why for example fish eagles and breast-fed babies are at risk from persistent pesticides such as D.D.T. - Eutrophication is an example of man's impact on a formerly self-regulating system.

SYLLABUS STD 10 HG	CONCEPTS & SKILLS	OBJECTIVES	SUGGESTED APPROACH	COMMENTS	SOURCES
		Pupils should:			
4.4.2	Environmental conservation and management	life support systems renewable-resources non-renewable resources quality of life 'spaceship earth' conservation preservation management	<ul style="list-style-type: none"> <li>- distinguish between the concepts: 'man in harmony with nature' 'man against nature'</li> <li>- assess the influence that 'man the manipulator' has had on his environment</li> <li>- distinguish between conservation, preservation and management</li> </ul>	<ul style="list-style-type: none"> <li>- Debate the relative merits of conservation vs management</li> </ul>	<ul style="list-style-type: none"> <li>- Environmental impact statements could be used to demonstrate how the quality of life can be affected by a local government. This involves geographical analysis and underlines the need for wise management.</li> </ul>

APPENDIX C

SYLLABUS MATRIX DRAWN UP TO CHECK IF ALL SECTIONS  
OF THE SYLLABUS HAD BEEN COVERED BY THE WORKSHEETS

QUESTIONS IN FIELD RESEARCH WORKSHEET

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STD 10 SYLLABUS

CONCEPTS, SKILLS  
OBJECTIVES

01 02 03 04 05 06 07 08 09 010 011 012 013 014 015 016 017 018 019 020 021 022 023 024 025 026 027

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SOILS

1. CHARACTERISTICS

Biotic vs Abiotic  
subsystems  
Soil properties  
Weathering

X X  
X X X  
X X X

2. PROFILES

Profile/Horizons  
Azonal vs Zonal \*

X  
X

3. SOIL FORMING )  
FACTORS )  
 ) \*  
Factors ) )  
Processes ) )  
Types ) )

X  
X  
X

4. SOIL EROSION/  
CONSERVATION

X X X X

---

ECOSYSTEMS

Ecosystem (Define  
& Examples)  
Biotic vs Abiotic  
Elements  
Producer  
Consumer  
Decomposer  
Seral Stages/\*\*Animals  
Climax Community  
Man the Manipulator  
Trophic Level  
Trophic Pyramid

X X  
X X  
X X  
X X  
X X X  
X X X  
X X X  
X X X

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STD 10 SYLLABUS

CONCEPTS, SKILLS  
OBJECTIVES

Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27

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HUMAN IMPACT ON  
ECOSYSTEMS

Ecosystem Imbalance (stable vs unstable)									X																	X
Environmental Degradation	X	X	X	X					X																	X
Pollution																					X					
Eutrophication *																										
Pesticide																			X							
Population Pressure Resources	X	X	X	X																						X
Spaceship Earth Throughput Model																										X
Man as Manipulator	X	X	X	X																						X
Conservation	X	X	X	X																						X
Preservation Management																										X

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\* AREAS TOUCHED ON IN QUESTIONS BUT COULD POSSIBLY BE EXPANDED INTO FULL QUESTIONS ON THEIR OWN



## APPENDIX D

### PILOT STUDY FOLLOW UP REPORT

FORMS 5 AND 6 SENIOR WORKSHEET. (Form 5 Set 1 - 10 pupils used in pilot study)

#### PUPIL SUGGESTIONS TO IMPROVE WORKSHEET AND FIELDWORK

Many of the points raised by the junior pilot group (as stated in the text the junior worksheet does not form part of this study but constituted part of a parallel study,) were also raised by the senior pilot group, particularly the time problem. It was pointed out that this problem could be overcome by breaking the worksheet up into two or three sections and tackling these sections in a series of class double periods.

The length of the worksheet was a concern, although if a thorough revision of the whole ecology section was being attempted, this problem could not be avoided. As was pointed out by the junior group time is required for observation of birds, butterflies and trees and allowance must be made for this. One reference booklet per group of 3 pupils was seen to be adequate provided each team member had access to it for an evening to acquaint themselves with its contents. Pupils pointed out that colour pictures of birds and butterflies are really required for accurate identification purposes but acknowledged that

duplication of such is not possible in the schools, both in terms of available equipment and financial cost. The idea of the reference booklet was very well received and was seen to be essential to the overall success of the field excursion, particularly the 'glossary of terms for Ecological Studies'. (F in reference booklet)

Some pupils felt the worksheet was a bit too thorough with repetition of a few concepts assisting this. The 'wordiness' of the worksheet could also constitute a problem although when the worksheet was devised, there was an awareness of the fact that a competently completed worksheet could constitute a thorough set of notes on the ecology section which could be revised for test/examination purposes. Pupils also felt that a lot of time was spent while on the excursion reading all the preamble leading up to the questions. Like with the junior group, it was felt that a preparatory lesson was essential prior to embarking on the excursion, telling pupils what was expected of them when in the study area and also giving them a basic lesson in ecology if they had not yet done in the section theoretically in class.

Pupils did feel that the time problems would in time be alleviated somewhat as a result of basic ecological concepts being introduced to pupils in the junior standards by teachers who have integrated them into other sections of work (good teaching, encouraged by NED).

Also in many schools Std 10 pupils will have done an Ecology course in Std 9 (the Std 10 Ecology section) and the worksheet was seen by them as an ideal way of revising the Ecology section, which was probably done in a theoretical way in Std 9.

There was overwhelming consensus of opinion that the worksheet and field research excursion was a worthwhile exercise, which was both enjoyable and educational.

#### Equipment required for field research excursion

Worksheets and A4 paper (3 pieces per person)

Clipboard

Pens, pencil, rubber

Wet and Dry bulb thermometer (preferably a whirling psychrometer) ( $\pm 1$  per group)

Soil thermometer ( $\pm 1$  per group)

Test tubes ( $\pm 3$  per group)

Magnifying glass ( $\pm 3$  per group)

Field microscope ( $\pm 3$  per group)

Microscope glass slides ( $\pm 3$  per group)

Litmus paper Universal indicator paper (2 pieces per group)

Meter rule ( $\pm 1$  per group)

Magnetic compass ( $\pm 1$  per group)

Tape recorder (for taping bird calls for later identification)

Large size plastic bag (for leaf and other samples)

## APPENDIX E

### FORMS 5 AND 6 ECOLOGY TRAIL

#### (FIELD RESEARCH)

#### PIGEON VALLEY ECOSYSTEM

TEACHERS' GUIDE: This trail is designed to last 7 periods (4½ hours), but can be modified by individual teachers to suit their requirements, i.e. Sections of the Worksheet could be done during a double period and the Worksheet completed at a later stage, as, for example, a revision exercise.

Many aspects of Georgraphy will be touched on in this trail, e.g. Settlement, Climatology, Geomorphology, etc., as well as aspects of other disciplines, e.g. Biology and Science, although its main aim is to serve as an introduction to the new section of ecology in the syllabus, using the field research approach to fieldwork, viz. a problem-solving approach.

This approach has 3 basic stages - a preparation phase, which is done in class as preparation for the outdoor field research, the fieldwork phase done in the field, and a follow-up phase, done for homework or in class.

The main purpose of the preparation phase would be for the teacher to familiarise the pupils with the study area,

e.g. - the location of Pigeon Valley (B in Reference Booklet), Pigeon Valley as an ecological environment (C in Reference Booklet), the value of Pigeon Valley to Durban residents, its role as part of the MOSS system, a green area, an urban lung, urban heat island, effect on bird migration in Durban area, etc. The reference booklet would be made available to pupils in this phase and studied by them as a means of introducing them to the area.

(Pupils must be told by the teacher to refer back continually to the reference booklet during the excursion and in the subsequent follow-up phase, especially F in the Reference Booklet - the glossary of ecological terms).

The field research phase would consist of data collection, interpretation and recording of information, testing of hypotheses and problem-solving by means of answering the questions posed in the Worksheet. Not all the questions posed should be answered during the fieldwork phase (time would not permit this), and the pupils will be expected to decide what questions could best be answered as part of the subsequent follow-up phase at home or in class (A weaker class could probably be helped here).

It is recommended that pupils work in groups of 3 or 4, with each pupil having his or her own worksheet to fill in and each group a Reference Booklet (Duplicating and paper costs are obvious constraints to each pupil having his or

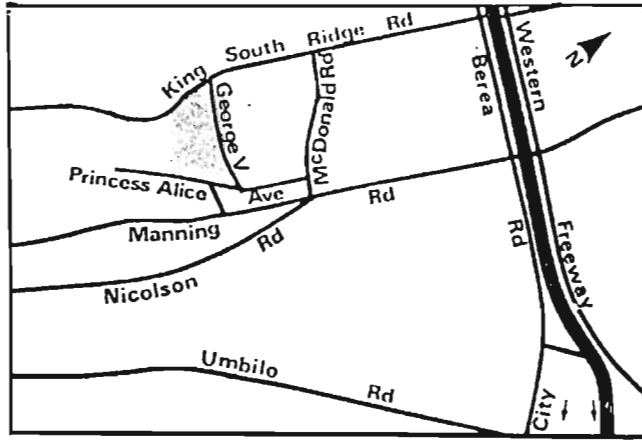
her own Reference Booklet, the obviously desirable situation.) Even though a group work approach is advocated, the teacher should still expect some individualism in answers when marking or assessing the Worksheets.

The follow-up phase, Pupils' homework on the night of the excursion, or as a class exercise the following day, is to complete the Worksheet by interpreting what they observed in the field and by writing up their observations and presenting them in a project form.

D and E in the Reference Booklet must serve as a framework for the fieldwork phase, and pupils are expected by the end of the excursion and subsequent follow-up writing phase to be able to relate all that they have learnt to the framework and be in a position to understand the framework details.

At the completion of the follow-up phase and teacher assessment of the Worksheets, the pupil will hopefully have a better idea of the practical application of the new section of the syllabus, with the fieldwork approach showing that the skills, concepts and objectives listed for this section in the syllabus guide can be successfully realised in this way.

ECOLOGY TRAIL - PIGEON VALLEY



**PIGEON VALLEY**

Bush Manners WHILE IN THE VALLEY

**NOISE IS A NO-NO**  
 IT FRIGHTENS ANIMALS AND DISRUPTS  
 THE PEACE - NO RADIOS, PLEASE!



**ONLY YERKS LEAVE JUNK**  
 PLEASE CARRY ALL YOUR RUBBISH OUT OF  
 THE VALLEY AT THE END OF YOUR VISIT.



**REGRET NO TAKE-AWAYS**

OLD SKULLS AND BONES FORM PART OF THE ECOSYS-  
 TEM, AND ARE USED AS TEACHING AIDS. PLEASE DO  
 NOT REMOVE THEM. **DO NOT DISTURB ANY NESTS**  
 OR NATURAL HABITAT WHICH YOU MAY ENCOUNTER

SOME FRIENDLY ADVICE:

- ~ AVOID DRINKING WATER FROM THE VALLEY.
- ~ KEEP TO THE ROAD AND PATHS.
- ~ KEEP TOGETHER WHILE ON TRAIL
- ~ DO NOT WANDER OFF FROM THE CAMP.
- ~ ACCIDENTS ARE AVOIDABLE - HAVE FUN, BUT DON'T BE RECKLESS



HAVE A GOOD TIME AND LET OTHERS DO THE SAME

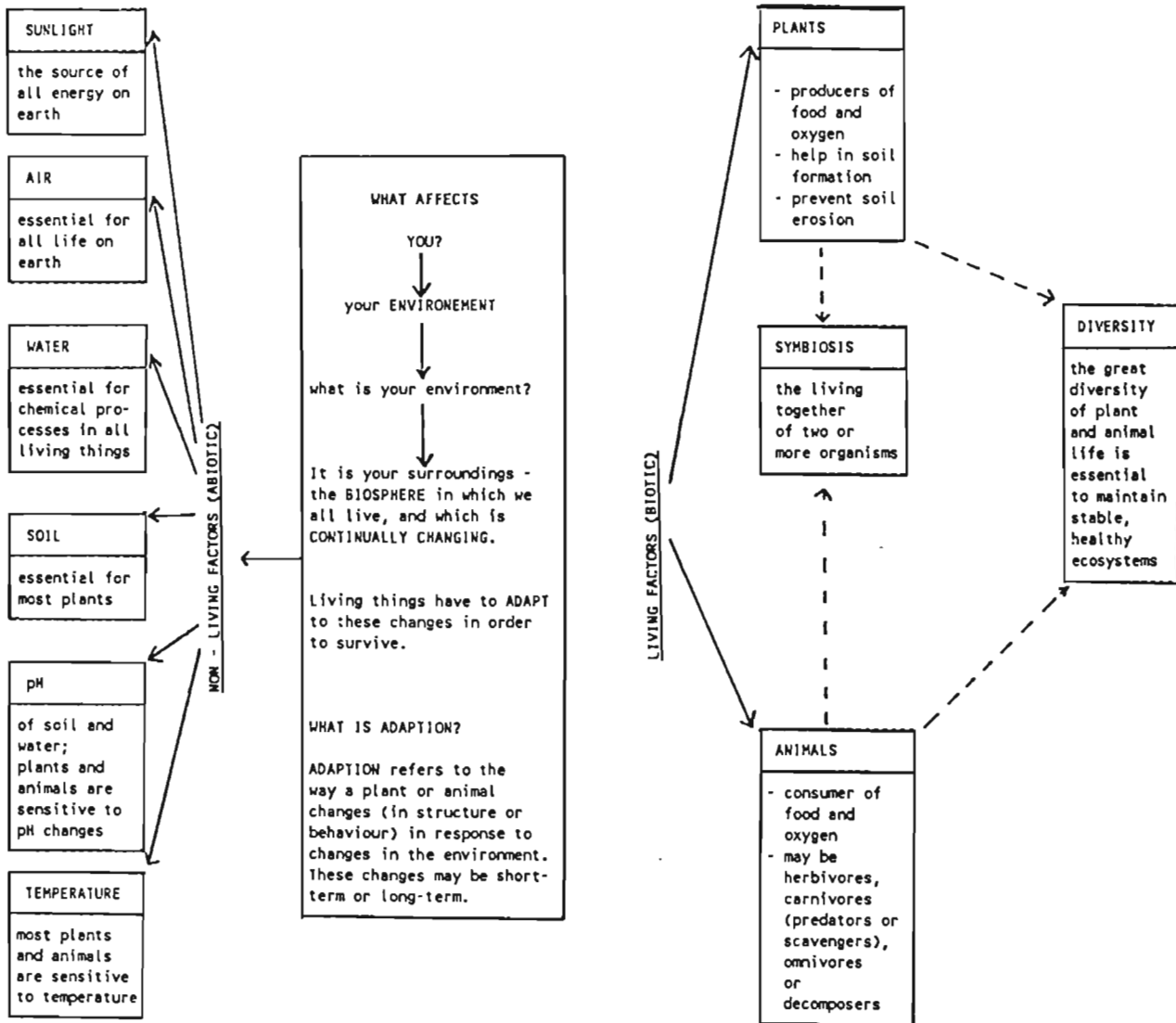
**BE AWARE!**



TRY TO:

- SEE** - not just LOOK
- SMELL** - not just SNIFF
- LISTEN** - not just HEAR
- TASTE** - not just SWALLOW
- FEEL** - not just TOUCH

## FRAMEWORK FOR ECOLOGICAL STUDIES





FORMS 5 AND 6 ECOLOGY TRAIL (FIELD RESEARCH)

(PIGEON VALLEY ECOSYSTEM)

W O R K S H E E T

NAME: \_\_\_\_\_ CLASS: \_\_\_\_\_

1. Enter Pigeon Valley at the main gate behind the visitors' centre near the information board.

You are now standing on the footpath at the start of the Elm Trail.

Observe the footpath

Q.1 What effect will excessive use of this footpath have? \_\_\_\_\_

\_\_\_\_\_

Q.2 What effect will the tree roots lying horizontally across the path have on this process? \_\_\_\_\_

\_\_\_\_\_

Q.3 How can man assist in preventing this process?

\_\_\_\_\_

\_\_\_\_\_

Q.4 What has been done within this Reserve to prevent this process? \_\_\_\_\_

\_\_\_\_\_

(Note: This is part of the management policy of the Reserve. Man is managing his resources, working with nature.

Note also at this point the role of Vegetation in the prevention of soil erosion)

Observe the large Strangling Natal Fig tree in front of you.

Notice it has a hollow trunk formed by the intertwined roots that started life high up in the fork of a Forest Cabbage tree. Once the fig roots had reached the ground, they were able to enlarge and eventually encircle the Cabbage tree trunk and smother it.

Q.5 Explain briefly why the above process occurred.

(Clue: Think of the effect sunlight has on plant growth. You will notice, too, many creepers in the Reserve, climbing up trees, being supported by them. The diagram below (Diagram No. 1) can help you in your explanation. You will also notice other areas in the valley where there is little undergrowth beneath the tree canopy for the same reasons).

Green plants can make their own food by a process known as PHOTOSYNTHESIS.

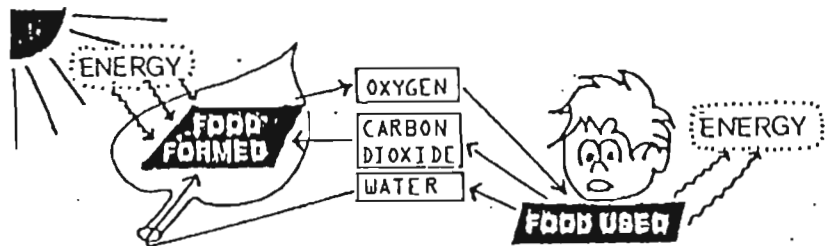


DIAGRAM NO. 1

SOURCE: WILDLIFE SOCIETY OF SOUTH AFRICA BOOKLET ON UMGENI VALLEY. SENIOR CONSERVATION COURSE.

Q.6 What effect will the hollow trunk have on bird and animal life in the area? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Other tree species in this area are the Dragon Tree and Natal Camwood. Observe them.

2. Turn left off the Elm Trail and start wandering up the central pathway in the Valley. As you walk through the Reserve, look for birds and listen for any bird calls. Write down what the bird looked like and then check the list of birds found in Pigeon Valley and the diagram of some of the more common types to try and identify them from the reference booklet given you (I in booklet). Failing this, check Roberts Birds of South Africa in the School library.

Also observe the types of butterflies (K in booklet) which can be seen in the area, and look for signs of animal life (droppings, dung, and spoor).

Make a note, too, of the names of the main indigenous trees which you come across in the Reserve. You will find they have labels on them. Tick them off on your list of trees (G in booklet). (Encourage your parents to plant one of these in your garden this weekend). Trees can be checked in the National List of Trees book in the library.

Observe the topography of the Valley. Notice that the valley has north and south facing slopes draining down into the Central Pathway.

Q.7 What do you notice about the vegetation on the different facing slopes in terms of a) density, b) variety, c) height? Look for evidence of **XEROPHYTIC** plants - plants **ADAPTED** in some way or other to surviving periods of prolonged moisture stress. Discuss briefly ways plants do this. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Q.8 What geographical term is given to this situation? \_\_\_\_\_

**MICRO-CLIMATIC STUDY** using field research approach.

**Problem:** Can Pigeon Valley be used to demonstrate some of the essential characteristics of microclimates?

**Hypothesis:** Pigeon Valley shows some of the essential characteristics of a valley climate situated within an urban area.

Q.9 Test the above hypothesis by taking temperature and humidity readings, checking the influence of aspect and of slopes on air drainage, etc. Based on your test results, conclude whether or not the hypothesis formulated above provides a

solution to the stated problem.

Explain why temperature is such an important abiotic factor in ecosystems, especially its effect on plants.

**USE THE SEPARATE FOOLSCAP SHEET PROVIDED FOR THIS STUDY**

Observe how areas of the Reserve have been cleared of the natural tree and bush vegetation as part of the Reserve's management policy and grassland areas have been maintained for ease of human movement, picnics, etc. (an example of human manipulation of an ecosystem), but also to maintain a more suitable habitat for grassland animals. (H in reference booklet).

As you wander up the central pathway, you will observe some patches of open space in the forest. These are areas which have been cleared of fast-growing exotic vegetation like the **Triffid Weed** (*Chromolaena Odorata*) and **Lantana Camara** or **Confetti Bush** (sometimes called **Tickberry**). These exotics flower in winter and are ready to germinate in spring with the first rain. In some natural areas in and around Durban, 60% of the plant Biomass is alien.

Q.10 What is the difference between exotic and indigenous vegetation? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Find a Chromolaena plant and a Lantana plant - take a sample of a twig with leaves and a flower to press at home and hand it in as part of your project.

