A STUDY OF THE PROBLEMS AND POSSIBILITIES OF USING THE MARINE INTERTIDAL ZONE FOR TEACHING PRINCIPLES OF ECOLOGY IN SENIOR SECONDARY SCHOOLS: A SURVEY OF BIOLOGY TEACHERS IN THE WESTERN CAPE.

BY

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I _____ declare that **A STUDY OF THE PROBLEMS AND POSSIBILITIES OF USING THE MARINE INTERTIDAL ZONE FOR TEACHING PRINCIPLES OF ECOLOGY IN SENIOR SECONDARY SCHOOLS: A SURVEY OF BIOLOGY TEACHERS IN THE WESTERN CAPE** is my own work, and that all the sources I have cited or used have been acknowledged and indicated by means of complete references.

ABSTRACT

In this study I investigate the attitudes of a group biology teachers in the Western Cape, to using the marine intertidal zone for teaching principles of ecology in senior secondary schools, by exploring the problems experienced and solutions envisaged. The study investigates the problems perceived/experienced by means of a semi-structured interview and seeks solutions via teacher workshops and an excursion to the seashore.

Teachers mentioned many constraints and school based problems such as time-tabling, teacher attitudes, lack of ethos, lack of funds, large numbers in classes and collectively found useful answers which reduced the emphasis of many of the problems mentioned. Problems such as, the lack of knowledge of the marine environment, limited experience of fieldwork technique and management, could only be solved by pre and in-service teacher education programmes. The workshops produced useful solutions and suggestions for implementation by teachers, education departments and governmental and non-governmental agencies that would assist in making this a reality. These include resource development, teacher networking, peer teaching, in-service and pre-service programmes with a marine emphasis, and funding of appropriate programmes.

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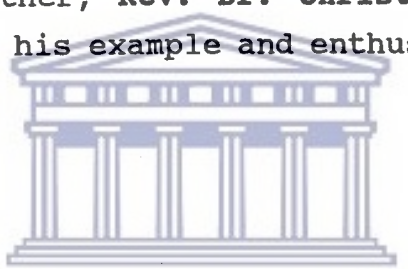
Dedicated to my father, **Rev. Dr. Christian Nelson Reddy (D.Ed)**, who through his example and enthusiasm, engendered a love of learning.



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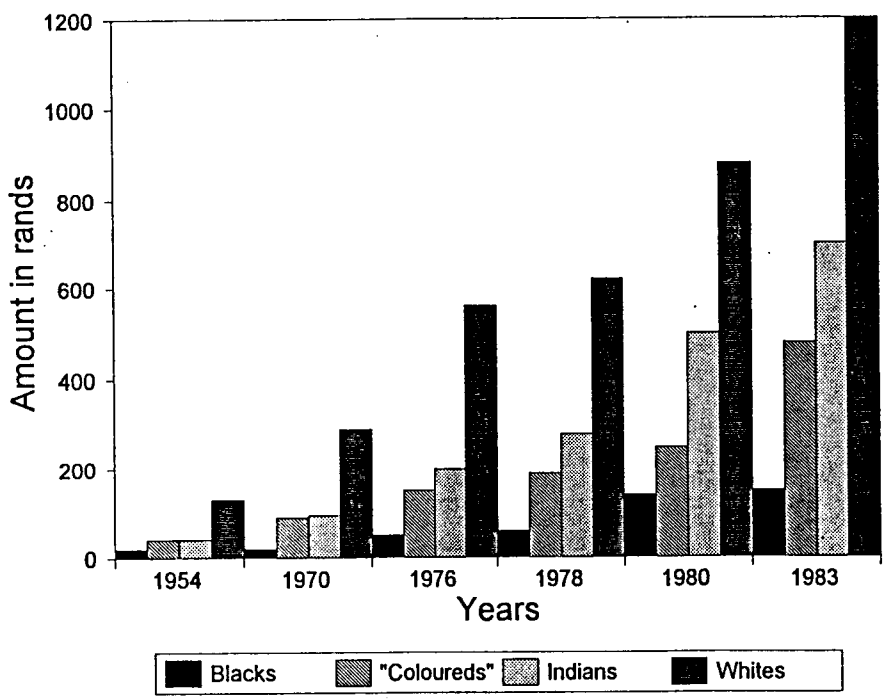
CHAPTER 1 : INTRODUCTION

1.1 BACKGROUND TO THE STUDY.

The present education system, which is a relic of apartheid, has created many problems in schools in South Africa. This political philosophy, which sought to divide and keep people apart along on racial lines, spawned fifteen education departments, each with its own controlling body and budget (Christie 1985). Great disparities exist in the financial allocations to the schools in the different education departments (Figure I), resulting in some schools, notably those in black areas, having meagre resources while other schools are well supplied. Due to a lack of funds, fewer schools were built in traditionally disadvantaged communities, resulting in large student-teacher ratios and general overcrowding. Since education was used to entrench the ideological policies of the regime, the state maintained tight control over all aspects of education, including, curriculum development and content (Christie 1985).