Large areas of the Reserve were cleared of exotic vegetation in 1979. The invasion of an area by alien plant species shades out and prevents the growth of indigenous plants, and results in the area becoming biologically sterile. The alien plants tend to dominate the area, having no natural enemies, and provide very little ecological diversity. Although some may provide a quantity of food (for birds, for example) (e.g. the Syringa), they decrease the number of habitat types for birds and are therefore not good for the ecosystem. Unfortunately, monkeys and birds eat exotic fruit, thus aiding seed dispersal of these alien species.

Observe how slowly the patches recover, with local indigenous understory species of plants coming in and young trees starting to grow. (Once again management of ecosystem, positive man-induced interference in an ecosystem). This process is called succession, with the natural vegetation progressing from pioneer stages through to a climax. Note: Pigeon Valley has reached its climax in plant successional terms. Both plant and animal

communities in an ecosystem pass through stages called SERAL STAGES in order to reach a climax stage.

Find an area under the trees which is devoid of vegetation except leaves which have fallen from the trees. Observe how the leaves collect under the tree. Here they slowly decompose with the aid of various soil organisms to form humus.

Q.11 What is meant by the term humus? Why is it important? \_\_\_\_\_

\_\_\_\_\_

Q.12 Scoop a sample of soil up in your hands. You will notice a large number of organisms present. Use your magnifying glass to help you. What is their role in the soil forming process? \_\_\_\_\_

\_\_\_\_\_

Q.13 Why is soil important to plants and hence to life on earth? (Use the terms **nutrients** and **minerals** in your answer - make sure you know the meanings of these terms).

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#### SOIL STUDY USING FIELD RESEARCH APPROACH

**Problem:** To analyse soil characteristics from a sample of soil taken in Pigeon Valley.

**Hypothesis:** A comprehensive soil analysis can be undertaken in Pigeon Valley through a series of simple experiments.

Test/analyse the following soil characteristics (EDAPHIC Factors) following methods studied during class lessons a) Soil colour, b) Soil texture - simply feeling by hand, simple sausage test, c) particle size and structure - use magnifying glass and field microscope, d) Soil pH and e) Soil temperature - ABIOTIC factors, f) animal/plant matter - study organisms with magnifying glass and field microscope - ABIOTIC factors. Based on your test results, conclude whether or not the hypothesis formulated above provides a solution to the stated problem. **NOTE THAT ALL THESE EDAPHIC FACTORS ARE IMPORTANT IN INFLUENCING PLANT GROWTH IN THE ECOSYSTEM.**



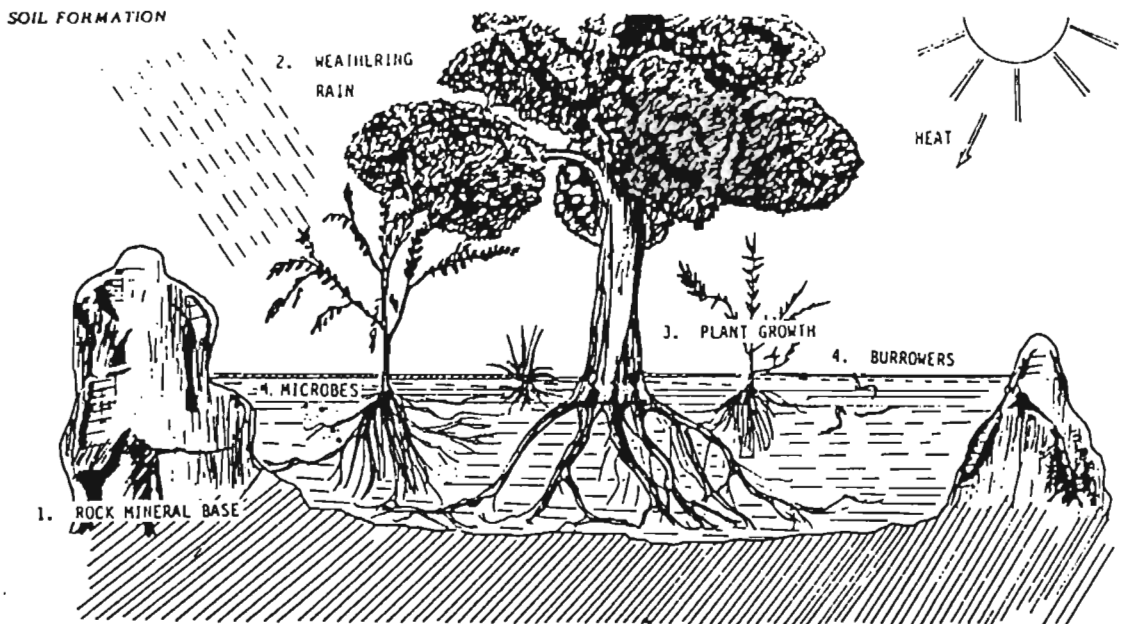
Be aware of the close interaction which exists between the **ABIOTIC** and **BIOTIC** factors found in the soil and the various factors which influence soil formation.

Diagram 2 illustrates diagrammatically the role of both biotic and abiotic factors in soil formation, all of which occur in Pigeon Valley.

Briefly discuss each of the main soil forming factors shown in the diagram (including Time and Topography) as they relate to soil formation in Pigeon Valley.

Briefly discuss the role of weathering in the formation of soil.

**THIS STUDY IS TO BE DONE ON ANOTHER SEPARATE FOOLSCAP SHEET PROVIDED FOR YOU**



*Factors influencing soil formation in this diagram are:*

*1. Rock-mineral base material; 2. Weathering, rain and heat; 3. Plant root branching; and, 4. Burrowing animals or microbes (bacteria) that live in the soil.*

**DIAGRAM 2**

**SOURCE: PILLAY AND SEATON (ED.), 1986.**

STUDY OF TOPSOIL

Closely examine a handful of topsoil from a damp, shady area.

Write a short paragraph explaining what is meant by humus and the role played by microscopic organisms in the complex food webs which occur not only in the soil but in the whole Pigeon Valley ecosystem.

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Note the role played by termites, which are responsible for soil aeration and breakdown of organic matter. It has been estimated that termites will completely turn the soil of any given area to a depth of 1m every 500 years.

Study Diagram 3, which shows the diverse components of HUMUS

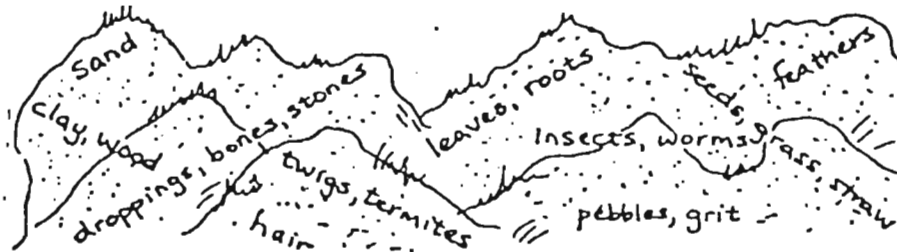


DIAGRAM 3

SOURCE: WILDLIFE SOCIETY OF SOUTH AFRICA BOOKLET  
ON UMGENI VALLEY SENIOR CONSERVATION COURSE

Energy flows through an ecosystem with the sun providing a continual supply of energy. However, there is no equivalent supply of nutrients, so the same ones are used again and again, i.e. they are re-cycled. Briefly explain the role micro-organisms in the nutrient cycles.

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Study Diagram 4, which shows a simplified soil profile for Pigeon Valley (not drawn to scale).

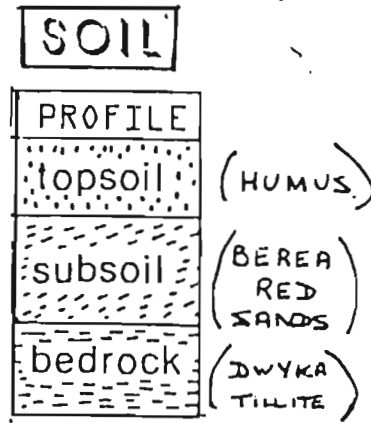


DIAGRAM 4

SOURCE: WILDLIFE SOCIETY OF SOUTH AFRICA.  
BOOKLET ON UMGENI VALLEY SENIOR CONSERVATION  
COURSE

Soil Profiles: Note that below the topsoil (humus) layer are vast deposits of Berea Red Sands between 60 and 76m thick, lying on bedrock of the Karoo System, i.e. Dwyka Tillite.

NOTE: THE ZONAL NATURE OF THIS SOIL PROFILE BEING THE RESULT OF THE LATITUDE OF PIGEON VALLEY AND THE RESULTING CLIMATE.

Plant and Animal Life in Pigeon Valley

Find a wood log and observe log life. You will notice fungi and bacteria breaking down the log for re-cycling and to make the soil richer. These decomposers are consumers and play an important role in any ecosystem.

Q.14 In a sentence, briefly explain the meaning of the 3 underlined terms used above. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Observe the large number of trees in the Reserve which produce fruit and berries (trees like Forest Fever Berry and Pigeon Wood). Pigeon Valley gets its name from the hundreds of doves and pigeons that come into the area to feed on the fruit (birds like Redeyed Dove, Laughing Dove, Tambourine Dove, Sombre Bulbul and Terrestrial Bulbul). The feeding relationships which exist between plants and animals are called food chains. Food chains are linked by the different organisms making up the food chain, e.g. grass - cow - man, leaves - locusts - birds - snakes

1. In a food chain, plants are called the producers because they produce the food for the rest of the chain. They are **AUTOTROPHIC** because they make their own food.

2. The animals that feed off the plants are )  
called herbivores. )
3. The animals that feed off other animals )  
are called carnivores (predator or ) CONSUMERS  
scavengers) )
4. Some animals, like monkeys, eat both plants )  
and animals, and are called omnivores. )

Study Diagram 5.



DIAGRAM 5

SOURCE: WILDLIFE SOCIETY OF SOUTH AFRICA BOOKLET  
ON UMGENI VALLEY SENIOR CONSERVATION COURSE

Note that animals are HETEROTROPHIC, i.e. cannot make their own food and rely on a sufficient quantity of producers so that an ecological balance can be maintained.

Pupils must be made aware of the loss of energy at each transfer in the food chain. Study Diagram 6.

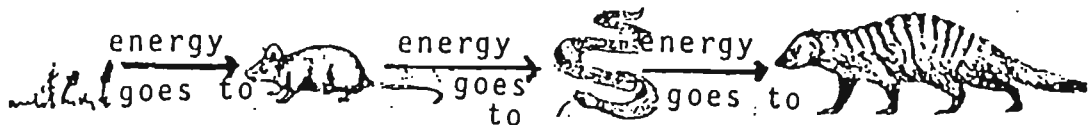


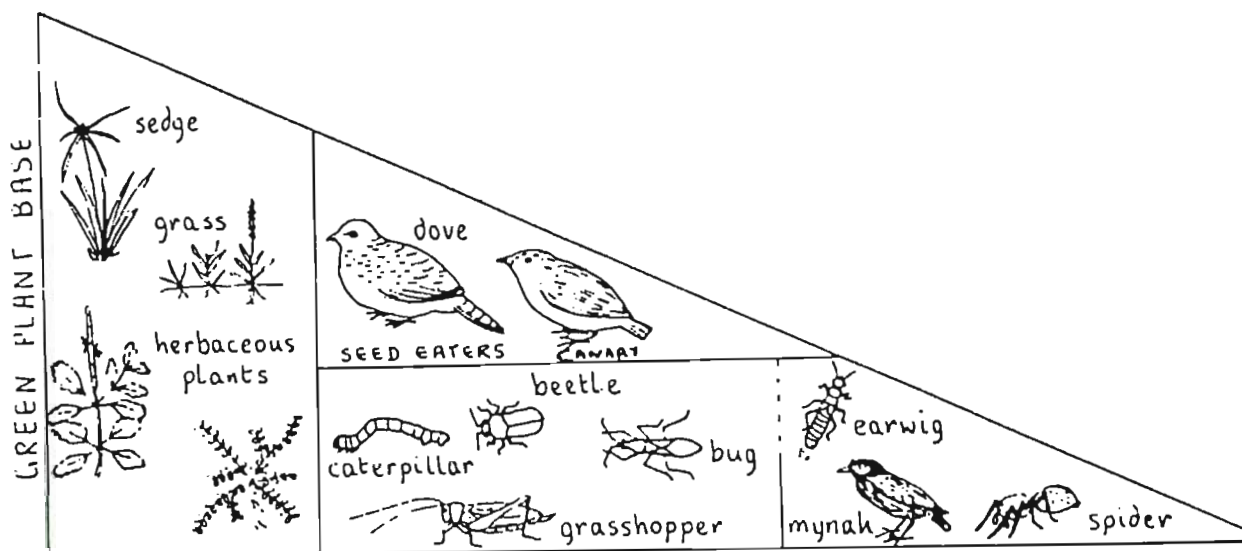
DIAGRAM 6

SOURCE: WILDLIFE SOCIETY OF SOUTH AFRICA BOOKLET  
ON UMGENI VALLEY SENIOR CONSERVATION COURSE

PUPILS MUST KNOW THE 10% LAW AND THAT ENERGY CAN BE  
CONVERTED FROM ONE FORM TO ANOTHER. ALSO THAT

ENERGY DEGRADATION AND DISPERSAL TAKES PLACE AS IT MAKES ITS WAY THROUGH AN ECOSYSTEM.

REMEMBER, you can study food relationships in the school grounds, too (an ecosystem). Refer Diagram 7.



Food relationships in a school playground

DIAGRAM 7

SOURCE: PILLAY AND SEATON (ED.), 1986.

Besides the various types of birds and insects to be found in Pigeon Valley, there are also a few species of small buck (duiker - Blue and Grey), mongoose (Banded and Slender and Striped), Vervet monkeys, Striped Weasel, Genet, Shrews and Rats.

Q.15 Construct a land-based food chain, using the organisms that exist in Pigeon Valley.

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Note that energy is lost at each trophic level of a food chain.

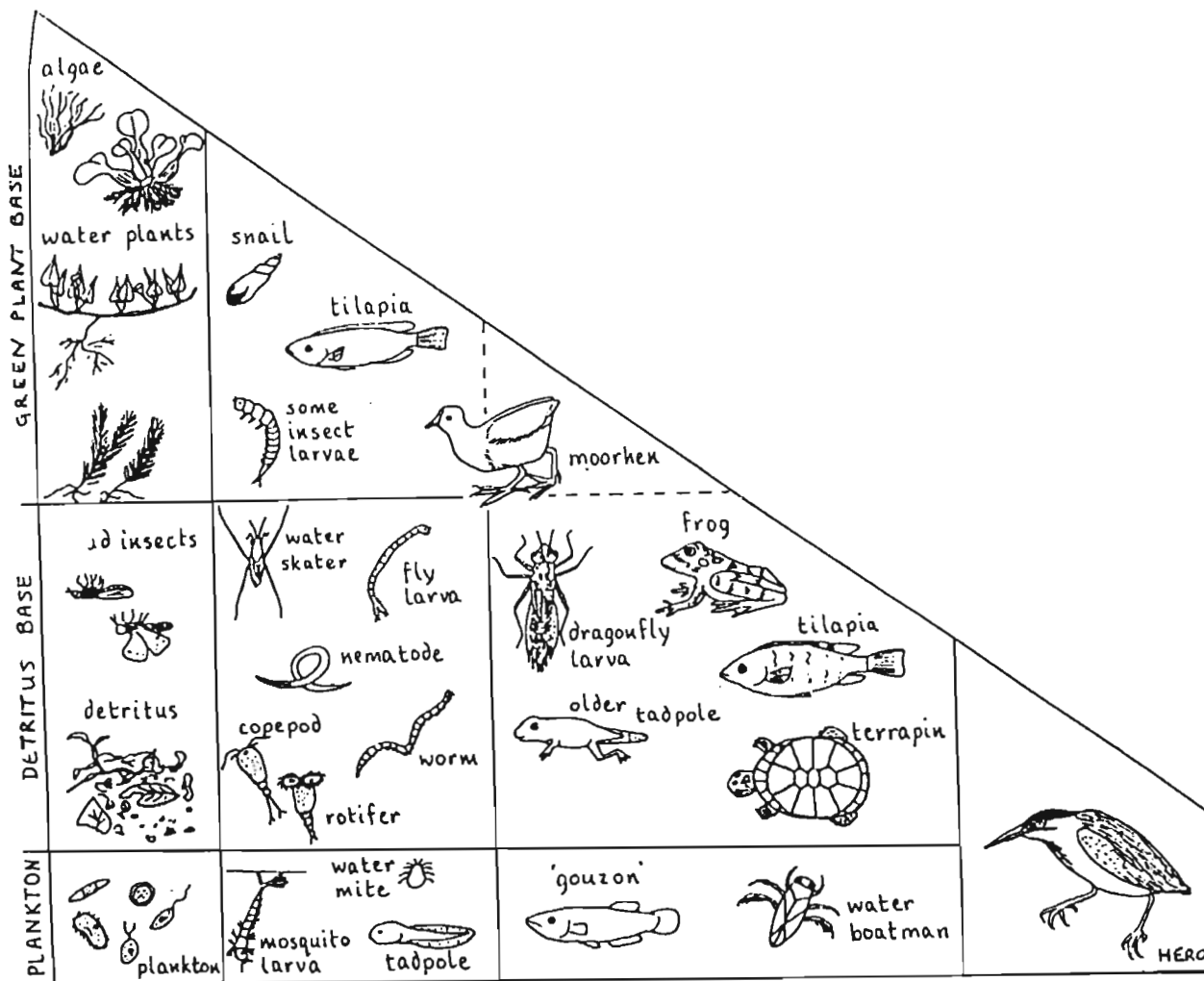
Q.16 Construct a separate aquatic food chain, using the organisms which you think may exist in the small pond half-way up the central pathway in the Valley.

Note that a food web consists of several interlocking food chains.

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Spend time observing the pond - insects, fish, plants, etc. Diagram 8, showing a food relationship pyramid for a freshwater pond must be studied and will act as a frame of reference for the next section on Water Study.



**Food relationships in a freshwater marsh or pond**

**DIAGRAM 8**

**SOURCE:** PILLAY AND SEATON (ED.), 1986.

**WATER STUDY**

The organisms (insects, plants, fish, etc) living in the pond ecosystem are affected by several abiotic and biotic factors which influence each other.



Take note of the following abiotic factors and measure those which you can.

- i) pond depth
- ii) nature of pond bottom
- (iii) extent of exposure to sunlight
  
- (iv) pH of water
- (v) water temperature
- (vi) water flow

Biotic factors: 1.) Plants

Examine the plant life occurring in and around the stream. Record your observations by ticking those plants which are present. (See table below)

Algae	<input type="checkbox"/>
Mosses	<input type="checkbox"/>
Ferns	<input type="checkbox"/>
Small herbaceous plants	<input type="checkbox"/>
Shrubs	<input type="checkbox"/>
Trees	<input type="checkbox"/>
Other	<input type="checkbox"/>

These plants, and many microscopically small plants in the water, are the producers in this ecosystem.

2.) Animals and Insects:

Make a note of those you can observe (You should see Crabs, Frogs, Shrimps, etc.)

Take a water sample and examine it with the aid of a microscope.

This aquatic ecosystem, like any other ecosystem, can only be maintained in a stable state if the cycles and delicate inter-relationships within the system are not disrupted.

Mention ways in which the 'balance' of this pond might be upset, including Eutrophication Levels. Show in your answer a clear understanding of the meaning of this term.

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Note that animals outside the ecosystem of the pond are dependent on it for 1) drinking; 2) some flying insects spend parts of their life cycles in the water, as larvae or nymphs; 3) many animals, e.g. birds, depend on aquatic animals (e.g. frogs) for food.

Many plants and animals live together in symbiotic relationships.

Q.17 What is the meaning of this term?

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Find, while in the Valley, at least 1 example of each of the following types of symbiosis:

1. Commensalism (+N) \_\_\_\_\_

\_\_\_\_\_

2. Parasitism (+-) \_\_\_\_\_

\_\_\_\_\_

3. Mutualism (++) \_\_\_\_\_

\_\_\_\_\_

Fairly recently, some buck species were introduced into the Pigeon Valley Ecosystem so as to maintain a 'balanced state' situation through the controls and interactions within it. The greater the diversity of the ecosystem, the more stable it is, and the more likely it is to be able to survive environmental changes. J in the reference booklet shows a selection of animals to be found in the Reserve.

Be aware of the tremendous diversity of plant and animal life in the Valley - from the smallest insect to the largest buck, from the smallest algae to the biggest fig tree - each type of organism is important and has a role to play in helping to maintain a balanced ecosystem. (HOMEOSTASIS). Each occupies its niche in the ecosystem which indicates both its place in the ecosystem and the role it fulfils.

Every organism that makes up part of the great diversity of Pigeon Valley ecosystem has adapted to its environment there, viz. the appearance and structure make it well suited to live in its habitat.

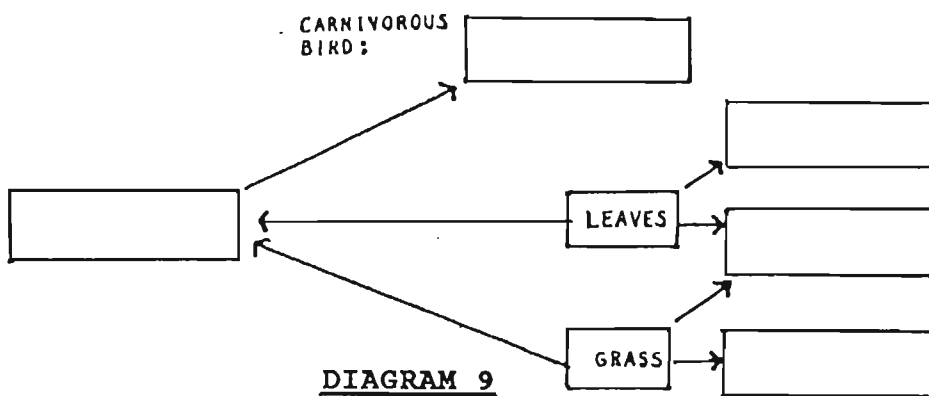
Q.18 Give one example of how a plant and an animal found in the Reserve have adapted to their environments. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Q.19 Construct a simple food web, using organisms from both the aquatic habitat and the land habitat. Diagram 9 below will show you how to set out your answer.

In the FOOD WEB below, fill in specific examples, as you come across them.



Obviously part of the management policy in the Reserve is the maintenance of the food chains and food webs that exist. Even weeds form part of the food chain; however, they need to be controlled. Farmers use poisonous chemicals to get rid of weeds, but this method is not

supported in Pigeon Valley. This is because some of the poisons are stored in the bodies of animals that eat them and then become passed down the food chain, e.g. locusts are sprayed by chemicals, lizards eat the locusts, wild cats eat the lizards, birds of prey eat the wild cats, etc. Figure 10 below shows this in diagrammatic form.

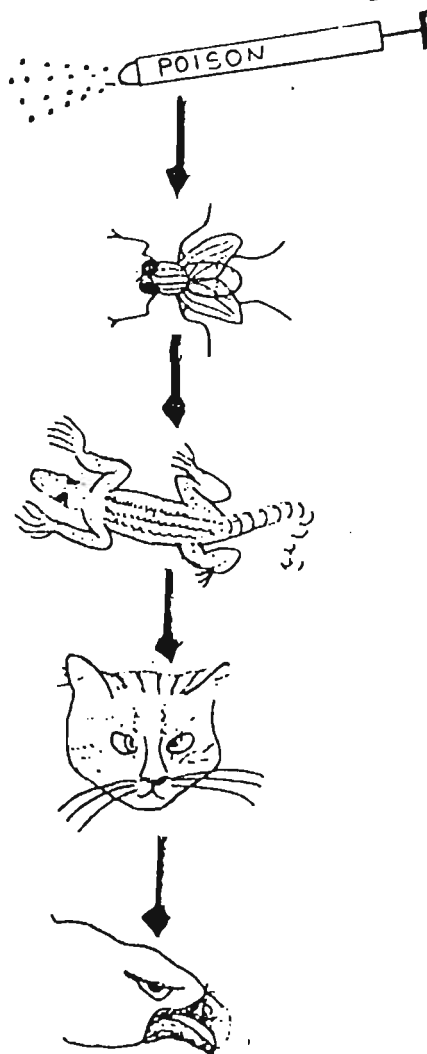


FIGURE 10

SOURCE: WILDLIFE SOCIETY OF SOUTH AFRICA BOOKLET  
ON UMGENI VALLEY SENIOR CONSERVATION COURSE

The poisonous chemicals used are called pesticides and herbicides. Very little use is made of these in Pigeon Valley to clear exotic vegetation, most of which is manually cleared.

Q.20 List at least 2 of these poisons which you use at home or in your garden. \_\_\_\_\_

\_\_\_\_\_

Thus, by man using certain substances, nature can be disturbed. This is called Pollution.

Consider the effects on man of the persistent use of pesticides in agriculture.

Q.21 Do you see any evidence of pollution in Pigeon Valley? \_\_\_\_\_

\_\_\_\_\_

Note the important effect pollutants have on the pH of soil and water in ecosystems by referring back to the pH readings taken in your soil and water studies done previously.

Observe the trunks and branches of many trees in Pigeon Valley and you will notice light blue-green patches growing there. These patches are plant-like creatures called lichen. Lichen only grows where the air is quite clean, and thus is found in areas where there is little or no pollution.

Q.22 What effects do areas like Pigeon Valley have on:

1. air quality in urban areas? \_\_\_\_\_
2. the microclimate of the area? \_\_\_\_\_

A few buck have been introduced into the area. In nature there is a delicate balance between plants and animals, e.g. there is always enough grass to feed a certain number of buck and there are enough buck to feed a certain number of lions, etc. Part of the management policy of the Reserve is to observe the carrying capacity of the area.

Q.23 What is meant by this term? \_\_\_\_\_

Make sure you know how positive and negative feedback provides checks and balances to control animal population numbers.

As you wander up and down the central pathway, you will notice certain trees (especially Flat Crowns and Wild Plums) which have had part of their bark peeled off. The Zulus use the bark to make up various potions and, in an attempt to prevent this from happening, the trees have had their trunks painted with PVA paint, which discourages the herbalists from using the bark. Of course, this is no longer a problem in Pigeon Valley as the area has recently been fenced off. If the herbalists cut deeply into the bark, the **CAMBIUM** tissue can be damaged and the tree cannot heat itself and diseases can enter the tree.

Q.24 Find out more about the CAMBIUM tissue. \_\_\_\_\_

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### PROBLEM SOLVING EXERCISES

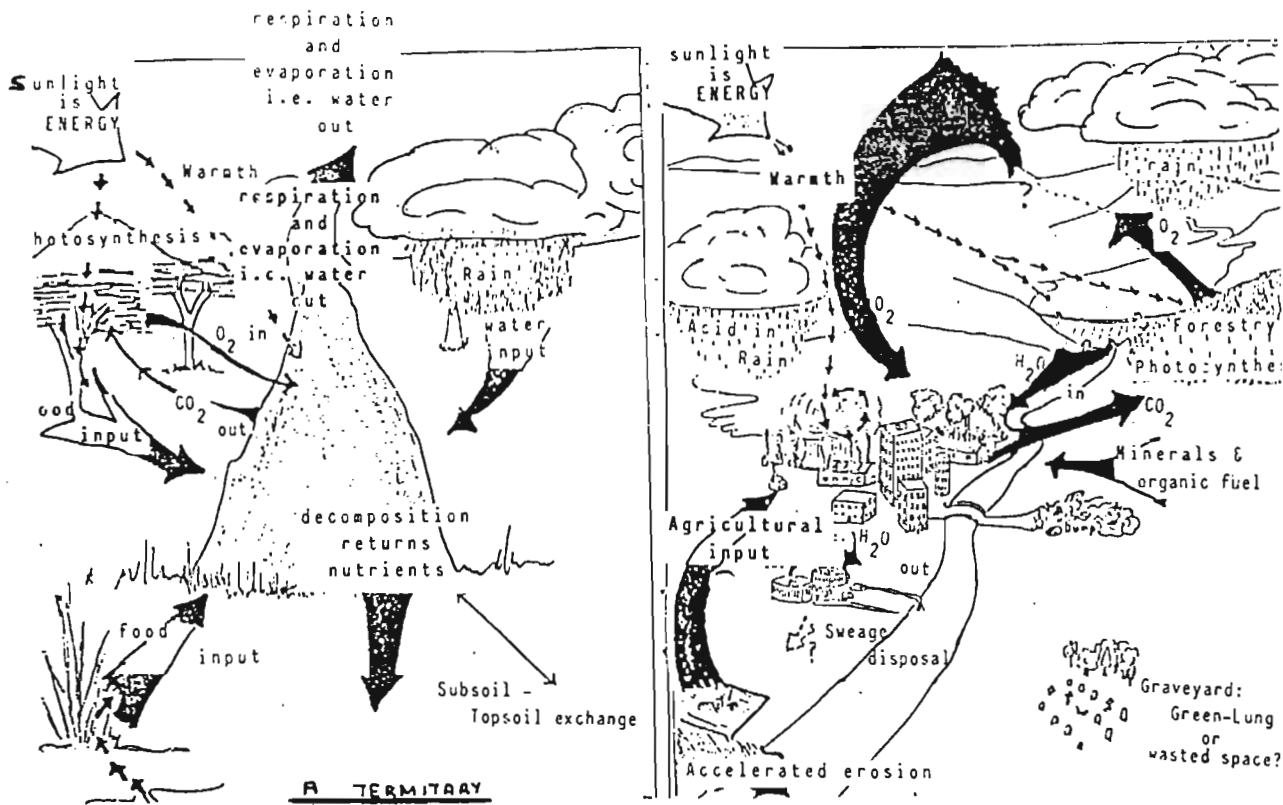
Ecology is an important subject to study because of the following reasons:

Man depends entirely on the environment and, over the years, he has upset the balance of nature by polluting natural areas and through the unwise use of natural resources. In order to preserve his environment, man must first understand how it works, so as to aim to achieve a spaceship earth system (an "Earthmanship" Society) and not his present 'rubbish dump' system (The "Throwaway" Society). Man must learn to live in harmony with nature by maintaining balanced ecosystems through environmental conservation and management to ensure survival of our **Biosphere.**

In view of man's important and dominant role as the Earth's 'caretaker', discuss briefly the following questions.

Study the two diagrams on the next page and answer the question posed.





**SOURCE:** WILDLIFE SOCIETY OF SOUTH AFRICA BOOKLET  
ON UMGENI VALLEY SENIOR CONSERVATION COURSE

Q.25 Compare these two ecosystems with regard to 1) their energy flow and 2) conservation practices.

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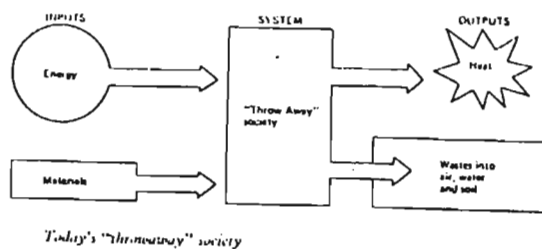


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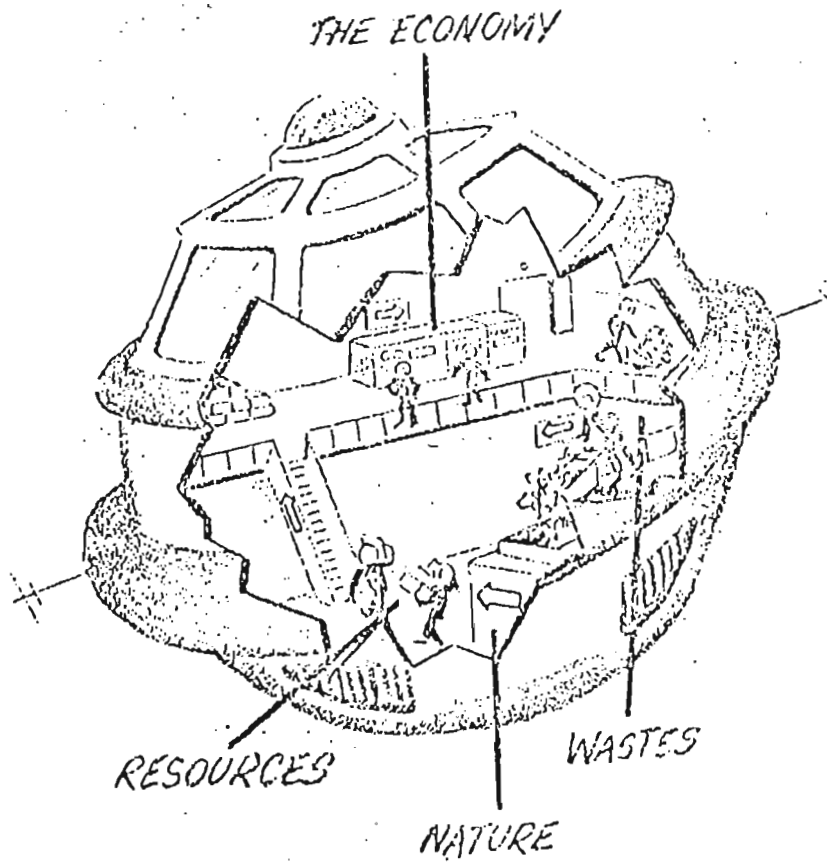


Q.27 Study the diagrams below and discuss what is meant by 'The Throughput Economy' and 'The Spaceship Earth', and why we need to move from the one to the other. (Reference should be made to the way nature recycles waste in the various Nutrient cycles.)

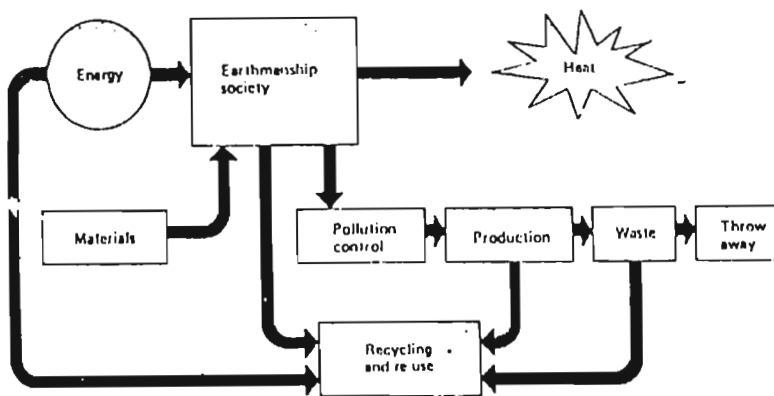
**ANSWER THIS QUESTION ON THE SEPARATE FOOLSCAP SHEETS PROVIDED.**



**SOURCE:** FINCHAM, 1985 AND TYLER MILLAR, 1979.



THE SPACESHIP EARTH



An "earthmanship" society

SOURCE: FINCHAM, 1985 AND TYLER MILLAR, 1979.



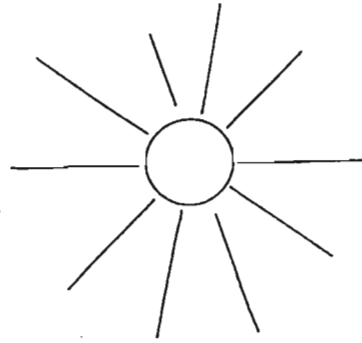
APPENDIX F

REFERENCE BOOKLET

FOR ECOLOGY TRAIL IN PIGEON VALLEY FOR ALL FORMS (CLASSES)

- A    LOOKING AT LANDSCAPES THROUGH 'ECOSPECS'.
- B    PIGEON VALLEY MAP
- C    AN ENVIRONMENT.
- D    A FRAMEWORK FOR ECOLOGY FIELD STUDIES.
- E    A WORD AND PICTURE DICTIONARY FOR FIELD STUDIES.
- F    GLOSSARY OF TERMS FOR ECOLOGICAL STUDIES.
- G    A SELECTION OF INDIGENOUS TREES TO BE FOUND IN PIGEON  
VALLEY - IN NUMERICAL ORDER ACCORDING TO THE S.A.  
NATIONAL LIST OF TREES. (4 PAGES).
- H    MAIN TYPES OF INDIGENOUS GRASS SPECIES TO BE FOUND IN  
PIGEON VALLEY.
- I    A SELECTION OF BIRDS TO BE FOUND IN PIGEON VALLEY -  
IN NUMERICAL ORDER ACCORDING TO ROBERTS BIRDS OF  
SOUTH AFRICA. (6 PAGES)
- J    A SELECTION OF ANIMALS TO BE FOUND IN PIGEON VALLEY.  
(2 PAGES).
- K    A SELECTION OF COMMON BUTTERFLIES TO BE FOUND IN  
PIGEON VALLEY.

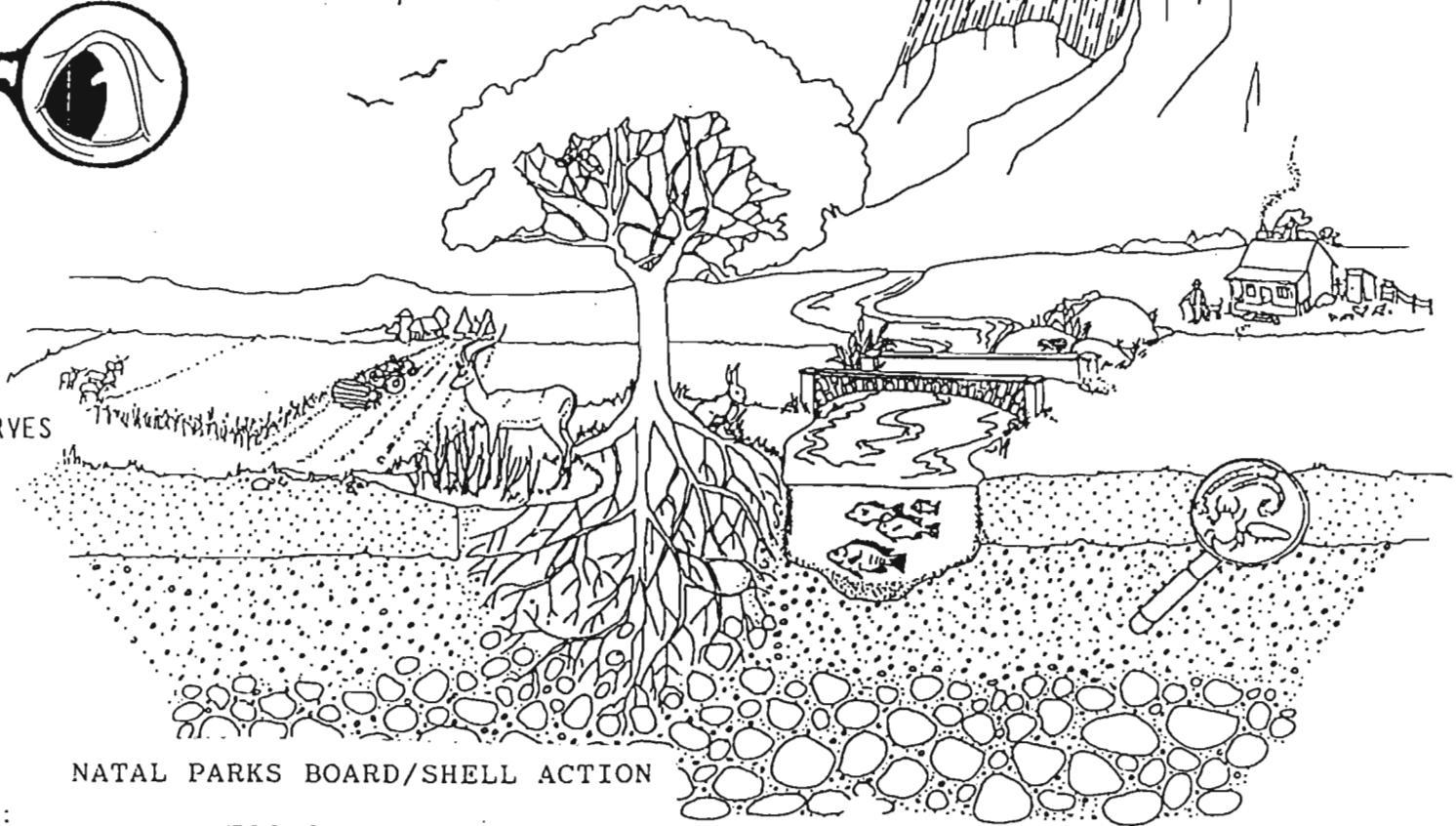
LOOKING AT LANDSCAPES  
THROUGH 'ECOSPECS'