FIGURE I . GRAPH OF PER CAPITA EXPENSE IN EDUCATION IN S.A. 1954 - 1983. (After Christie (1985).



Traditionally curricula have been designed by people outside the teaching body (scientists and University academics not in regular contact with schools), with varying degrees of research and consultation. In this "top down" mode of operation, commonly referred to as the RDDA model (Research, Developement, Dissemnation and Adoption), central planners and so-called "experts" determine the curricula of schools (Figure II). The syllabus documents produced, are then sent to schools for implementation.

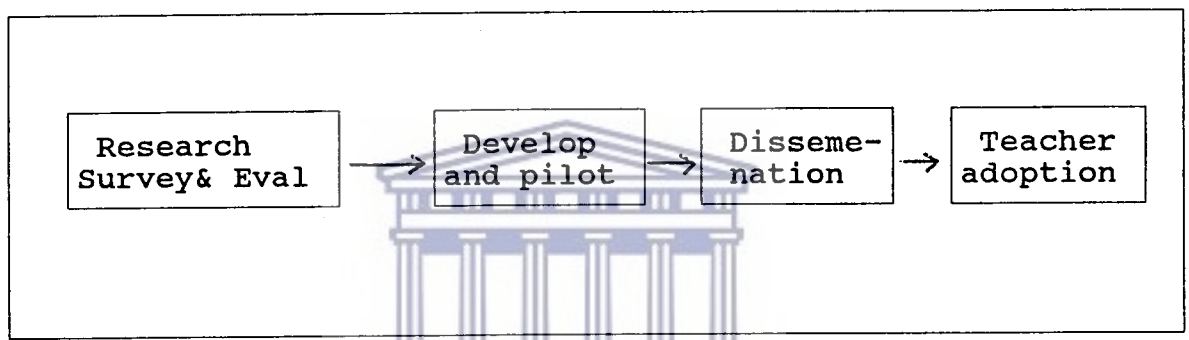


Figure II Scheme of RDDA METHOD OF CURRICULUM DEVELOPEMENT. (After Mcnaught et al (1990) in Bannerman et al 1990)

Two features of the RDDA model are: 1) it is relatively quick to implement, and 2) that it produces a degree of uniformity of action throughout the receiving schools. The system has many flaws and its application has met with limited success world-wide, Popkewitz in O'Donaghue (1989).

Experience has shown that the RDDA model is not always well adopted by teachers, and implemented with varying degrees of support, Pillay and Naidoo (1991). They contend that this approach has to a large extent deskilled and disempowered teachers, reducing them to technicians who have to implement pre-designed syllabi and curricula unquestioningly. Furthermore, documents produced in this way are often irrelevant and out of context, further

hampering effective application by teachers.

It is under this education system and political conditions which ecology (Table I) was introduced into the Senior Secondary (Std 8) Biology syllabus (Appendices I and II). Teachers were not were consulted before this section was included in the Biology syllabus. The inclusion of ecology into the Biology syllabus presented problems for Biology teachers in many schools.

TABLE I : SUMMARY OF THE STD.8 ECOLOGY SYLLABUS.
(After Wagiet 1991)

	SUB-SECTION OF ECOLOGY SYLLABUS
1	Practical study of an ecosystem with emphasis on the relatioships between its components.
2	Abiotic components: (physical,edaphic, physiographic).
3	Biotic components: producers, consumers, decomposers.
4	Biological rhythms.
5	Symbiotic relationships.
6	Trophic levels.
7	Nutrient cycling.
8	Biosphere.
9	Ecosystems: Aquatic and terrestrial.
10	Humans and the ecosystem.
11	Conservation of indigenous flora and fauna.