URBAN AREAS

RURAL AREAS

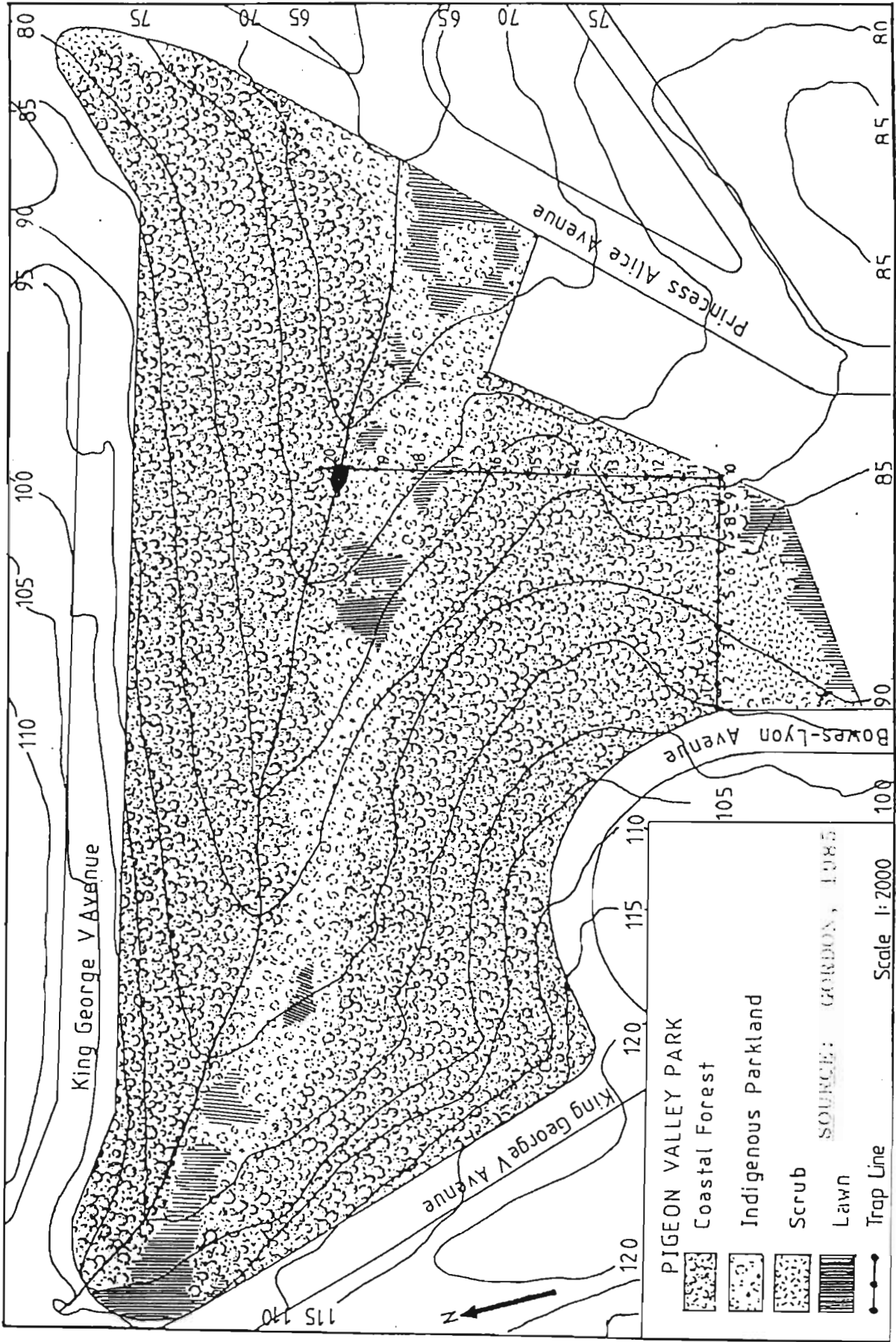
NATURE RESERVES



NATAL PARKS BOARD/SHELL ACTION

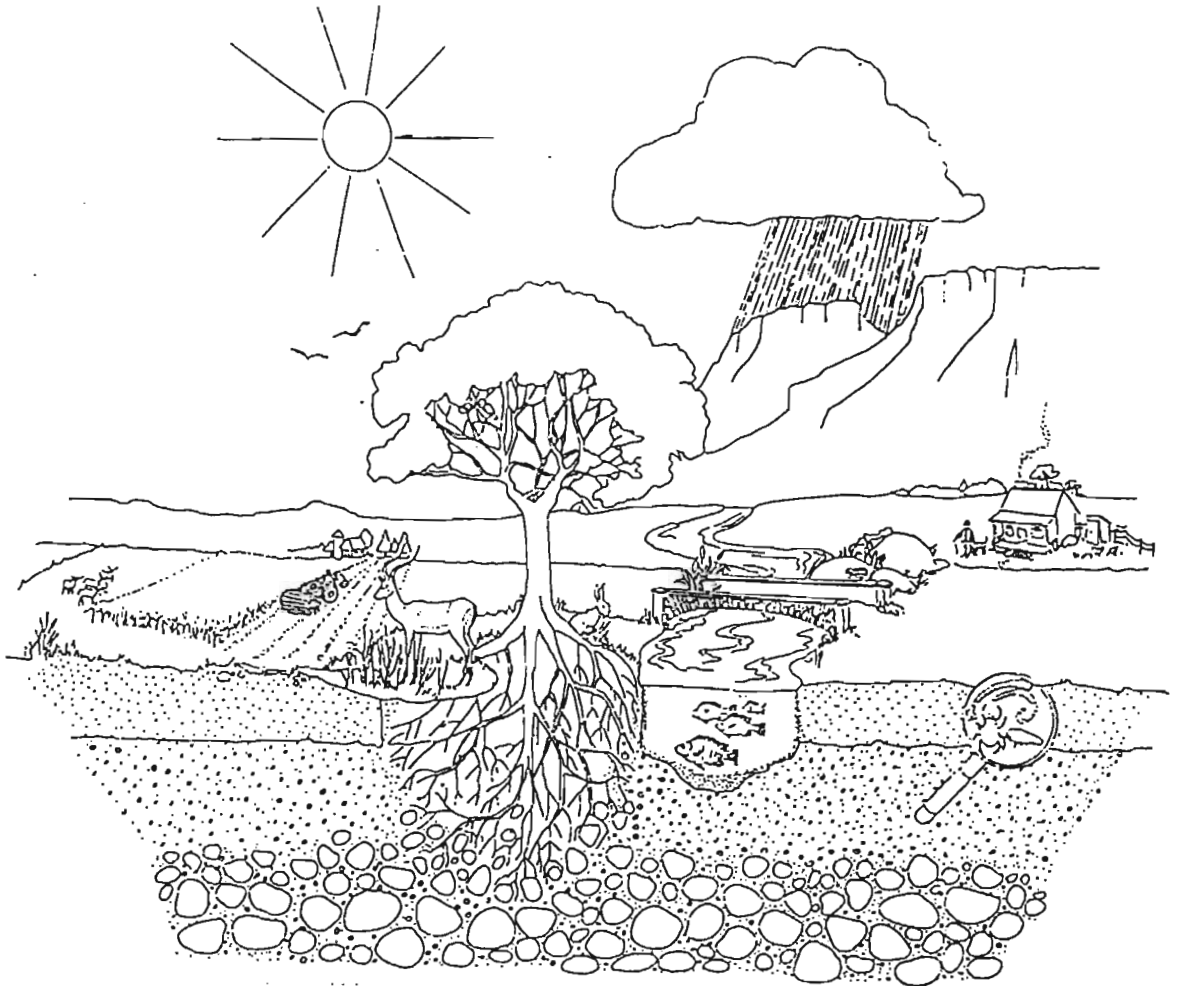
SOURCE:

ECOLOGY SERIES





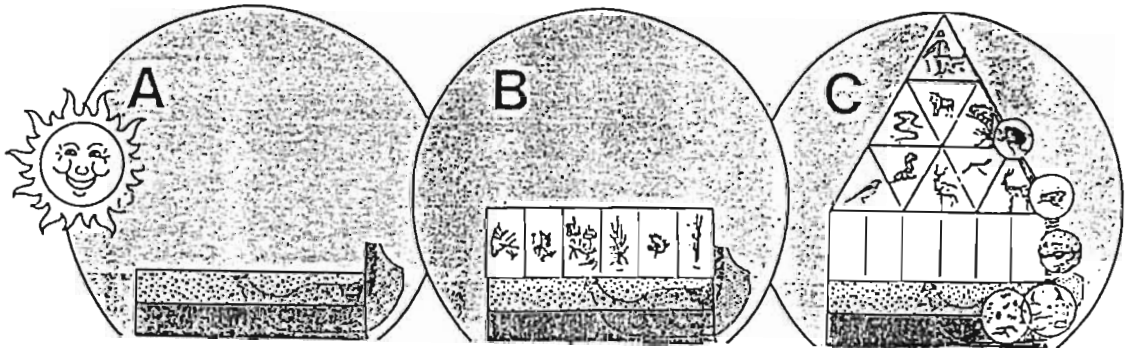
AN ENVIRONMENT.



PHYSICAL  
WORLD

PLANT  
COMMUNITY

ANIMAL  
COMMUNITY



**SOURCE:** NATAL PARKS BOARD/SHELL ACTION  
ECOLOGY SERIES

OUR AIM IS

A FRAMEWORK FOR ECOLOGY FIELD STUDIES



THE STUDY OF OUR HOME



TO UNDERSTAND ITS LIFE SUPPORT SYSTEMS



AND THEN CONSERVE PLANTS AND ANIMALS

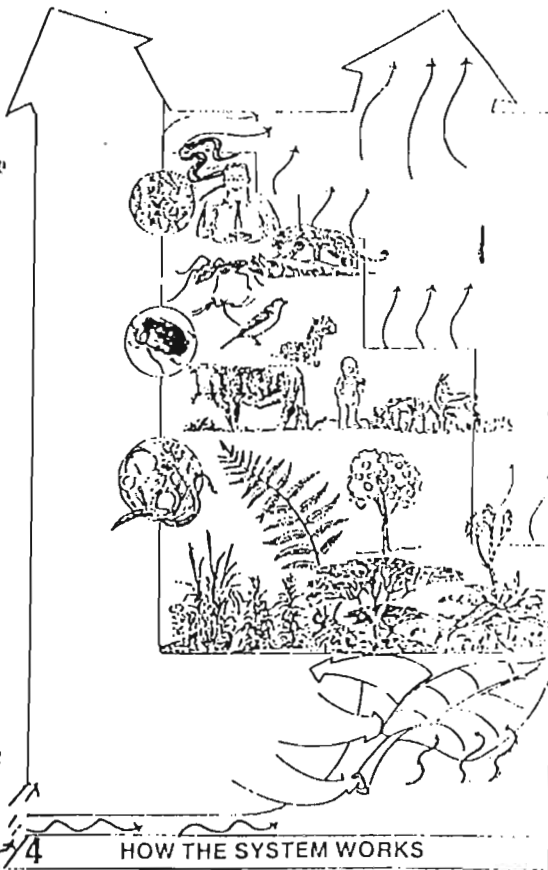
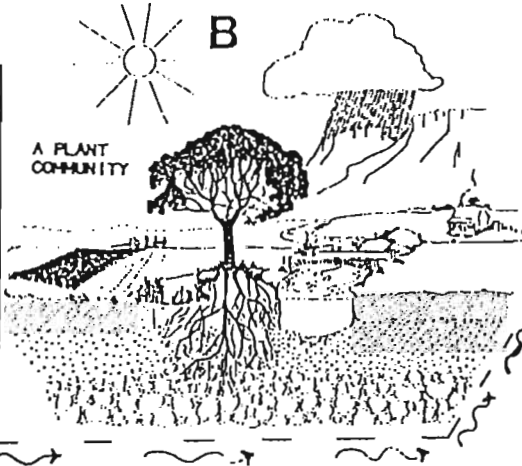
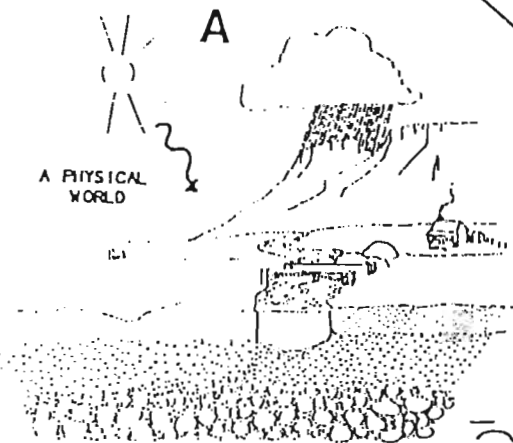
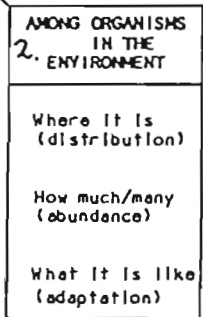
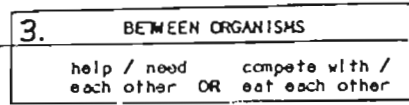
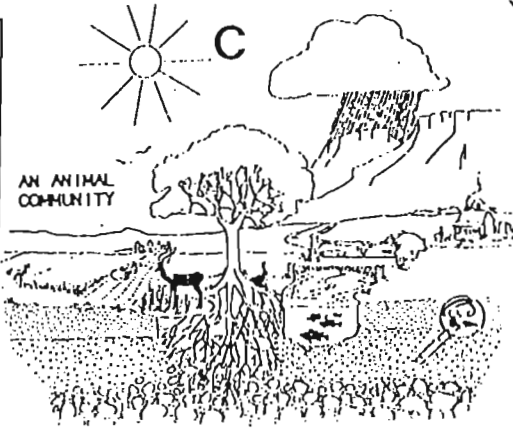
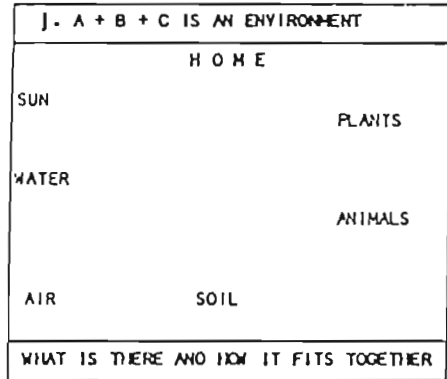


THROUGH WISE USE OF RESOURCES



SOURCE: NATAL PARKS BOARD/SHELL ACTION

ECOLOGY SERIES






SOURCE: NATAL PARKS BOARD/SHELL ACTION

ECOLOGY SERIES


359

**ENVIRONMENTAL EDUCATION**


**A WORD AND PICTURE DICTIONARY FOR FIELD STUDIES**




THE STUDY OF OUR HOME  
(ECOSPHERE/ECOSYSTEM/HABITAT)




TO UNDERSTAND AND PRESERVE  
ITS LIFE SUPPORT SYSTEMS



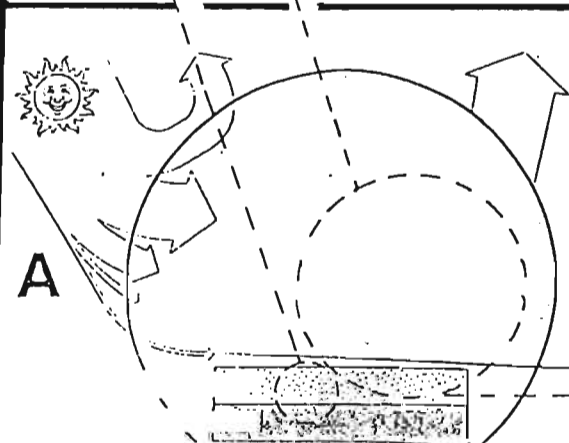
SO AS TO ENSURE THE  
CONSERVATION OF GENETIC DIVERSITY



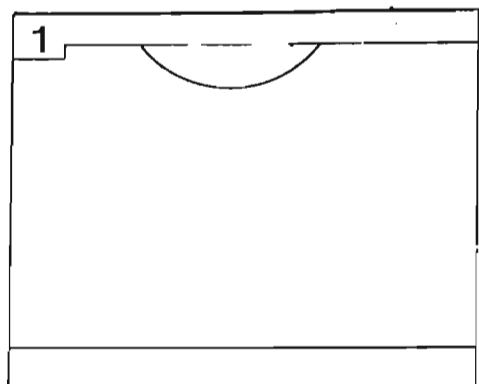
THROUGH WISE USE OF RESOURCES  
ON A SUSTAINED YIELD BASIS



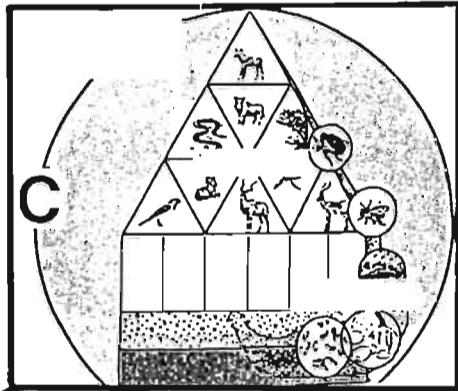
**A**

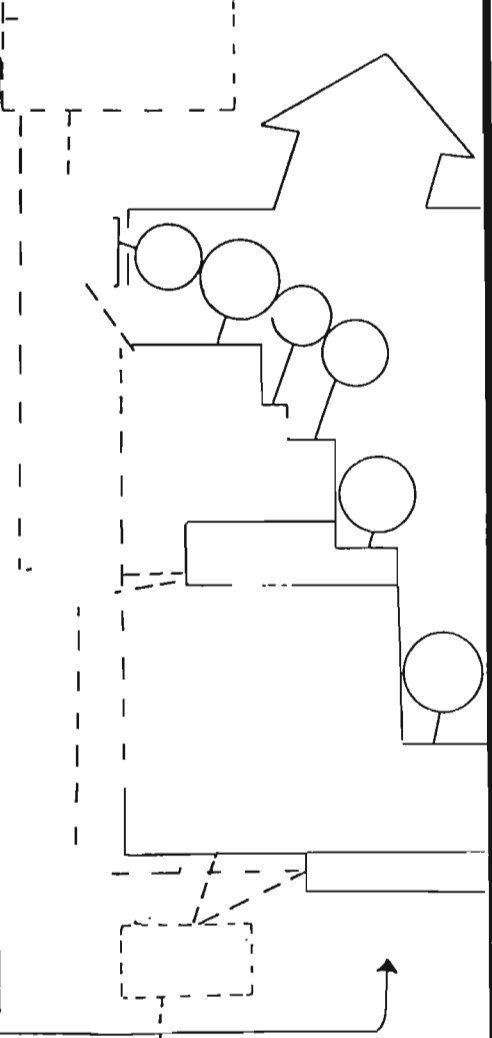


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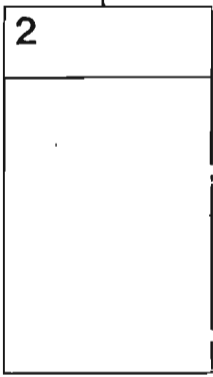


**C**






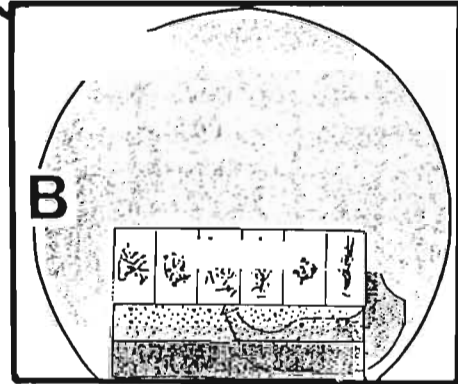
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
**3**



**B**



**4**



## F

**ABIOTIC FACTORS** physical and chemical, (non living) ecosystem components. Some abiotic factors that affect us are air, water, soil, sunlight (see biotic).

**ADAPTATION** any structural feature of activity of an organism that contributes to its survival in its environment.

**ATMOSPHERE** the layer of gases surrounding the earth.

**AUTOTROPH** a plant able to manufacture its own food is said to be autotrophic, e.g. green plants.

**BIOGEOCHEMICAL CYCLES** bio (living) geo (water, rocks and soil) chemical (change from one chemical into another). How matter is cycled in the ecosphere through gaseous, sedimentary and hydrologic mediums to be made available over and over again.

**BIOMASS** total quantity of living material, usually expressed in dry mass, present at a given time in an ecosystem. (see productivity)

**BIOME** A distinct plant or animal community which has developed in a particular climatic zone, e.g. coniferous forests.

**BIOSPHERE** see ecosphere

**BIOTIC FACTORS** factors in the environment resulting from the influence of living organisms. (see abiotic)

**CARRYING CAPACITY** the number of animals a given area can sustainably support.

**CHLOROPHYLL** green pigment of plants essential for converting light energy into chemical energy in autotrophs.

**CLIMAX** a plant community which is in equilibrium with the environmental factors present. (see succession)

**COMMENSALISM** a relationship between two different species in which one organism derives benefit and the other suffers no harm eg bird nesting in a tree (see symbiosis).

**COMMUNITY** in ecology a group of cycles of plants and animals, usually dissimilar, that live near one another in the same environment.

**COMPETITION** two or more species in the same ecosystem attempting to use the same scarce resource. Green plants mainly compete for light, water and nutrients, and animals for food and a place to live.

**CONSUMER** an organism that lives off other organisms. Generally divided into primary consumers (herbivores), secondary and tertiary consumers (carnivores/omnivores) and micro consumers (decomposers).

**MATTER CYCLING** a system of redistribution pathways of essential building blocks for the growth and development of organisms e.g. carbon, oxygen, nitrogen and phosphorus (see biogeochemical cycles).

**DECOMPOSER** specialised consumer (bacteria or fungus) that causes the chemical breakdown (rot or decay) of organic matter. (see minerals and humus)

**ECOLOGY** the science concerned with the relationship between plants and animals and their environment.

**ECOSPHERE** (biosphere) total of all the ecosystems of the planet. The area of air, water and land in which all life is found.