One of the main problems was that teachers had a lack of theoretical knowledge about principles of ecology. This is largely due to the fact that many teachers were not

exposed to theory of ecology during their pre-service teacher education. A survey of Biology teachers (Wagiet 1991), found that 71% of teachers canvassed received preservice tuition in ecology. The majority of respondents (university and training college graduates), however indicated that the tuition received in ecology theory, did not equip them adequately for teaching ecology at schools. From this it appears that many teachers are inadequately trained for teaching ecology and it comes as no surprise that this section presented teachers with problems.

Fieldwork is another area in which pre-service training leaves much to be desired, and which has lead to problems in the teaching of ecology. Only 52% of teachers surveyed by Wagiet (1991) stated that they were exposed to fieldwork during their pre-service teacher education.

The educational value of field trips and education out of doors have been argued by many educators. Smith et al (1963)pg 35, summarise the unique contributions of the outdoor setting to learning, Nightingale (1978) in Opie (1989) identifies a list of reasons why fieldwork is crucial to the total educational experience. In summary they contend that educational experiences in the outdoors contribute towards the enrichment of classroom learnings and add realism to the educative process. Klepper (1990) further states: "getting students out into the field provides an invaluable learning experience, one without substitute because it presents students with a hands-on, minds-on science lesson."

Further positive arguments for fieldwork are well documented in the literature. These include (Klepper 1990) who states, "there is no substitute for hands on experiences, and an afternoon or a weekend that allows students to observe nature- plants and animals in their habitats, interrelationships in a community, abiotic

factors and other ecological concepts- is more worthwhile than a lecture series in a classroom". Opie (1979) indicates that fieldwork was found to encourage a good working relationship with both pupils and parents. Openshaw and Whittle (1993), mention that a field course contains a variety of learning experiences, which include, classroom and laboratory work, fieldwork, project work, research in the library and other resource areas, seminars and tutorial help. They also mention that many authors have reported that this learning environment (outdoors) can increase interest, raise the level of enthusiasm and pose problems worth solving, often with interesting outcomes.

There is some evidence that field teaching can affect and modify values, encourage cross curriculum skills and provide an active "hidden curriculum", Openshaw and Whittle (1993). Klepper (1990), states that a field trip can arouse an awareness and an appreciation for nature that young people can cultivate for a lifetime, and that a field trip may be the greatest contribution toward forming a responsible adult who is aware of the need to preserve and conserve the environment. Openshaw and Whittle (1993) state that ecology without fieldwork is like medical training without an internship.

Nightingale (1978) in Opie (1989), and other educationists, have expressed the need for fieldwork to be an integral part of the teaching of ecology. Personal experience of teaching ecology, and communication with colleagues, confirmed the need for "hands on", practical projects and real life examples which field work can provide, for teaching this sub-section. The selection of suitable sites, relevant to the student's experiences, accessible to schools, and suitable for teaching has not always been easy.

During post graduate study, exposure to the marine environment alerted the researcher to the ecological "treasure house" which existed in the intertidal zone of the rocky shore. Keats (1991) described the South African seashore as an "under-utilised natural laboratory." Archer-Thompson (1991) lists the following attributes which makes the intertidal zone of the rocky shore suitable as a resource for ecology teaching :

1. Naturalness
   Rocky shores are to a large extent unspoilt natural areas.
2. Accessibility
   Rocky shores are within striking distance of most people.
   No specialised equipment and skills are needed and few problems exist with land ownership.
3. Variety
   Richness and diversity of species.
   Compression in space : Variation of organisms occurs over small areas.
4. "User friendly"
   Sizes of animals and plants are convenient to handle.

Despite the excellent attributes of this ecosystem, preliminary research (interview data) and personal experience, indicated that many teachers in the Western Cape were not going to the seashore on field trips. This prompted the research questions which formed the foundations of this project, viz. why are many teachers not going to the seashore ? What are the perceived problems ? Would teachers like to go and how do they envisage to overcome or find solutions to the problems or constraints by which they are presently hampered ?

As a discipline, biology is characterised by various orientations, and the teaching of, and approaches to

biology are constantly changing. Since the project is involved with the teaching of ecology, which is treated as a sub-section of biology in South African schools, it is felt that a discussion of current practices and debates concerning biology teaching/education would be appropriate at this stage.

Generally, the approach to ecology teaching has been the same in many countries of the world for a long time. Ecology is viewed as a discrete entity within or a sub-section of Biology and, involves mainly the discussion of relationships between organisms and their environment (Harper 1982, Kinchin 1993, Schreuder 1991, Uma 1988, Wagiet 1991). Harper (1982) calls the ecology sub-section of the biology syllabus, a "rag-bag" of loosely related topics linked by little more than the word "ecology".

Teaching of this sub-section is often coupled with syllabus related fieldwork and practicals. These field exercises are often inadequate with many being done in what Seamen (1993) calls, the "old" way, involving mere descriptions of the environment. Oppenshaw and Whittle (1993) also found that very few schools apply an experimental approach to fieldwork, reducing these activities to mere counting and measuring exercises. Changing trends in society, the deepening environmental crisis, and a shift in emphasis in education has resulted in this approach to ecology teaching being questioned, and new trends and suggestions emerging from the debates.

A prominent trend is the theme approach advocated by Harper (1982) and mentioned by Degenaar (1986) and Van Rooyen (1990) in Loubser (1993). This basically involves ecology serving as a thread or theme which links various aspects of the biology syllabus as opposed to ecology being a separate entity within the biology syllabus. The ecological aspects and significances of processes such as

photosynthesis are highlighted and discussed when these topics are handled. Examples of suggestions by Harper (1982) include teaching respiration with energy flow, photosynthesis with food chains and reproduction with population dynamics. Hale (1991) advocates that ecology should be seen as an "integral part" of broader based environmental studies. She states that ecology, by emphasising the understanding of processes and the interactions between organisms and their environment, can form the scientific basis for field investigations in schools. A range of skills and other subject disciplines can be incorporated or lead from such field investigations. Van Rooyen (1990) in Loubser (1993), maintains that unitary themes supply structure to a discipline like biology.

More recently (in SA at least), the prominent call is for the natural sciences to be taught along Environmental Education (EE) principles. EE is a complex topic open to various interpretations and riddled with misconceptions. A definition of environmental education as developed by the International Union for the Conservation of Nature and Natural Resources (IUCN) in Schreuder (1991) follows

> " Environmental Education is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings. Environmental education also entails practice in decision-making and self formulating of a code of behaviour about issues concerning environmental quality". (Carson 1978:viii)

Many other definitions have appeared subsequent to this but show mainly nuancial variations to the one above. Although the philosophy and approach to environmental education has changed and evolved with time, the guiding principles for

this approach to education have always been the Belgrade charter (1975) and the Tiblisi principles (1978), (Appendix III). These guidelines have been used as the basis for the implementation of environmental education programmes in many countries. Some of the arguments and debates regarding biology/ecology teaching, relate to the principles of environmental education as outlined above.

The cross-curricular approach to ecology teaching has been advocated by many authors (Adams and Greene 1990, Hale 1986, Hale 1991, Harper 1982, Tyldesley 1990, Van Rooyen and de Beer 1994). This is basically an integrative approach which involves breaking down the artificial divisions between and teaching topics across many disciplines. Adams and Greene (1990), suggest that teachers should be able to teach natural resource issues in terms of political, economic and cultural as well as ecological, considerations. Baines (1983) feels students will only understand human use of the environment if they also study the relevant social, economic and political factors. Hale (1986) recommended that ecology serve as a central theme which can enhance the application of other disciplines. Gorham (1990) feels that ecology can provide a bridge from the sciences to the social sciences and help students to understand their own actions. Reynolds (1992) considers the teaching of environmental knowledge only under the headings of Biology or Geography as an "outdated notion". She mentions that it is now recognised that teaching pupils about the environment can be undertaken under all headings whether it be Art, Mathematics, Literature, Science, Drama, Language or Biology. She indicates further "I believe the oceans are under-exploited in terms of themes which they can provide for teaching all subjects."

The issue based-approach to ecology as suggested in (Adams and Greene 1990, Evans 1988, Hale 1991, Seamen 1991, Schreuder 1991, Watson 1990), is another method which fits

in with the environmental education approach as set out in the Tiblisi principles. This approach to teaching makes for greater relevance in biology/ecology syllabi as it addresses ecological problems and issues and does not only concentrate on the content of ecology syllabi. Relevant issues for discussion, around which questions can be formulated, abound in ecology: pollution, environmental degradation, habitat destruction and many others. These can often be traced back to human activity, Schreuder (1991) and thus provides relevance to the experience of the student. Russel (1988) feels that science students should encounter contextual problems as mentioned above because not only will it improve their scientific skills, but it will also help them gain insight as to how their work fits into a broader culture.