**ECOSYSTEM** a systems idea developed by scientists to isolate areas in which living and non-living things sustainably interact and in which materials are used over and over again.

**EDAPHIC** to do with soil.

**ENERGY FLOW** in ecology the one way transfer of energy through an ecosystem or more specifically the way in which energy is converted and dispersed at each trophic level.

**ENVIRONMENT** the total of biological, physical and chemical conditions surrounding an organism.

**FOOD PYRAMID** a quantified (numbers, biomass, energy) or graphic food chain indicating the large producer population and progressively decreasing herbivores and carnivores.

**FOODS** chemical combinations of matter containing the nutrients and energy requirements of organisms (see autotroph and heterotroph).

**FOOD SYNTHESIS** building up processes with the products of photosynthesis and nutrient uptake.

**GENETIC DIVERSITY** variety within plants and animals.

**HABITAT** the place where a given organism normally lives.

**HETEROTROPH** an organism which is incapable of making its own organic food, and therefore must obtain it from its environment.

**HUMUS** organic matter in the soil, formed by the decay of plant and animal matter.

**HYDROSPHERE** water covering the earth, (seas, rivers, lakes, etc)

**INTERACTIONS** any relationship between environmental factors, between organisms and the environment or between organisms.



**LIMITING FACTORS** any factor such as temperature, light, water or a chemical that limits the existence, growth, abundance or distribution of an organism.

**LITHOSPHERE** layer of soil and rocks close to the earth's surface.

**METABOLISM** all of the chemical changes, building up (anabolism) and breaking down (catabolism) occurring in living organisms. These processes include nutrition, energy production by respiration and synthesis of more tissue.

**MINERAL** an inorganic substance or compound.

**MUTUALISM** two organisms of different species which live in close contact to their mutual benefit. eg fungus and algae in lichen.

**NEUTRALISM** neither population apparently affects the other.

**NUTRIENT** a substance usable in metabolism; a metabolite; includes inorganic and organic substances.

**OMNIVORE** an animal that may subsist on plant or animal food or both.

**ORGANISM** a living plant or animal, however large or small.

**PARASITISM** the interaction through which an organism obtains food from the living tissues of another organism.

**PHOTOSYNTHESIS** the energy trapping process that occurs in the cells of green plants whereby light energy is used to build up  $\text{CO}_2$  and  $\text{H}_2\text{O}$  into carbohydrates such as glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ). Oxygen is a biproduct.

**PIONEER** plant, animal or community that first invades a bare area. (see succession).

**POPULATION** a grouping of individuals of the same species.

**PREDATION** one population (predator) directly affect the other (prey) but are nevertheless dependent on them.

**PRODUCER** a green plant producing food by photosynthesis; (see autotroph).

**PRODUCTIVITY** the quantity of organic material produced within a certain period by organisms or the energy that this represents (see biomass)

**CELLULAR RESPIRATION** not breathing but a complex chemical breakdown process that releases energy.

**SPECIES** category of taxonomic classification, below genus rank; reproductively isolated from other groups, i.e. interbreeding and gene flow does not occur among members of different species.

**SUCCESSION** a progressive change in the plant types present in an area from the pioneer stages through to a climax. (see pioneer and climax).

**SUSTAINED YIELD** depletion and degradation are avoided by managing ecosystems to strike a balance between production and consumption.

**SYMBIOSIS** the close co-existence of two different organisms, for the benefit of both, or of one, or of neither. (See mutualism, commensalism and parasitism)

**TROPHIC LEVEL** feeding position or energy exchange level in a food chain such as herbivore, primary carnivore etc.

**SYNTHESIS (Foods)** the building up or putting together of the products of photosynthesis and nutrient uptake (plants) or metabolism (animals) to make living tissue.

Glossary collated from:

Oliver J and Wright T. (1985) Wild Words. Wildlife Society ISBN 094996924

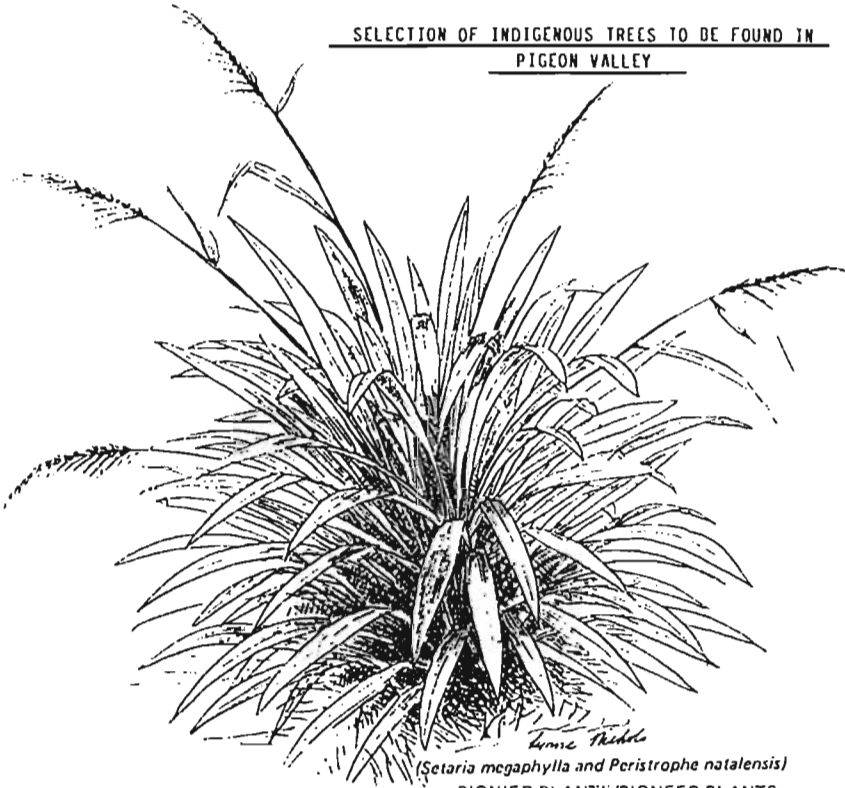
Thienel A et al (1985) Exploring Biology 8. Shuter & Shooter PMB.

with thanks

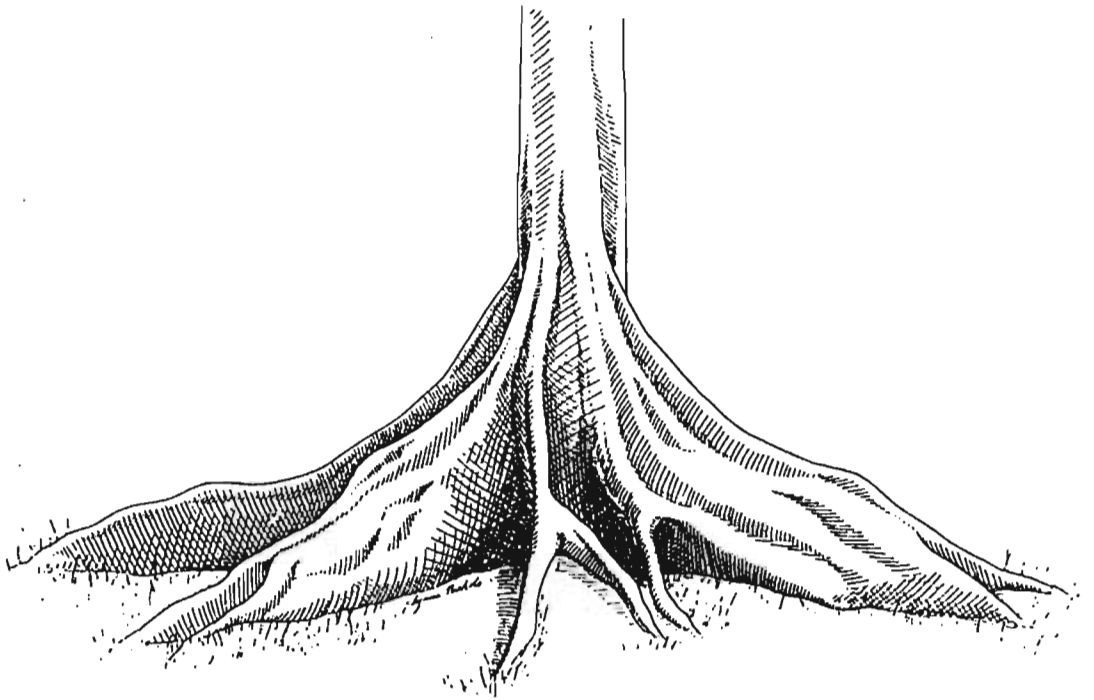
Natal Parks Board, P O Box 662, Pietermaritzburg, 3200.

SOURCE: NATAL PARKS BOARD/SHELL ACTION ECOLOGY SERIES

SELECTION OF INDIGENOUS TREES TO BE FOUND IN  
PIGEON VALLEY



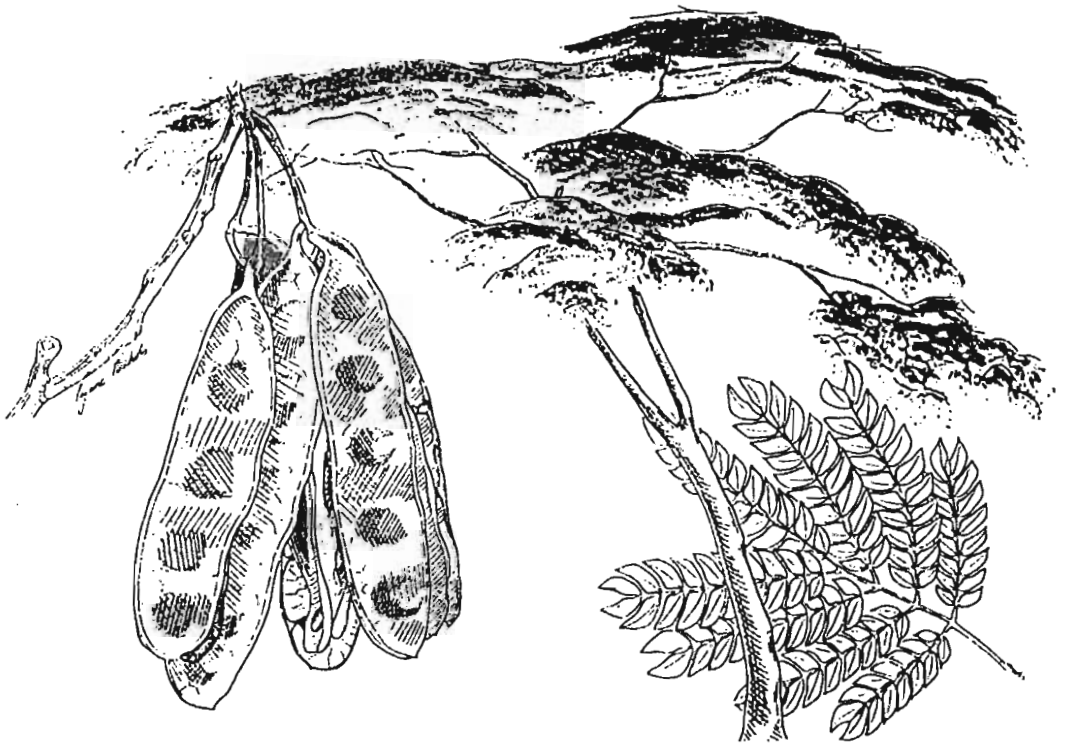
(*Setaria megaphylla* and *Peristrophe natalensis*)  
PIONIER PLANTE/PIONEER PLANTS



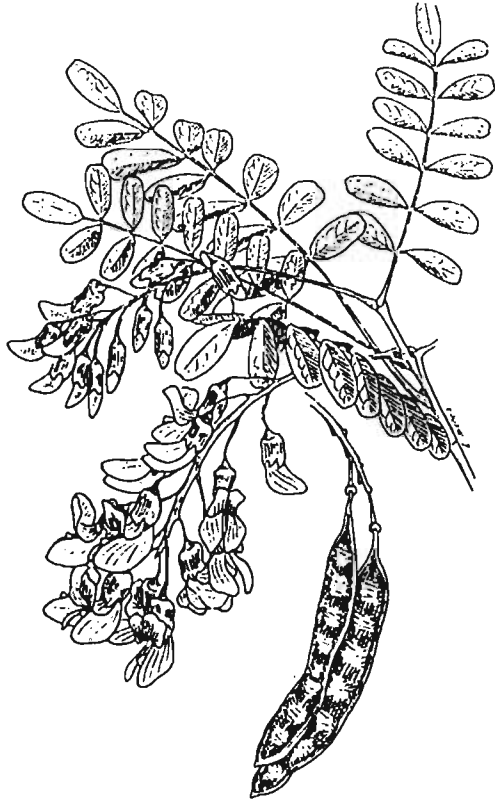
NATALSE OLM/NATAL ELM (*Celtis mildbraedii*) 41



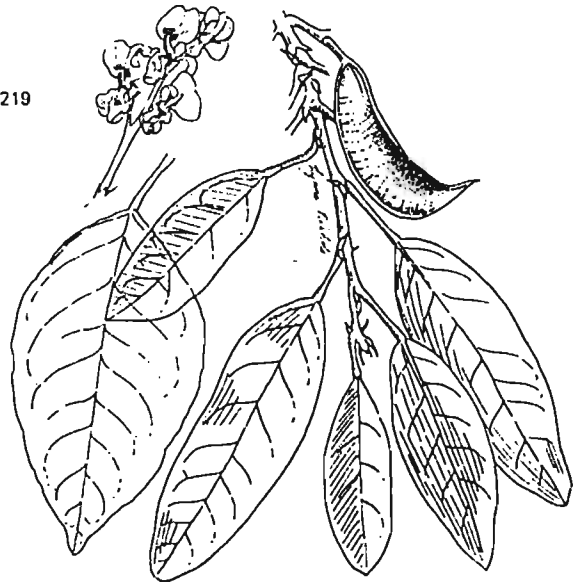
DORINGOLM/THORNY ELM (*Chaetacme aristata*) 43



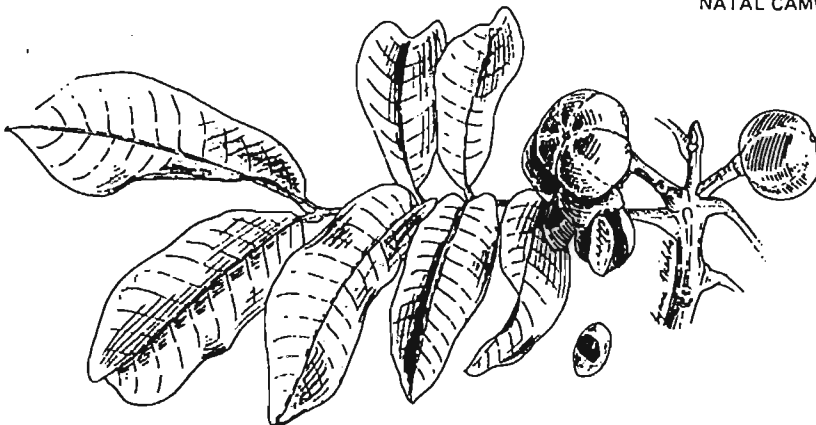
PLATKROON/FLAT-CROWN (*Albizia adianthifolia*) 148



NATALSE GEELKEUR/NATAL LABURNUM (*Calpurnia aurca*) 219



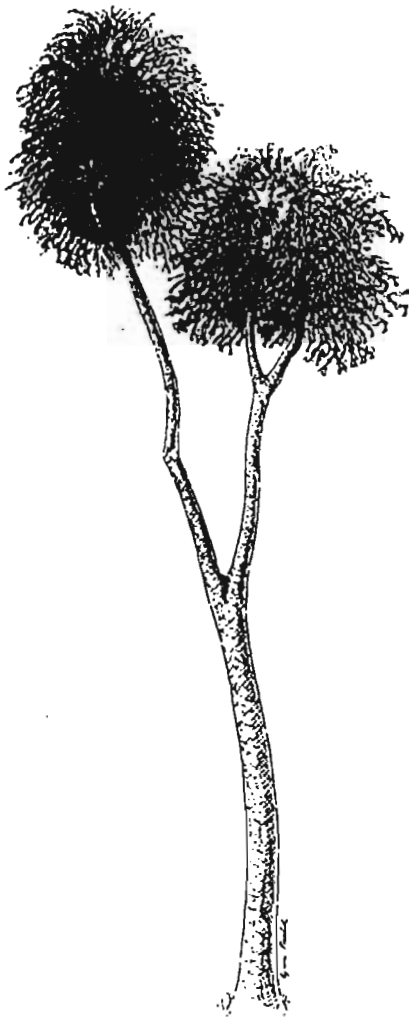
NATAL CAMWOOD/NATALKAMHOUT (*Baphia racemosa*) 224



FOREST MAHOGANY/BOSROOIESSENHOUT (*Trichilia dregeana*) 300



FOREST WILD PEAR/BOSDROLPEER  
(*Dombeya tiliacca*) 472



FOREST CABBAGE TREE/BOSKIEPERSOL  
(*Cussonia sphaerocephala*) 561.1



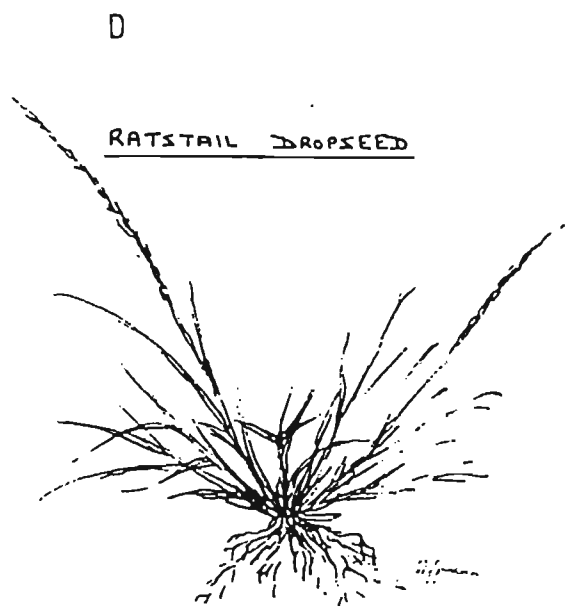
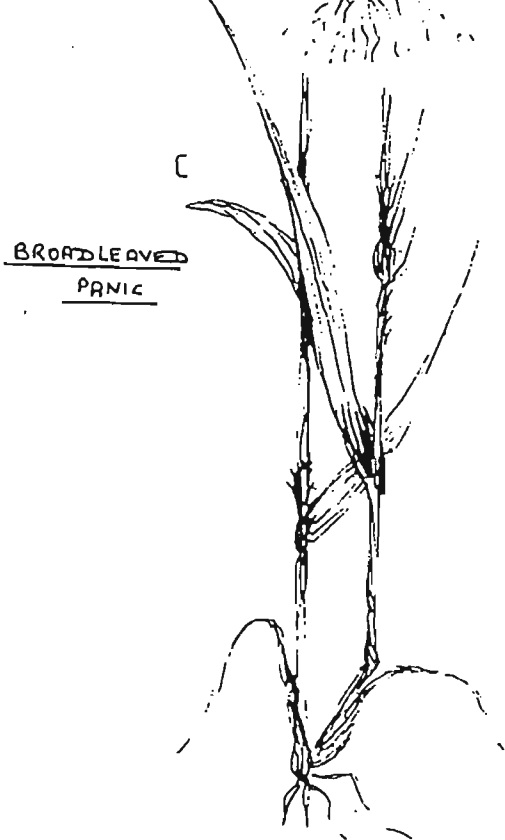
BOSSTAMVRUG/FLUTED MILKPLUIM  
(*Chrysophyllum viridifolium*) 580