In South Africa the value of EE has been recognised by educators for a long time. The department of environmental affairs published the white paper on EE in 1989 and EE has subsequently been the topic of many conferences, seminars and workshops, research papers and many projects have had an EE focus. The approach to EE in South Africa has evolved in keeping with international trends and today features high in the current education debate in this country.

Although many educators have highlighted the value of EE for South Africa, and others hinted for an environmental approach to school syllabi, it has not become official policy in education departments, Loubser (1993). Environmental education has largely been implemented informally, mainly by non-governmental agencies, conservationists and individuals. The recent conference at Dhikollolo spearheaded by the Environmental Education Policy Initiative (EEPI), discussed ways in which EE could be included in the formal curriculum of schools, and this augurs well for the future of the EE approach for South

African schools.

1.2 AIMS OF THE RESEARCH.

The aim of this research project is to try to identify and resolve the perceived problems with field trips to the marine environment and in doing so, to make the seashore (rocky intertidal zone) more accessible to teachers and to encourage teachers to take pupils on field trips to the seashore to teach the principles of ecology. It is also hoped that the exchange of ideas during the discussions and suggestions of teachers emanating from the research project, will serve to improve the teaching of ecological and general biological principles.

The main aim was to determine the attitudes of teachers concerning the possibilities of the intertidal zone, and then together with teachers, to find solutions to the perceived problems inhibiting them from going on marine field trips. The findings of this project are seen as the first phase of an action research cycle which will be reviewed, evaluated, improved and amended as deemed necessary by the participants in the research group, in further research cycles or spirals (See Action Research methodology Chapter 3).

1.3 LOCATION OF RESEARCH

The research was done in the Western Cape. The twenty-six teachers who were contacted are employed at schools in various locations in the Cape Peninsula. Most of the schools from which the teachers were selected are located on the Cape Flats, some of the schools are located close to the seashore and others within easy reach, either by private or public transport (train and busses).

Most of the schools involved in this project fall under the auspices of the Department of Education and Culture, House of Representatives (HOR). Three teachers

were from the House of Assembly (HOA) and one from the House of Delegates (HOD)[1]. The selection of teachers and schools from different Education departments was unintentional (not for comparison), but did assist in giving a broader perspective to the project, and helped to make the sample somewhat more representative of the teachers in the Western Cape.

A workshop was held at Oaklands High School, in Lansdowne, the school at which the researcher works. This venue is fairly centrally situated off a major freeway and participants found no difficulty in reaching the school in time for the start of the workshop.

A field trip was undertaken to the Dalebrook Marine Reserve on the False Bay coast. This site is commonly used by educational institutions as it is conveniently situated, easily accessible (eg train station nearby), and it offers a variety of marine life.

1.4 STRUCTURE OF THE STUDY

The method followed involved a three stepped process

1. A semi-structured interview to assess:
   - 1.1 whether teachers were using the marine environment.
   - 1.2. whether teachers found it a useful and viable proposition and would like to use it.
   - 1.3. the perceived constraints teachers felt prevented them from taking classes to the seashore. (See Appendix IV for detailed copy of the interview schedule).

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[1] Tricameral system of parliament: Three houses of parliament for different "race" groups each with its own education department. HOR "Coloureds", HOA "Whites", HOD "Indians"

2. A workshop was organised to :

2.1 provide a forum for teachers to discuss the issue of the possibilities of the marine environment for teaching ecology

2.2 collectively discuss and look for solutions to the perceived constraints which came out in the interviews.

3. A site visit and report back discussion. This included:

3.1 Activity on the seashore : Worksheet of Heathfield High. (Appendix V).

3.2 A report back session during which possibilities and future plans were discussed.

This excursion was planned to test some of the recommendations made during the workshop and to discuss the teachers first hand experiences at the seashore.

The reasons for following the steps outlined above and the chosen methodology, is discussed in more detail in Chapter 3.

1.5 THESIS PLAN: OUTLINE OF CHAPTERS

Chapter 2 looks at relevant research and the work of organisations and institutions involved with activities related to the marine environment. The research method and instruments employed in the survey of teachers, are described in Chapter 3. The results of the research and the data collected are presented in Chapter 4. Chapter 5 discusses of the results and Chapter 6 deals with the conclusions and recommendations emerging from them.

CHAPTER 2. AN OVERVIEW OF MARINE ENVIRONMENTAL EDUCATION IN SOUTH AFRICA.

2.1 INTRODUCTION

This chapter is devoted to academic projects and resource materials on the marine theme. Most of the work relevant to the marine environment is done by organisations and institutions throughout the country. The researcher relied heavily on articles in local journals and popular publications, as not much has been documented about local projects of a similar nature in academic literature. The literature and projects are reviewed in terms of their value to teachers and educational institutions.

2.2 RESEARCH AND PROJECTS

Opie (1979) introduced an alternative method to Biology teaching to promote affective learning in high school pupils. His project introduced field work in the rocky intertidal zone as an alternative to class or laboratory work. He substituted marine animals in place of the other animals specified by the syllabus and advocated a "hands on" approach to the subject. He chose the rocky shore to test his hypothesis as he felt it represented, "a real life situation that promotes relevance and the challenges that promote positive attitude formation if correctly channelled" (Opie 1979). One of the aims of the project was to realise the aims for environmental education in terms of the following definitions :

"Environmental Education (EE) is concerned with developing informed attitudes of concern for environmental quality" Swan in Opie (1979)

"EE is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relationships between man, his culture and his biophysical surroundings. EE also entails practice in decision making

and formulation of a code of behaviour about issues concerning environmental quality". Hinton and May (1973) in Opie (1979).

In choosing the seashore as the setting for this project Opie indicates the possibilities and importance he attaches to this environment for education, especially the teaching of ecology.

A spinoff from Opie's project was the production of a comprehensive teachers manual for the rocky shore, and other rocky shore related booklets (eg. The Mighty barnacle, 1979) by the same author. Many of these references are still in use today, and form the basis of resource materials for teachers who take classes on field trips to the rocky shore.

The Naturalist society (NATSOC), an ecology based organisation of teachers and members of the public conducted a project to promote awareness of the marine environment in general, and as a teaching resource. This involved the production of a series of work sheets and arranging site visits for teachers, to test the materials produced. The researcher attended the series of workshops. The initiative taken is commendable in the absence of any official policy of in-service training.

The lack of implementation and use of the resources developed, can only be attributed to the manner in which the whole affair was conducted: top down, no teacher involvement in the process and consequently poor adoption and implementation. It is also felt that the lack of knowledge of teachers was not taken into account leading to many teachers being overwhelmed by the variety of marine life at the seashore.

The continuous low-level environmental observations (CLEO), project was developed by the Division of Earth, Marine and Atmospheric science and Technology of the CSIR (Council for Scientific and Industrial Research). The main objective is the "judicious management of our coastline", Heineckin (1992). Voluntary observers are trained and supplied with equipment (kits for monitoring various environmental factors), to record a variety of environmental factors at predetermined sites along the coast. The data generated are processed and analysed by a computer programme which was designed to handle this information. A regular newsletter will keep CLEO observers up to date with developments in the programme, Heineckin (1992).

The CLEO programme provides students in schools with an ideal opportunity to gain "hands on" experience in collecting scientific data. The exposure to a dynamic natural environment, can lead to a better understanding and appreciation of natural processes. The only unfortunate aspects from an educational viewpoint is that the data is processed in computers by other people and the that the observable trends of the processes, in most cases, are long term. Another problem for schools is that the equipment needed for the observations has to be bought and it is quite expensive, making it accessible only to schools in more affluent communities and thus excluding the majority of school pupils.

At the annual conference of the Environmental Educators Association of South Africa (EEASA), held in Windhoek 10-12 July 1991, a workshop was organised to ascertain what marine environmental education initiatives were operating in the country and elsewhere (Ashwell 1991). The aim of the workshop was to address the following needs: People involved, places where marine projects are operating, publications produced and what needs exist in

marine environmental education.

The above were addressed during the workshop which was attended by a number of individuals. An address list was compiled and publications and resources were displayed and shared. A number of approaches used on field courses were also discussed. Many people expressed the need for support materials, especially those people from inland areas. People were keen to know what additional marine resource materials were available (slide shows and videos).

Two important decisions emerged from the workshop. It was decided to: 1) circulate the address list compiled and 2) to produce and circulate a booklet that would include a list of people and information about resources and publications relating to the marine environment. To date this has not materialised largely because the original facilitators of the workshop and most of the participants in the workshop have changed residence and places of employment. The researcher, who was one of the participants in the workshop, is hoping to try and pursue the initiatives started at the Windhoek workshop in 1991, at the annual EEASA conference in June later this year.