NATALMELKPRUIM/NATAL MILKPLUM  
(*Bequaertiodendron natalense*) 582

SOURCE: SELF-GUIDED TRAILS IN DURBAN  
DURBAN PARKS, RECREATION AND BEACHES  
DEPARTMENT

MAIN TYPES OF INDIGENOUS GRASS SPECIES  
TO BE FOUND IN PIGEON VALLEY

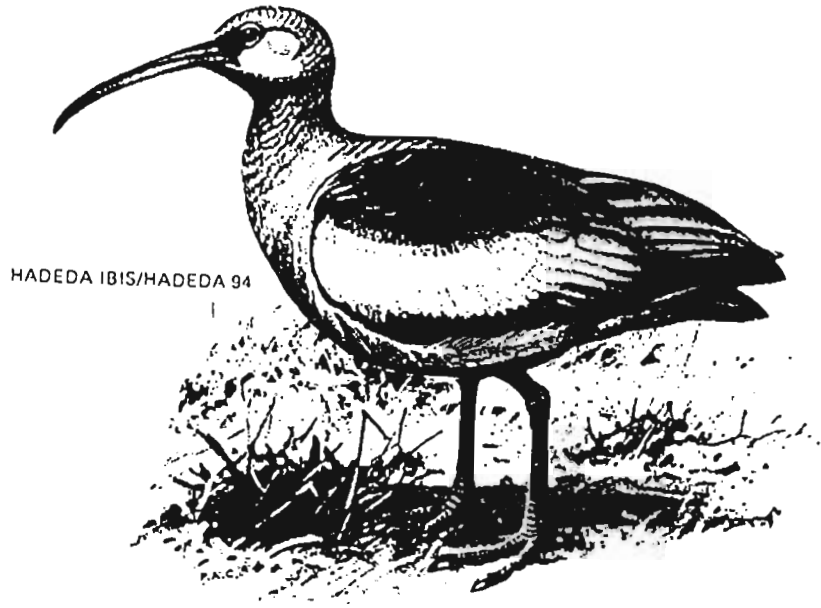


SOURCE: GORDON, 1985



I

A SELECTION OF BIRDS TO BE FOUND IN PIGEON VALLEY



HADEDA IBIS/HADEDA 94



AFRICAN GOSHAWK/AFRIKAANSE SPERWER 160

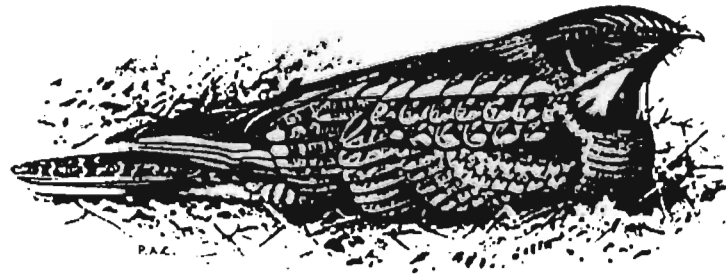


ROOIBORS-DUIFIE/LAUGHING DOVE 355

PURPLECRESTED LOURIE  
/BLOJKU!F-LOERIE 371



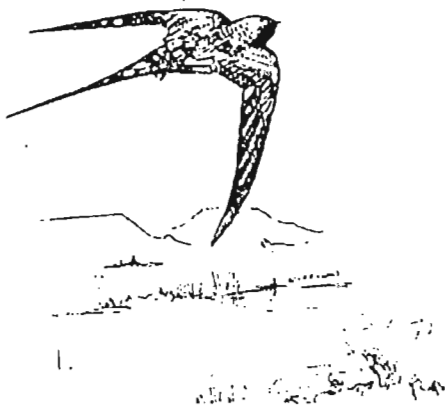
D!EDERIK CUCKOO/DIEDRIKKIE 386



FIERYNECKED NIGHTJAR/AFRIKAANSE NAGUIL 405



LITTLE SWIFT/KLEIN WINDSWAEL 417



PALM SWIFT/PALM-WINDSWAEL 421

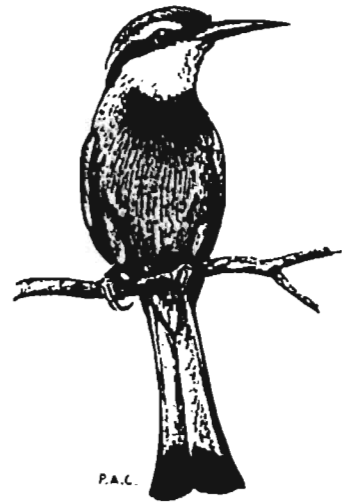


P.A.C.

SPECKLED MOUSEBIRD  
/GEVLEKTE MUISVOËL 424



BRUINKOP-VISVANGER  
/BROWNHOODED KINGFISHER 435



P.A.C.

LITTLE BEE-EATER/KLEIN BYVRETER 444



P.A.C.

ROOIKOP-HOUTKAPPER  
/BLACKCOLLARED BARBET 461



P.A.S.

KARDINAAL-SPEGT  
/CARDINAL WOODPECKER 486



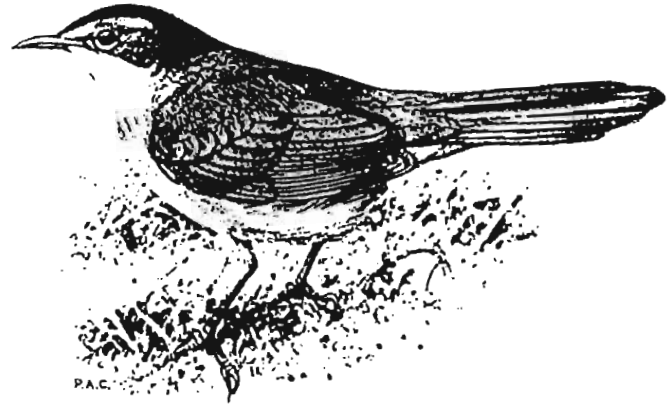
FORKTAILED DRONGO  
/MIKSTERT-BYVANGER 541



SOUTHERN BLACK TIT  
/SUIDELIKE SWART MEES 554



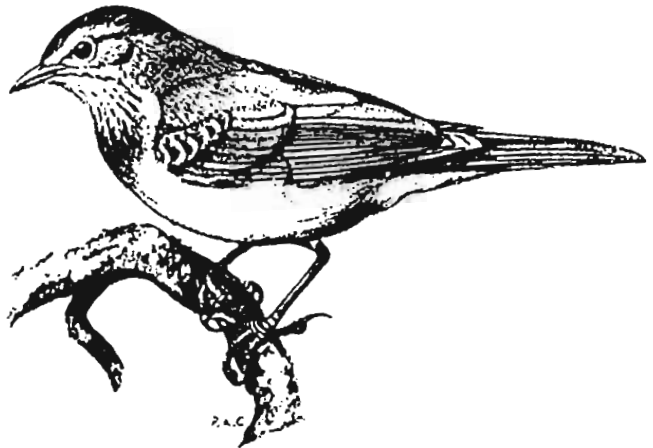
SWARTOOG-TIPTOL/  
BLACKEYED BULBUL 568



BOSKRAPPER/TERRESTRIAL BULBUL 569

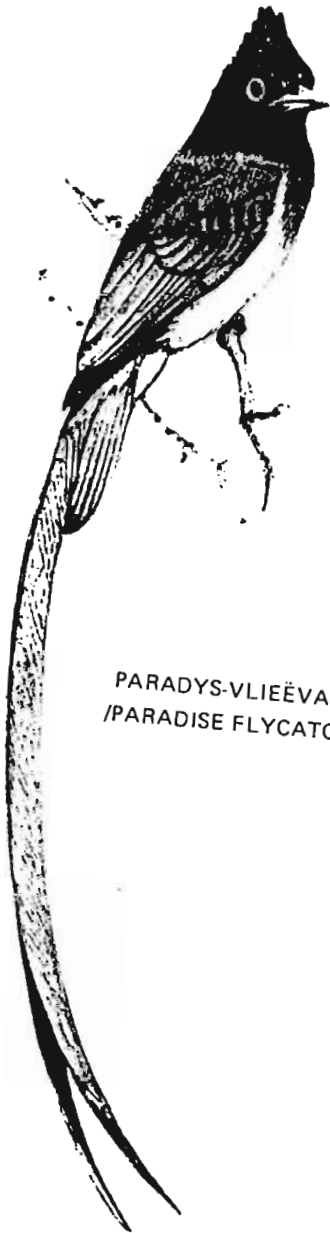


WILLIE/SOMBRE BULBUL 572



ROOIBEK-LYSTER/KURRICHANE THRUSH 576

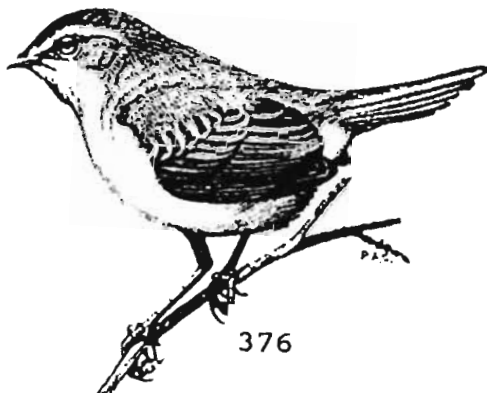
SPOTTED THRUSH/NATAL-LYSTER 578



PARADYS-VLIEËVANGER  
/PARADISE FLYCATCHER 710



NATAL-LAWAAIMAKER/NATAL ROBIN 600



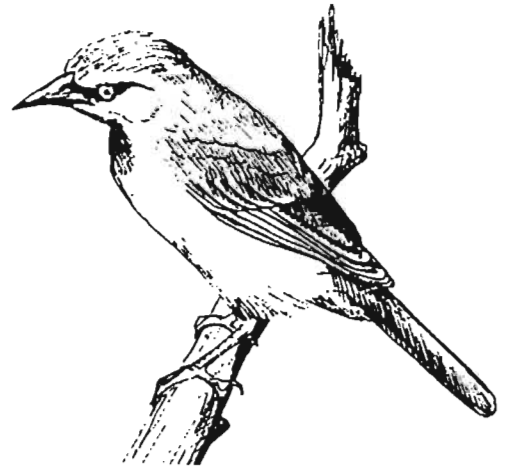
376



KORTBEK-SUIKERBI  
/COLLARED SUNBIR



THICKBILLED WEAVER/DIKBEK-WEWER 807



SPECTACLED WEAVER/BRILWEWER 810

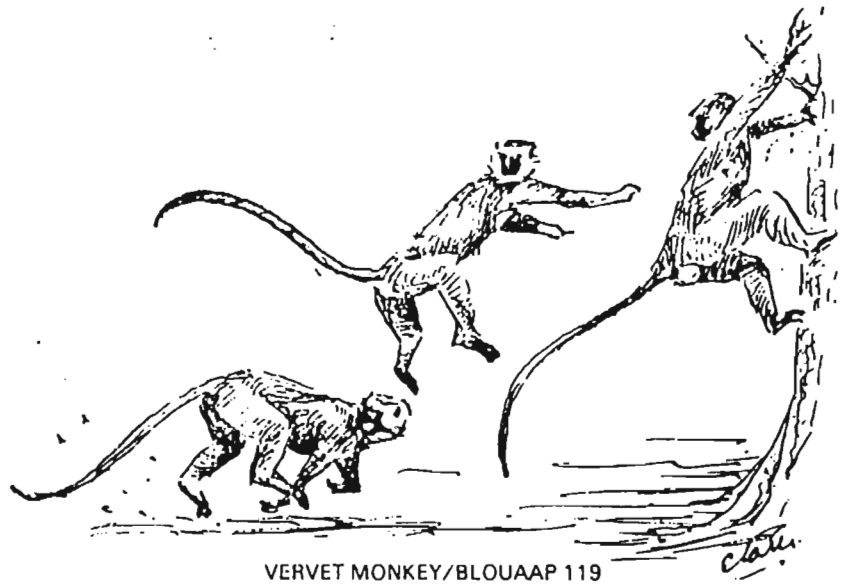


SPOTTEDBACKED WEAVER  
/BONTRUG-WEWER 811



GEELOOG-SYSIE/YELLOWEYED CANARY 869

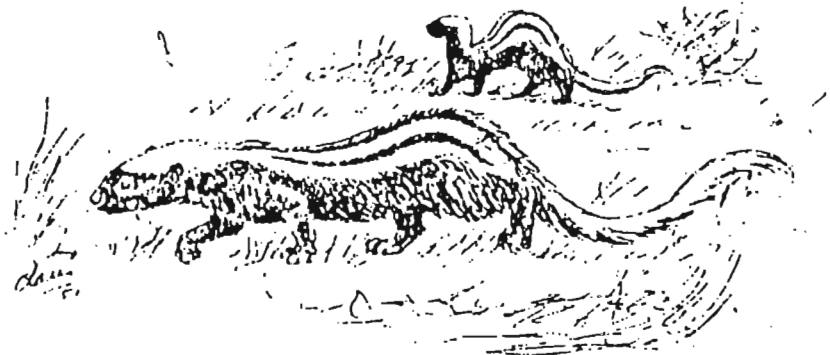
SOURCE: SELF-GUIDED TRAILS IN DURBAN  
DURBAN, RECREATION AND BEACH  
DEPARTMENT



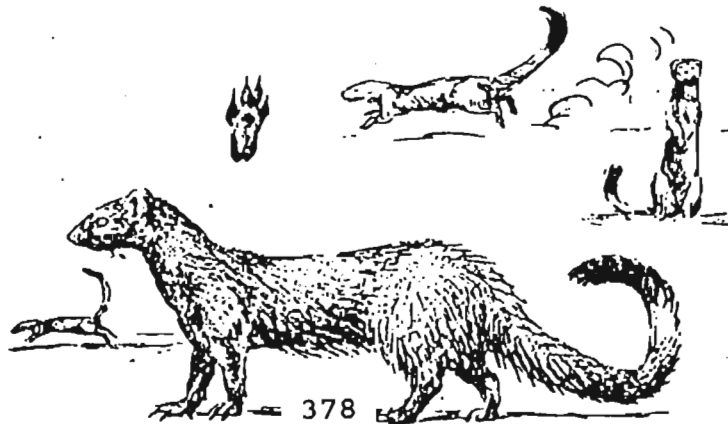
VERVET MONKEY/BLOUAAAP 119



RAT



STRIPED WEASEL/SLANGMUISHOND 263



378

SLENDER MONGOOSE/ROOIMUISHOND 274



WATER MONGOOSE/KOMMETJIEGATMUIHOND 278



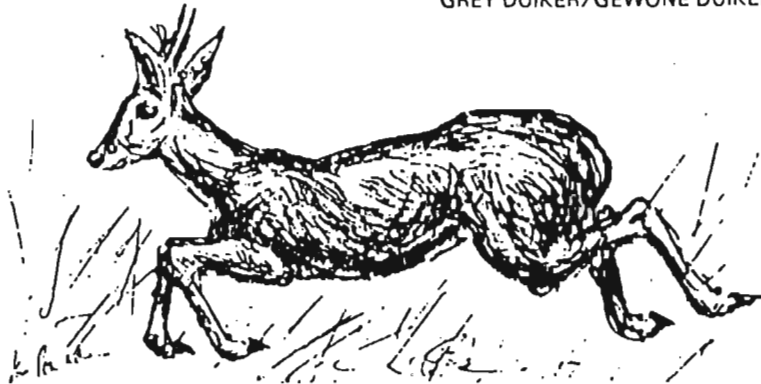
BANDED MONGOOSE/GEBANDE MUIHOND 279



BLUE DUIKER/BLLOUDUIKER 311



GREY DUIKER/GEWONE DUIKER 313



GREY DUIKER/GEWONE DUIKER 313

SOURCE: SELF-GUIDED TRAILS IN DURBAN  
 DURBAN PARKS, RECREATION AND BI  
 DEPARTMENT.



K

A SELECTION OF COMMON BUTTERFLIES  
TO BE FOUND IN PIGEON VALLEY



*Phalanta phalnia aethiopica*  
(POPLAR TREE LEOPARD)



*Junonia hierta cebrene*  
(YELLOW BAND)



*Colotis euippe*  
(SMOKEY ORANGE TIP)



*Coliades keithloa*  
(RED TAIL POLICEMAN)



*Myrina dermaptera*  
(LESSER FIG TREE BIRD)



*Eurema brigitta*  
(BROAD BORDERED YELLOW)



*Acraea natalica*  
(NATAL BORDER)



*Eronia leda*  
(AUTUMN LEAF VAGRANT)



*Melanitis leda*  
(TWILIGHT BROWN)



*Eurytela liarbas*  
(MED PIPER)



*Colotis erone*  
(RED TIP)



*Papilio demodocus*  
(CHRISTMAS BUTTERFLY)



*Mylothris chloris*  
(DOTTED BORDER)



*Bicyclus salitza*  
(COMMON BUSH BROWN)



*Charaxes brulus*  
(WHITE BARRED CHARAXES)



*Belenois creona* ♂  
(AFRICAN COMMON WHITE)



*Danaus chrysippus*  
(AFRICAN MONARCH)

## APPENDIX G

### FORM 5 AND 6 ECOLOGY TRAIL (FIELD RESEARCH)

#### WORKSHEET MARKING GUIDE

- Q.1 Vegetation on footpath destroyed. Erosion of footpath - soil erosion - dongas could develop. (5)
- Q.2 Will help slow down erosion of the footpath. Soil washed down footpath will collect on upper slope of horizontal tree roots. (5)
- Q.3 Management of the reserve - numbers of visitors using footpaths must be monitored. Vegetation must be encouraged to grow on footpaths to help bind the soil. (5)
- Q.4 Excessively eroded footpaths have been closed and new footpaths created. Wood chips and sawdust are scattered on footpaths to slow down erosion. Plants purposely grown in existing dongas (Note: Some birds like the Little Bee-eater nest in eroded-out dongas.) (5)
- Q.5 Competition for sunlight (energy) so that photosynthesis can take place. (5)
- Q.6 Will provide protection from predators, a safe place for breeding, a place for food storage, a source of water. (5)

- Q.7 a. Greater density of vegetation on moister south-facing slope (Durban receives rainfall from south west - rain-bearing winds blowing up coast). (More shady forest-like vegetation on the south-facing slope) (2)
- b. Greater variety of vegetation on moister south-facing slope (soil more moist). Xerophytic plants (those adapted to surviving periods of moisture stress) found on north-facing slope. (2)
- c. Greater height of vegetation on moister south-facing slope. Lower canopy of trees on north-facing slope which receives more sunlight and is therefore drier. Moisture is lost through evaporation from the soil and through plant transpiration. (2)
- Plants survive periods of prolonged moisture stress through storage of moisture in leaves, branches, stems or roots. Some plants drop leaves and become totally or partially leafless during the dry winter months. (4)
- Q.8 Aspect. (1)

### MICRO-CLIMATIC STUDY

Q.9 Take temperature and humidity readings, using a whirling psychrometer (easiest) or separate thermometer and wet and dry bulb thermometer (hygrometer). Pupils are to compare these readings to what they would be, say, at the School or, better still, in the Durban CBD.

Pupils are expected to mention the aspect factor (discussed in Q.7 above), the anabatic/katabatic wind factor, possible temperature inversions, etc.

Pupils must show understanding of the fact that Pigeon Valley displays characteristics of a valley microclimate within the urban microclimate of Durban.

Pupils must show understanding of the importance of temperature in ecosystems like Pigeon Valley, highlighting the sensitivity of plants and animals to this abiotic factor, aspect, photosynthesis, sun as energy source, etc.

(10)

Q.10 Exotic vegetation - not indigenous to the area, not originally part of the natural vegetation of the area, introduced into an area usually by man (or by seeds dropped by migrating birds), flourishes in an area due to the scarcity of natural predators or enemies.

(2)

Indigenous vegetation - natural vegetation of the area, original virgin vegetation of the area, is, however, kept in check by natural predators or enemies. (2)

Q.11 Humus is the organic matter in the soil, formed by the decay of plant and animal matter.

It is important because it forms part of the fertile topsoil horizon (horizon A) of a typical soil profile. It is natural compost being broken down by decomposers to form soil. (5)

Q.12 The organisms are decomposers, responsible for breaking down the humus to form soil. They are specialised consumers (bacteria or fungus) that cause the chemical breakdown (rot or decay) of the organic matter. (3)

Q.13 Soil provides the essential nutrients and minerals plants require to grow. Nutrients are substances usable in metabolism and includes inorganic and organic substances. (5)

Minerals are inorganic substances or compounds required for plant growth.

**Soil Study - Test/analyse the following soil characteristics (edaphic factors):**

Pupils are simply to describe a) soil colour.

b) soil texture - simple hand test or sausage test (in soil sand, loam or clay);

- c) particle size and structure - use magnifying glass and field microscope;
- d) soil pH - wet a soil sample in a test tube (1 part soil, 5 parts water) and apply Universal indicator paper. Obtain pH by comparing the colour of the paper with the colours on the pH colour chart.
- e) soil temperature - find an area of soft soil and place the thermometer in it to read off temperature (insert only up to about 5cm in depth).
- f) animal/plant matter - check biotic component with magnifying glass/field microscope. (10)

Pupils will have done a course on pedology (soil science) in class (part of Std 10 syllabus) and should be conversant with the soil properties and the soil-forming factors.

A more detailed explanation of what humus is required here than what was required in Q.11 of the worksheet. Humus as a component of soil needs to be stressed in this section. (5)

The important role of the micro-organisms (decomposers) in the nutrient cycles must be stressed. Matter is cycled in the ecosphere through gaseous, sedimentary and hydrologic mediums to be made available over and over again. Matter cycling should be seen as a system of redistribution pathways of

essential building blocks for the growth and development of organisms, e.g. carbon or nitrogen cycle. (5)

Q.14 Re-cycling - re-use of matter after it has gone through a nutrient cycle. (6)

Decomposers - micro-organisms responsible for chemical breakdown of organic matter.