2.3 INSTITUTIONS

A variety of resource materials are produced by governmental and non-governmental institutions (Appendix VI). The resources are varied and include posters, work sheets, identification sheets and various activities and games. They are suitable for use on a variety of marine settings such as sandy and rocky shores, dunes and estuaries. Most of the materials are readily usable and easy to understand. Many pamphlets which are aimed at the general public, are also produced.

With some exceptions, most of the resources seem to be developed without consulting the users. The

institutions develop what they think the teachers and other users need and these people do not form part of the development process. Most institutions do not address the lack of theoretical knowledge which most teachers have concerning this ecosystem. Examples of such resources include marine day posters, worksheets for the seashore, envirofacts handouts and others. In the Cape Province, the institutions involved with marine matters and what they offer or produce, are not known to many teachers (Preliminary research :Interview data). Sadly, resources developed in this way are often out of context and rarely used by those for whom it was intended.

Collaborative resource development is becoming standard practice for many institutions. This approach was pioneered by the Share-Net organisation in Natal. In contrast to the above, teachers are directly involved in resource development, and form part of the project from the start. All materials produced are available to any teachers at minimal costs. Improvements and suggestions from users are fed back into the system and all materials produced are constantly evaluated and upgraded in this way.

2.4 MAGAZINES AND JOURNAL ARTICLES

The marine environment has been featured in many popular publications, with many producing special marine editions (Archemedes Vol 34 1992 , Veld and Flora Vol 77 (4)1991, Enviroteach No 3 1992). Articles vary from the dangers of marine pollution, the importance of the seashore in general ecology to possible consequences of bad coastal management. Magazine articles have also highlighted the importance of sensible attitudes to the marine environment.

Many articles also focus the educational value of this ecosystem. The marine environment has been highlighted as a solution to problems on field trips with large classes

Lubke and Avis (1992). This is one of the common problems mentioned by teachers in connection with field trips in a variety of research projects. Tips and ideas for teachers, such as interesting, "hands on" methods coupled with later project work at school, Ashwell (1992), are also featured regularly. Renolds (1992) makes a strong case for inclusion of marine studies in the school curriculum and expresses surprise that it is not already there. These clearly indicate the viability of this environment for teaching principles of ecology to school students.

The researcher was unable to access resources regarding research into marine environmental education in academic literature. The marine environment is however getting maximum exposure in a variety of popular and semi-scientific publications. This is good as it heightens awareness of the general public, and helps to address the need for more knowledge about this environment amongst many educators and lay people.

CHAPTER 3. RESEARCH METHODS AND METHODOLOGY

3.1 RESEARCH METHOD AND DATA COLLECTION

The research was planned as a survey of Biology teachers who teach ecology to Std. 8 pupils and involved the following stages:

1 Semi-structured interview.
2 A workshop at oaklands
3 Site visit & report back

The different stages inform each other, resulting in a process of data transfer. Aspects of the interview findings formed the basis of discussion at the workshop, and suggestions from the workshop were tested and discussed during the excursion. Qualitative research methods of data collection were considered to be most appropriate for the nature of the project. Qualitative research is being used increasingly in local school (Wagiet 1993) and field (Schultze 1992), based research projects.

Qualitative research has the aim of understanding experience as nearly as possible as its participants feel it. Qualitative implies, "a direct concern with the experience as it is lived, felt or undergone" Sherman et al (1984). As qualitative researchers direct their attentions to the meanings given to events by participants, they come to understand more than what a list of descriptions or a table of statistics could support.

Sherman et al (1988) consider the following criteria essential to qualitative research :

1. Focus on context
2. lived experience, patterns of experience
3. Judging or appraisal.

They further state: "in this kind of research, studies grow out of questions researchers ask about people in specific contexts". In this project, the research question arose out of the daily experience of the researcher, it tries to ascertain the feelings and views of colleagues in the same situation, attempts appraisal of ecology teaching in schools in the Western Cape (context).
The project undertaken fulfils the criteria for qualitative research, as it touches on all the aspects mentioned above.

Further justification for using qualitative research is found when comparing it to the aims and results quantitative research. Kincheloe (1991) states, "Qualitative research is distinguished from quantitative research in that quantitative research is concerned with frequency while qualitative research is concerned with abstract characteristics of events". Schratz (1993) further argues that, "educational research based on quantitative measurement, variables, experimentation and operationalization, usually transfers the original 'voices' of its subjects into statistical data, mathematical relations or other abstract parameters. Therefore very little is left of the social context in which the research occurs". Qualitative research on the other hand emphasises the vital "human factor" and preserves the social context of the research setting. Van Maanen et al (1982) in Schultz (1992) regard quality as the essential character of something and quantity the amount, and see quality as the what and quantity as how much. They add that "qualitative research wants to describe what is occurring in a given place at a given time." Since the methods of enquiry must be appropriate to the aims of the research, it was decided to follow the methodology of action research in this project.