Consumers - any organism which lives off other organisms.

Q.15 e.g. grass --- beetle --- spider --- pigeon (dove)  
grass --- grasshopper --- frog --- snake --- owl (4)

Q.16 e.g. plants --- snail --- fish --- bird  
e.g. phytoplankton --- zooplankton --- insect larvae  
--- fish. (4)

(In the pond the following organisms have been found - guppies, shrimps, crabs, frogs and water spiders).

#### Water Study (1) Abiotic Factors

- (i) pond depth - use meter rule, get as close to middle of pond as possible.
- (ii) nature of pond bottom - muddy (ascertained from meter rule when raised from pond bottom).
- (iii) extent of exposure to sunlight - area surrounded by vegetation, hence not very exposed.
- (iv) pH of water - use Universal indicator paper and accompanying colour chart.
- (v) water temperature - use thermometer used for micro-climate and soil study.

(vi) water flow - still pond, fed with fresh water only during rainfall with rainwater flowing down pathway into pond.

(2) Biotic Factors

(i) Plants - examples of all types listed can be observed.

(ii) Animals and Insects - most of the life forms shown in Diagram 8 of the Worksheet can be observed except for large fish species and fresh water turtles.

'Balance' of pond can be upset by, for example, pollution of water filling pond, large fluctuations in amount of water in the pond, amount of vegetation growing in pond and on pond banks, amount of sunlight entering water, etc.

(20)

Q.17 Symbiosis - the close co-existence of 2 different organisms, for the benefit of both, or of one, or of neither.

(2)

1) Commensalism (+N) - relationship between 2 different species in which one organism derives benefit and the other suffers no harm, e.g. bird nesting in a tree.

(2)

2) Parasitism (+-) - the interaction through which an organism obtains food from the living tissues of another organism, e.g. tick living in the fur of a buck.

(2)

(3) Mutualism (++) - two organisms of different species which live in close contact to their mutual benefit, e.g. fungus and algae in lichen.

(2)



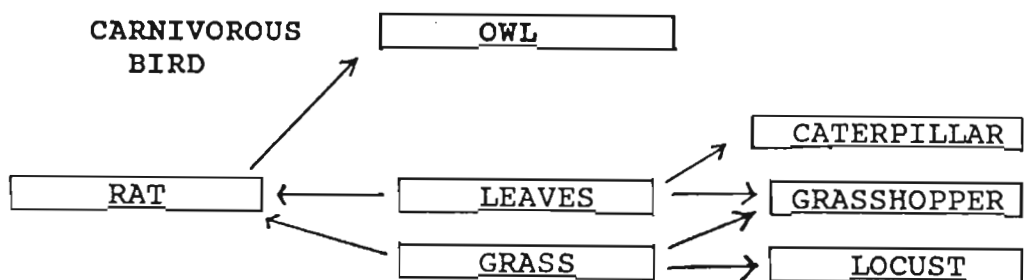
Q.18 e.g. Plant - Strangling Natal Fig using Forest Cabbage Tree for assistance.

e.g. Bird - to reach Sunlight.

e.g. Animal - areas of slight subsidence from Glenwood water tunnel found in the reserve have made ideal nesting habitats for birds like the Brownhooded Kingfisher, Little Bee-eater and Pygmy Kingfisher.

(5)

Q.19 Food Web



(5)

Q.20 e.g. Week killers, 'Doom' type insect spray  
DDT or Dieldrin

(2)

Q.21 Some evidence of littering

Air pollution

Noise Pollution

(Because it is fenced off, Pigeon Valley does not suffer from dumping. Also, because it does not have a stream or river, water pollution is not a problem.)

(2)

Q.22 (1) Good for air quality - vegetation filters pollution from the air.

(2) Makes area more comfortable from a climatic point of view.

(5)

Q.23 Carrying capacity - the optimum number of plants or animals a given area can sustainably support. (2)

Q.24 Cambium - Tissue found in the tree just below the bark layer and is responsible for the regeneration of tissue. If the cambium is removed or damaged, the tree cannot heal itself. (4)

#### Problem-solving Exercises

Q.25 1) Natural ecosystem - balanced systems (inputs, outputs balanced), nutrient cycles, energy flows operating normally.

Conservation in practice.

2) Man created ecosystem - unbalanced system, nutrient cycles, energy flows not operating normally. Conservation not in practice. (15)

Q.26 The middle ground between 2 extremes of 'Hands off Nature!' and 'All Out Exploitation!' must be exploited while monitoring, measuring, managing the environment the whole time. The objectives of conservation education must be realised. (15)

Q.27 We need to move (as rapidly as possible) from 'The Throughput Economy' to a 'Spaceship Earth' society. Pupils must highlight the essential characteristics of the above two concepts - basically to move from a throwaway society to a recycling one. (15)

Q.28 A subjective answer is required, with the pupils expected to be candid, constructive, helpful, etc. Much valuable feedback can be gleaned from an analysis of pupil answers to this question.

(No marks have been allocated to this question so as to encourage genuine pupil response to the questions posed)

[200]

APPENDIX H

UNIVERSITY OF NATAL (DURBAN)

DEPARTMENT OF EDUCATION

FIELDWORK IN ENVIRONMENTAL STUDIES

CONFIDENTIAL    QUESTIONNAIRE TO PUPILS

Thank you for taking the time to complete this questionnaire.

Do not put your name on it or sign it.

Its purpose is to try to ascertain the success or otherwise of using the fieldwork approach and the worksheets in particular when studying the Ecology section of the new Standard Ten Syllabus.

**Answer each question by placing a tick in the block of your choice**

e.g. Which section of the syllabus has been covered by the fieldwork you have just undertaken?

Geomorphology  Ecology  Climatology

The space which has been left below the questions is for either elaboration or explanation (where appropriate) of the answers given. Answers should be as concise as possible.

THE FIELD STUDY

1. Did you clearly understand the instructions, questions and tasks required of you in the worksheets?

Yes  Only partly  No

If not, what was not understood?

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2. Did the worksheets supply sufficient information (by way of diagrams, data, written instructions, etc.) for you to successfully complete the questions and tasks set?

Yes  Only partly  No

If not, what additional information was required?

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3. Do you feel that the fieldwork exercise enabled you to acquire the ability to conduct the experiments required in Ecology?

Yes  Only partly  No

Give reasons for your answer.

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4. Did you achieve a greater understanding of Ecological Terminology as a result of the fieldwork undertaken?

Yes  No  Not sure

If Yes, which terminology?

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5. Did the fieldwork exercises make you more aware of the importance of the environment?

Yes  No  Not sure

If Yes, in what way?

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6. Do you think that the purposes of the Ecology Syllabus (as stated by your teacher at the beginning of the course) were achieved as a result of the fieldwork undertaken?

Yes  No  Not sure

7. Did you find you were kept fully occupied by the fieldwork exercise?

Yes  Only partly  No

If not, how could you have been more fully occupied?

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8. Were the fieldwork exercises enjoyable?

Yes  Only partly  No

9. How successful do you think the worksheets used during the fieldwork exercises were in developing your understanding of the new Ecology section of the syllabus?

Successful  Only partly  Not   
successful successful.

Give reasons for your answer.

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10. Are there any further points you wish to make relating to the fieldwork exercises and/or the worksheets used?

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**THANK YOU FOR COMPLETING THIS QUESTIONNAIRE!**



APPENDIX I

UNIVERSITY OF NATAL (DURBAN)

DEPARTMENT OF EDUCATION

FIELDWORK IN ENVIRONMENTAL STUDIES

CONFIDENTIAL

INTERVIEW OF PUPILS

1. Did you have any problems with the worksheets and reference booklets used in the Pigeon Valley fieldwork?
2. Did you have any problems working as a group in Pigeon Valley? Would you have preferred working individually? Why?
3. Did you have any problems with the equipment used in the experiments/tasks/exercises?
4. Should more problem solving/experiments/tasks have been set or should more time be allocated for observation and exploration?
5. Was too much time spent filling in the worksheets while you were in the Valley instead of more time being spent on observation or experimentation?
6. How important is a preliminary 'acquaintance' visit to the area, using the reference booklet, before a more detailed worksheet based visit?

7. How much of a problem was the time available to you while you were doing the fieldwork?
8. Are there any other points you wish to make relating to the fieldwork exercises and the worksheets used?

## APPENDIX J

### FORMS 2, 3, 4 ECOLOGY TRAIL

#### (TRADITIONAL FIELDWORK)

#### PIGEON VALLEY ECOSYSTEM

#### TEACHER'S GUIDE

This trail is designed to last 4 periods (+-2 hours), but can be modified by individual teachers to suit their requirements. Many aspects of Geography will be touched on in this trail, e.g. Settlement, Climatology, Geomorphology, etc., as well as aspects of other disciplines, e.g. Biology and Science, although the main aim is to serve as an introduction to the new section of ecology in the syllabus, using the fieldwork approach.

This approach has 3 basic stages - a preparation phase which is done in class as preparation for the outdoor fieldwork, the fieldwork phase done in the field, and a follow-up phase, done for homework or in class.

The preparation phase would involve providing the pupils with a background for the subsequent fieldwork phase by acquainting them with maps, aerial photographs and written publications of the study area and by familiarising them with details of the study area, e.g. - the location of Pigeon Valley (B in reference booklet), Pigeon Valley as an ecological environment (C in reference booklet), the value of Pigeon Valley to Durban residents, its role as part of the MOSS

system, a green area, an urban lung, urban heat island, effect on bird migration in Durban area, etc.

(Note: The reference booklet will be given to pupils in this preparation phase and studied beforehand as a means of introducing them to the area. Pupils must be told by the teacher to continually refer back to the reference booklet during the excursion and the subsequent follow-up phase - especially F in the booklet - the glossary of ecological terms).

The fieldwork phase would consist of observation, recording and interpreting by means of answering the questions posed in the Worksheet. Not all the questions posed should be answered during the fieldwork phase (time would not permit this), and the teacher is expected to give some indication to the pupils of what questions need to be answered during the excursion and what questions could best be answered as part of the subsequent follow-up phase at home or in class. (A bright class could possibly be left to decide for themselves).

It is recommended that pupils work in groups of 3 or 4, with each pupil having his or her own worksheet to fill in and each group a reference booklet. (Duplicating and paper costs are obvious constraints to each pupil having his or her own reference booklet, the obviously desirable situation). Even

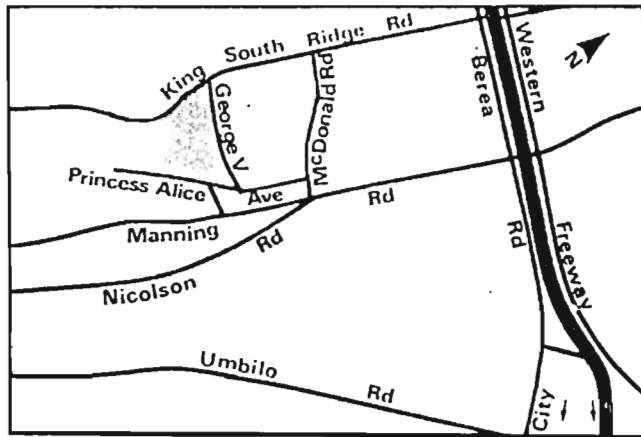
though a group work approach is advocated, the teacher should still expect some individualism in answers when marking or assessing the worksheets.

The follow-up phase: Pupils' homework on the night of the excursion, or as a class exercise the next day, is to complete their worksheet by interpreting what they observed in the field, and by writing up their observations and presenting them in a mini-project.

D and E in the reference booklet must serve as a framework for this ecological fieldwork study, as pupils are expected, by the end of the excursion and subsequent follow-up writing phase, to be able to relate all that they have learnt to the framework, and to be in a position to understand the framework details.

At the completion of the follow-up phase and teacher assessment of the worksheet, the pupil will hopefully have a better idea of the practical application of the new section of the syllabus, with the fieldwork approach showing that the skills, concepts and objectives listed for this section of the syllabus guide can be successfully realised in this way.

**ECOLOGY TRAIL - PIGEON VALLEY**



**PIGEON VALLEY**

***Bush Manners***

WHILE IN THE VALLEY

**NOISE IS A NO-NO**

IT FRIGHTENS ANIMALS AND DISRUPTS THE PEACE — NO RADIOS, PLEASE!



**ONLY JERKS LEAVE JUNK**  
PLEASE CARRY ALL YOUR RUBBISH OUT OF THE VALLEY AT THE END OF YOUR VISIT.



**REGRET NO TAKE-AWAYS**

OLD SKULLS AND BONES FORM PART OF THE ECOSYSTEM, AND ARE USED AS TEACHING AIDS. PLEASE DO NOT REMOVE THEM.

**SOME FRIENDLY ADVICE:**

- ~ AVOID DRINKING WATER FROM THE VALLEY.
- ~ KEEP TO THE ROAD AND PATHS.
- ~ KEEP TOGETHER WHILE ON TRAIL
- ~ DO NOT WANDER OFF FROM THE CAMP.
- ~ ACCIDENTS ARE AVOIDABLE — HAVE FUN, BUT DON'T BE RECKLESS



HAVE A GOOD TIME AND LET OTHERS DO THE SAME

**BE AWARE!**



TRY TO :

- SEE** - not just LOOK
- SMELL** - not just SNIFF
- LISTEN** - not just HEAR
- TASTE** - not just SWALLOW
- FEEL** - not just TOUCH

FORMS 2, 3, 4 ECOLOGY TRAIL (FIELDWORK)

(PIGEON VALLEY ECOSYSTEM)

W O R K S H E E T

NAME: \_\_\_\_\_ CLASS: \_\_\_\_\_

1. Enter Pigeon Valley Reserve at the main gate behind the visitors' centre near the information board. You are now standing on the footpath at the start of the Elm Trail.

Observe the footpath

Q.1 What effect will excessive use of this footpath have? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Q.2 What effect will the tree roots lying horizontally across the path have on this process? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Q.3 How can man assist in preventing this process?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Q.4 What has been done within this Reserve to prevent this process? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
  
(Note: This is part of the management policy of the Reserve. Man is managing his resources, working with nature. Note also at this point the role of vegetation in the prevention of soil erosion.)

Observe the large Strangling Natal Fig Tree in front of you. Notice it has a hollow trunk formed by the intertwined roots that started life high up in the fork of a Forest Cabbage Tree. Once the fig roots had reached the ground, they were able to enlarge and eventually encircle the cabbage tree trunk and smother it.

Q.5 Explain briefly why the above process occurred. (Clue: Think of the effect sunlight has on plant growth. You will notice, too, many creepers in the Reserve climbing up trees, being supported by them. Diagram 1 below can help you in your explanation.



Green plants can make their own food by a process known as PHOTOSYNTHESIS.

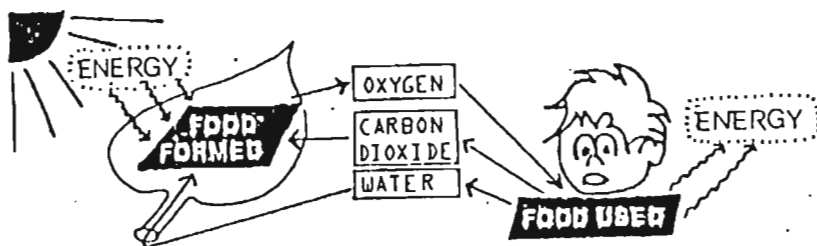


DIAGRAM 1

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You will also notice other areas in the valley where there is little undergrowth beneath the tree canopy for the same reasons.

Q.6 What effect will the hollow trunk have on bird and animal life in the area? \_\_\_\_\_

Other tree species in this area are the Dragon Tree and Natal Camwood. Observe them.

2. Turn left off the Elm Trail and start wandering up the central pathway in the Valley. As you walk through the reserve, look for birds and listen for any bird calls. Write down what the bird looked like and then, from the reference booklet given you (I in booklet), check the

list of birds found in Pigeon Valley and the diagrams of some of the more common types, to try and identify them. Failing this, check Roberts' Birds of South Africa in the school library. Also observe the types of butterflies (K in booklet) which can be seen in the area, and look for signs of animal life (droppings (dung) and spoor).

Make a note, too, of the names of the main indigenous trees which you come across in the Reserve. You will find they have labels on them. Tick them off on your list of trees (G in booklet). Encourage your parents to plant one of these in your garden this weekend. Trees can be checked in the National List of Trees book in the library.

The area has a gently undulating topography, ranging in altitude from 65m to 115m above sea level. Observe the topography of the Valley. Notice that the valley has north and south facing slopes, draining down into the central pathway.

Q.7 What do you notice about the vegetation on the different facing slopes? Note how some plants have adapted to surviving periods of moisture stress. Discuss briefly ways plants do this.

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Q.8 What geographical term is given to this situation?

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Remember temperature is an important ABIOTIC factor influencing an ecosystem, especially plants and animals.

As you wander up the central pathway, you will notice the dense forest-type vegetation to be found on either side of the pathway. Pigeon Valley is a small remnant (10 hectares in area) of the once extensive Stella Bush of sub-tropical coastal forest which once covered this area.

Observe the 3 main layers of vegetation which exists:

i) an understory, ii) a sub-canopy, iii) canopy.

Q.9 The forest-type vegetation found in this reserve gives a clue to the rainfall which occurs. Explain briefly.

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Observe how areas of the Reserve have been cleared of the natural tree and bush vegetation as part of the Reserve's management policy and natural grassland areas

have been maintained for ease of human movement (picnics, etc) (An example of human manipulation of an ecosystem), but also to maintain a more suitable habitat for grassland animals (H in reference booklet).

As you wander up the central pathway, you will observe some patches of open space in the forest. These are areas which have been cleared of fast-growing exotic vegetation like the Triffid Weed (Chromolaena Odorata) and Lantana Camara, sometimes called Confetti Bush or Tickberry), which kill the indigenous vegetation by smothering it. These exotics flower in winter and are ready to germinate in spring with the first rains.

Q.10 What is the difference between exotic and indigenous vegetation? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Find a Chromolaena plant and a Lantana plant - take a sample of a twig with leaves and a flower to press at home and hand it in as part of your project.

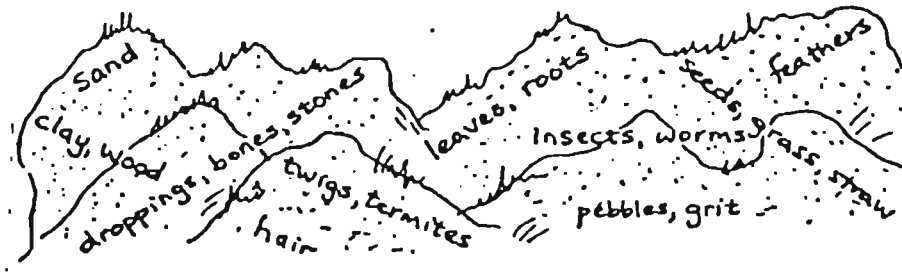
Large areas of the Reserve were cleared of exotic vegetation in 1979. The invasion of an area by plant species shades out and prevents the growth of indigenous plants and results in the area becoming biologically sterile. The alien plants tend to

dominate the area, having no natural enemy, and provide very little ecological diversity. Although some may provide a quantity of food (for birds for example - e.g. the Syringa), they decrease the number of habitat types for birds and are therefore no good for the ecosystem. Unfortunately, monkeys and birds eat exotic fruit, thus aiding seed dispersal of these alien species, through their droppings.

Observe how slowly the patches recover with local indigenous understory species of plants coming in and young trees starting to grow (once again management of ecosystems, positive man-induced interference in an ecosystem). This process is called succession, with the natural vegetation progressing from pioneer stages through to a climax.

NOTE: Pigeon Valley has reached its climax in plant successional terms.

Find an area under the trees which is devoid of vegetation except leaves which have fallen from the trees.  
Observe how the leaves collect under the tree. Here they slowly decompose with the aid of various soil organisms to form humus. Diagram 3 below shows the diverse components of humus.



Q.11 What is meant by the term humus? Why is it important? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

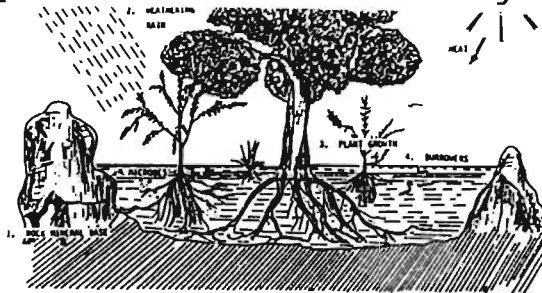
Scoop a sample of soil in your hands. You will notice a large number of organisms present. Use your magnifying glass to help you.

Q.12 What is their role in the soil-forming process?

\_\_\_\_\_

\_\_\_\_\_

Note the work of termites in soil aeration and breakdown of organic matter. Study the following diagram, which shows the main factors which influence soil formation, all of which occur in Pigeon Valley.



Factors influencing soil formation in this diagram are:  
 1. Rock-mineral base material; 2. Weathering, rain and heat; 3. Plant root branching; and, 4. Burrowing animals or microbes (bacteria) that live in the soil.

**DIAGRAM 2**

Q.13 Why is soil important to plants and hence to life on earth? (Use the terms **nutrients** and **minerals** in your answer - make sure you know the meanings of these terms.)

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Find a wood log and observe log life. You will notice fungi and bacteria breaking down the log for recycling and to make the soil richer. These decomposers are consumers and play an important role in any ecosystem.

Q.14 In a sentence, briefly explain the meaning of the 3 underlined terms used above. \_\_\_\_\_

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Observe the large number of trees in the Reserve which produce fruit and berries (trees like Forest Fever Berry and Pigeon Wood). Pigeon Valley gets its name from the hundreds of doves and pigeons that come into the area to feed on the fruit (birds like Redeyed Dove, Laughing Dove, Tambourine Dove, Sombre Bulbul and Terrestrial Bulbul). The feeding relationships which exist between plants and animals are called food chains. Food chains are linked by the different organisms making up the food chain,

e.g. grass - cow - man,

leaves - locusts - birds - snake

1. In a food chain, plants are called the PRODUCERS because they produce food for the rest of the chain.

2. The animals that feed off the plants are called HERBIVORES. )

3. The animals that feed off other animals are CARNIVORES (predators or scavengers. )

4. Some animals, like monkeys, eat both plants and animals and are called OMNIVORES. )

CON-  
SUMERS

Study Diagram 5.

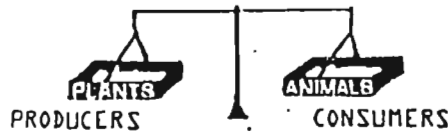


DIAGRAM 5

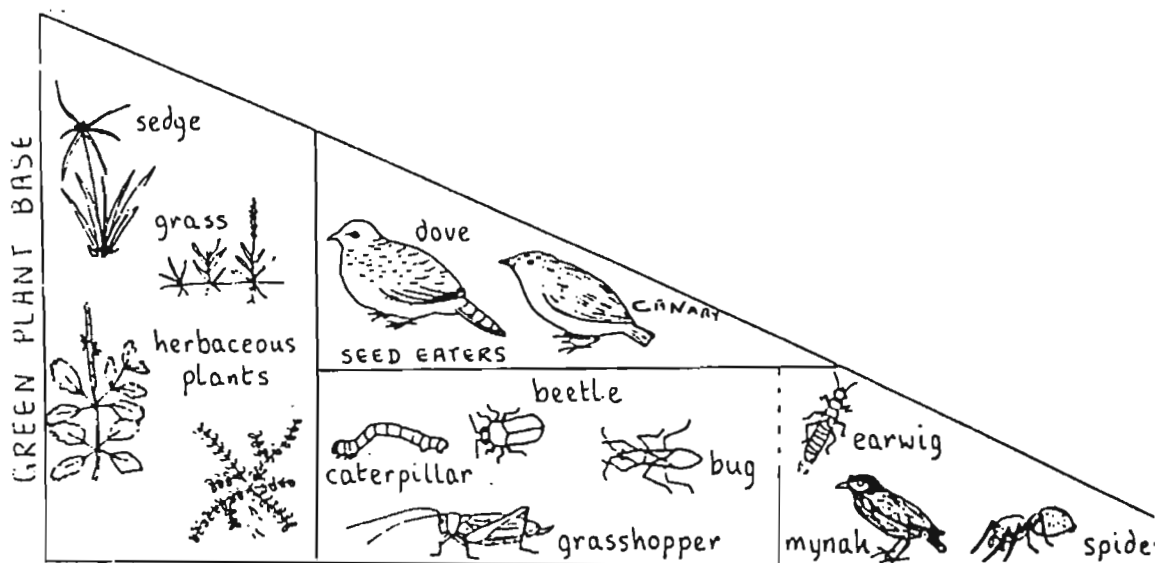
Note that plants (producers) make their own food. Animals (consumers) eat plants, and an ecological balance is needed between the two to get a balanced ecosystem.

Pupils must be made aware of the loss of energy at each transfer in the food chain. Refer to Diagram 6 below.





REMEMBER: YOU CAN STUDY FOOD RELATIONSHIPS IN THE SCHOOL GROUNDS TOO. SEE DIAGRAM 7.



**DIAGRAM 7**

Besides the various types of birds and insects to be found in Pigeon Valley, there are also a few species of small buck (duiker), mongoose, monkeys, weasels, genets, shrews and rats.

Q.15 Construct a land-based food chain, using the organisms that exist in Pigeon Valley.

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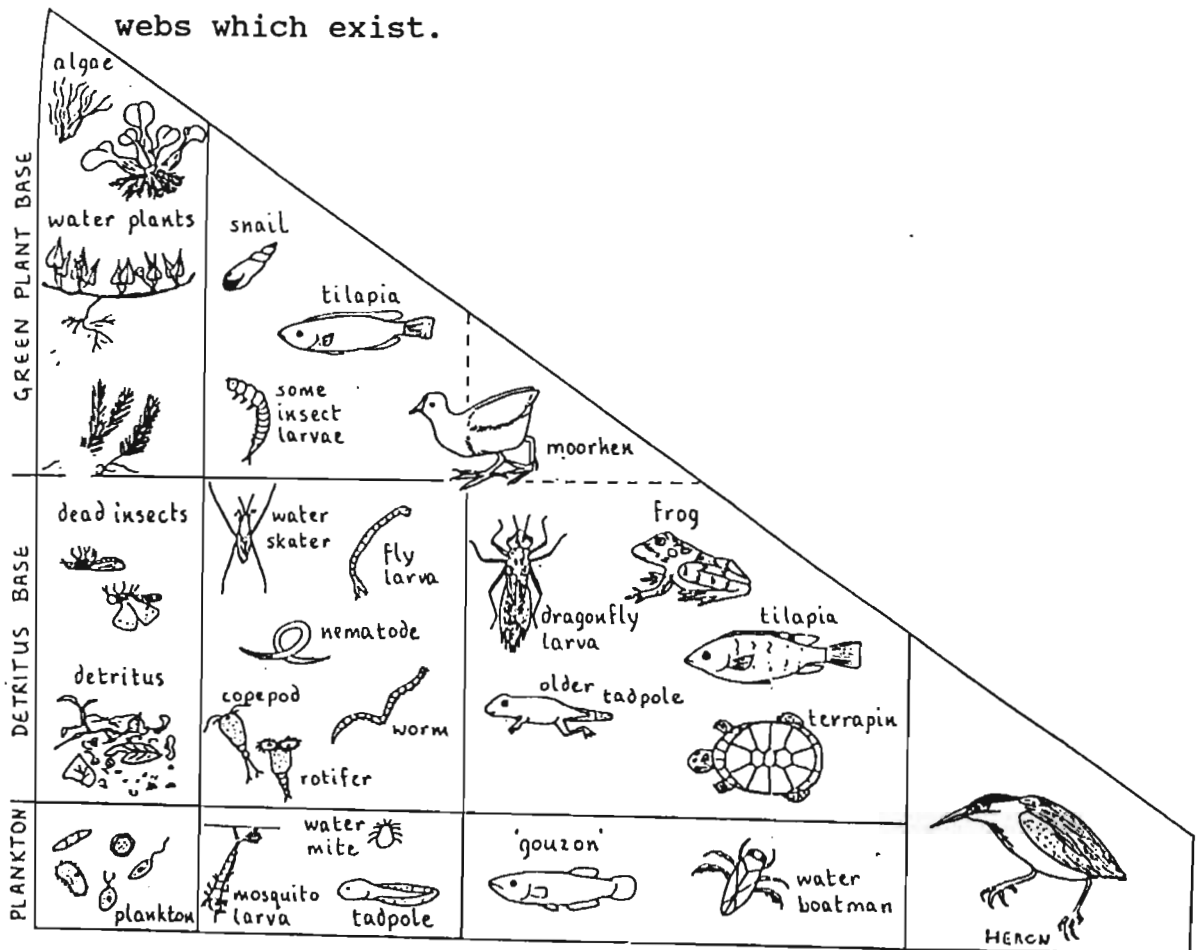


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Note that energy is lost at each trophic level of a food chain.

Q.16 Construct a separate aquatic food chain using the organisms which you think may exist in the small pond half-way up the central pathway in the Valley.

Note that a food web consists of several interlocking food chains. Spend time observing the pond - insects, fish, plants, etc. Diagram 8 below, showing a food relationship pyramid for a freshwater pond, gives an indication of the diversity of life in such an ecosystem and the complexity of food chains and food webs which exist.



Food relationships in a freshwater marsh OR POND.

**DIAGRAM 8**

Q.17 Construct a simple food web, using organisms from both the aquatic habitat and the land habitat. Figure 9 below will show you how to set out your answer.

In the FOOD WEB below, fill in specific examples, as you come across them.

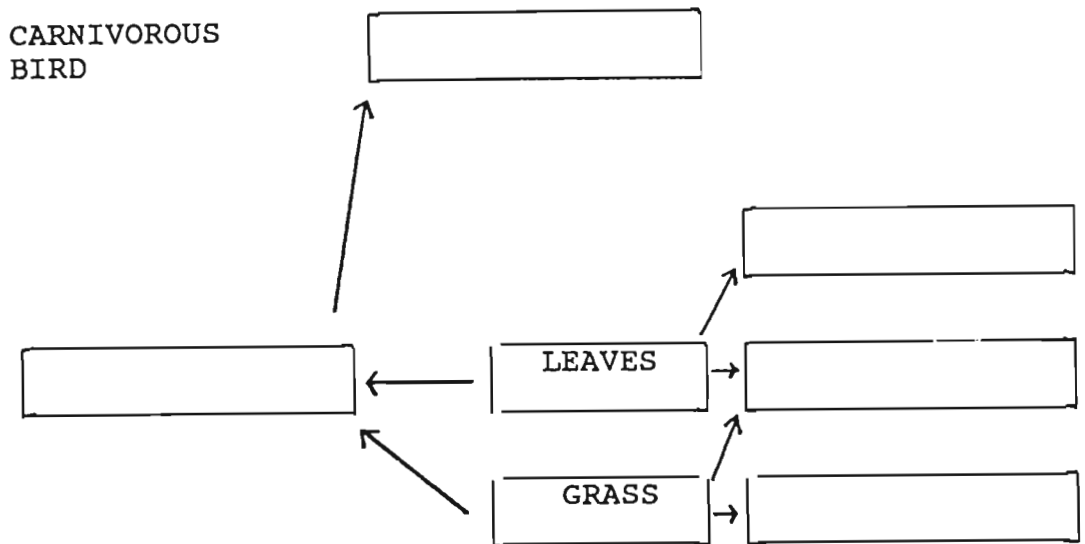


FIGURE 9

Obviously part of the management policy in the Reserve is the maintenance of the food chains and food webs that exist. Even weeds form part of the food chain; however, they need to be controlled. Farmers use poisonous chemicals to get rid of weeds, but this method is not supported in Pigeon Valley. This is because some of the poisons are stored in the bodies of animals that eat them and then become passed down the food chain, e.g. locusts are sprayed by chemicals,

lizards eat the locusts, wild cats eat the lizards, birds of prey eat the wild cats, etc. Figure 10 below shows this in diagrammatic form.

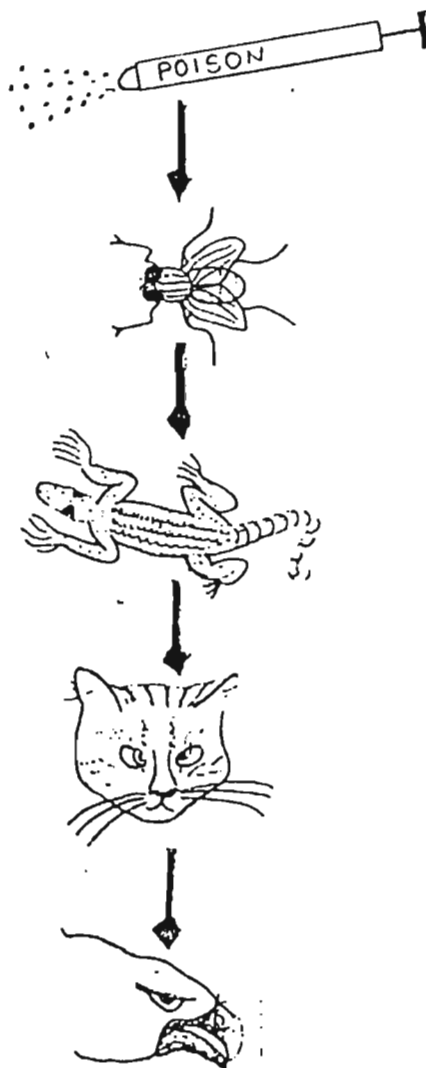


FIGURE 10

The poisonous chemicals used are called pesticides and herbicides. Very limited use of mild herbicide is used in Pigeon Valley to clear exotic vegetation, most of which is manually cleared.

Consider the persistent use of pesticides in agriculture on man.

Q.18 List at least 2 of these poisons which you use at home or in your garden. \_\_\_\_\_  
\_\_\_\_\_

Thus, by man using certain substances, nature can be disturbed. This is called Pollution.

Q.19 Do you see any evidence of pollution in Pigeon Valley? \_\_\_\_\_  
\_\_\_\_\_

Note the important effects pollutants have on the pH of soil and water in ecosystems.

Observe the trunks and branches of many trees in Pigeon Valley and you will notice light blue-green patches growing there. These patches are plant-like creatures called lichen. Lichen only grows where the air is quite clean and thus is found in areas where there is little or no pollution.

Q.20 What effects do areas like Pigeon Valley have on  
1) air quality in urban areas, and 2) on the microclimate of the area?  
\_\_\_\_\_  
\_\_\_\_\_

J in the reference booklet shows a selection of animals to be found in the Reserve. A few buck have been introduced into this area. In nature there is a delicate balance between plants and animals, e.g. there is always enough grass to feed a certain number of buck and there are enough buck to feed a certain number of lions, etc. Part of the management policy of this Reserve is to observe the carrying capacity of the area.

Q.21 What is meant by this term? \_\_\_\_\_  
\_\_\_\_\_

As you wander up and down the central pathway, you will notice certain trees (especially Flat Crowns and Wild Plums) which have had part of their bark peeled off. The Zulus use the bark to make up various potions and, in an attempt to prevent this from happening, the trees have had their trunks painted with PVA paint, which discourages the herbalists from using the bark. Of course, this is no longer a problem in Pigeon Valley, as the area has recently been fenced off. If the herbalists cut deeply into the bark, permanent damage is done to the tree and diseases can enter the tree.

Q.22 Simple Problem-solving Exercises: ((1) & (2))  
TO BE ANSWERED ON SEPARATE FOOLSCAP PROVIDED)

1. Urban areas all over the world are threatened by a shortage of space for housing and other urban land uses. Natural areas like Pigeon Valley are threatened, as some people believe the land could be put to better use and be more productive.

What are your views on this? Do you think areas like Pigeon Valley should be preserved? What about the larger game reserves and other natural areas which are threatened with agricultural expansion?

2. Make a simple list of what you as an individual can do to maintain the ecological balance required on earth and how you can contribute toward a better environment. Every citizen on Earth has a part to play in looking after the environment.

APPENDIX K

FORMS 2, 3, 4 ECOLOGY TRAIL (TRADITIONAL FIELDWORK)

WORKSHEET MARKING GUIDE

- Q.1 Vegetation on footpath destroyed. Erosion of footpath - soil erosion - dongas could develop. (3)
- Q.2 Will help slow down erosion of the footpath. Soil washed down footpath will collect on upper slope of horizontal tree roots. (3)
- Q.3 Management of the reserve - numbers of visitors using footpaths must be nominated. Vegetation must be encouraged to grow on footpaths to help bind the soil. (3)
- Q.4 Excessively eroded footpaths have been closed and new footpaths created. Wood chips and sawdust are scattered on footpaths to slow down erosion. Plants purposely grown in existing dongas (Note: Some birds like the Little Bee-eater nest in eroded out dongas). (3)
- Q.5 Competition for sunlight (energy) so that photosynthesis can take place. (3)



- Q.6 Will provide protection from predators, a safe place for breeding, a place for food storage, a source of water. (3)
- Q.7 Greater density, variety and height of vegetation on moist south-facing slope of drier north-facing slope. These plants adapted to surviving periods of moisture stress are found on the drier north-facing slope. (5)
- Q.8 Aspect. (2)
- Q.9 Fairly high (year round) rainfall required to sustain a forest-type vegetation. Durban rainfall over 1000 mm per annum, mostly in summer but some in winter, too. (3)
- Q.10 Exotic vegetation - not indigenous to the area, not originally part of the natural vegetation of the area, introduced into an area usually by man (or by seeds dropped by migrating birds), flourishes in an area due to the scarcity of natural predators or enemies. (2)
- Indigenous vegetation - natural vegetation of the area; original virgin vegetation of the area, is, however, kept in check by natural predators or enemies. (2)
- Q.11 Humus is the organic matter in the soil, formed by the decay of plant and animal matter.

It is important because it forms part of the fertile topsoil horizon (horizon A) of a typical soil profile. It is natural compost being broken-down by decomposers to form soil. (3)

Q.12 The organisms are decomposers, responsible for breaking down the humus to form soil. They are specialised consumers (bacteria or fungus) that cause the chemical breakdown (rot or decay) of the organic matter. (2)

Q.13 Soil provides the essential nutrients and minerals plants require to grow. Nutrients are substances usable in metabolism and include inorganic and organic substances. Minerals are inorganic substances or compounds required for plant growth. (3)

Q.14 Re-cycling - re-use of matter after it has gone through a nutrient cycle.

Decomposers - micro-organisms responsible for chemical breakdown of organic matter

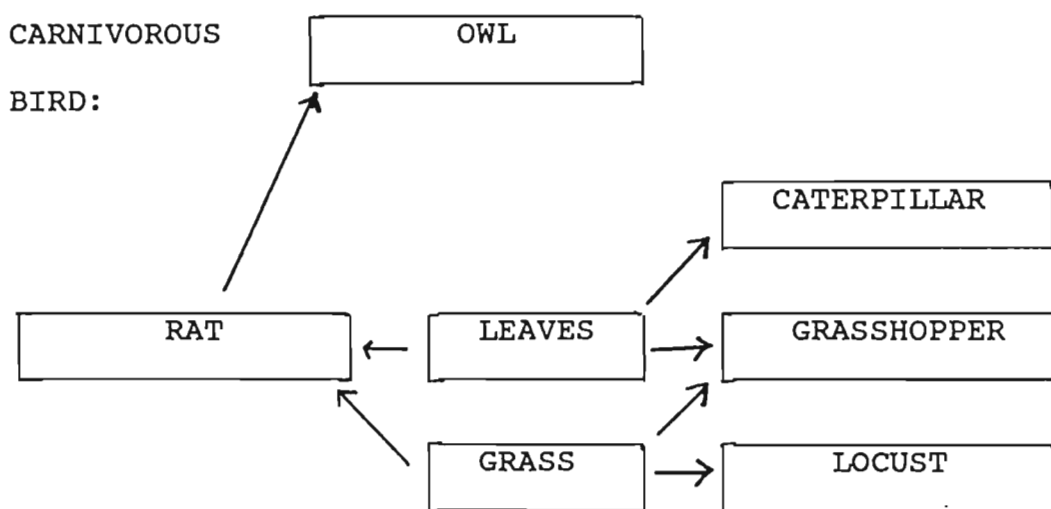
Consumers - any organism which lives off other organisms. (6)

Q.15 e.g. grass --- beetle --- spider --- pigeon (dove)  
grass --- grasshopper --- frog --- snake ---  
owl (4)

Q.16 e.g. plants --- snail --- fish --- bird  
 phytoplankton --- zooplankton --- insect larvae  
 --- fish (4)

(In the pond the following organisms have been found - guppies, shrimps, crabs, frogs, water spiders.)

Q.17 Food Web



(5)

Q.18 e.g. Weed Killer, 'Doom' type insect spray.

DDT or Dieldrin (2)

Q.19 Some evidence of littering

Air Pollution. Noise Pollution. (2)

Q.20 (1) Good for air quality - vegetation filters pollution from the air.

Makes area more comfortable from a climatic point of view.

Q.21 Carrying capacity - the optimum number of plants or animals a given area can sustainably support. (3)  
[70]

Q.22 (1) ) Subjective answers required. Pupils required to  
)  
(2) ) be candid and to show evidence of careful  
)  
) thought. Hopefully an attitude of concern for  
)  
) the environment will emerge.

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