Although the term action research was coined in the 1940's in America, a comprehensive definition of the method is difficult because the usage varies with context (time, place and setting). Halsey (1972) in Cohen and Manion (1979), describes action research as follows;

"action research is a small scale intervention in the functioning of the real world and the close examination of the effects of such an intervention".

Carr and Kemmis (1986) define action research as follows;

"... simply a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out".

A more complete definition from the participants in a National Invitational Seminar on action research held at Deakin University, Victoria, Australia in May 1981 describes action research as follows :

"Educational action research is a term used to describe a family of activities in curriculum development, school improvement programmes, and systems planning and policy development. These activities have in common, the identification of strategies of planned action which are implemented, and then sytematically submitted to observation, reflection and change. Participants in the action considered are integrally involved in all of these activities", Kemmis and Carr (1986).

The last definition is comprehensive and captures the "tangible features" of this research methodology, mentioned in Cohen and Manion (1979):

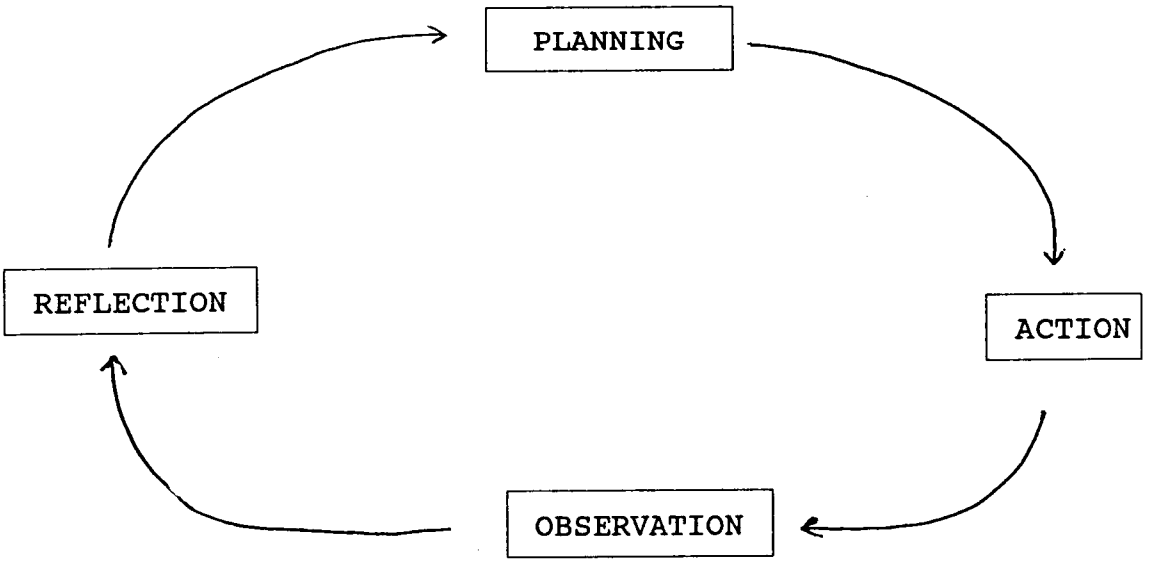
1. Situational: it is concerned with diagnosing a problem in a specific context and attempting to solve it in that context.
2. It is usually collaborative : practitioners and teams of researchers work together.
3. Participatory : Team members take part directly or indirectly in implementing the research.
4. Self evaluative : Modifications are continuously evaluated within the ongoing situation, the ultimate objective being to improve practice in some way or another.

The scope of action research as a method is impressive, and it can be applied in many areas of research. In the educational setting, projects range from simple, single teacher projects in the classroom, to teams of researchers with sponsors. Action research is increasingly being used by those involved with developmental programmes such as school based curriculum development, professional development and school improvement programmes. Many researchers (Carr and Kemmis 1986, Cohen and Manion 1979, Grundy and Kemmis 1981, Naidoo 1991), cite the following as important justification for the use of action research in the context of the school :

1. Improvement of practice.
2. Improvement of understanding of practice
3. Improvement of situation in which practice occurs.

Robottom (1987) describes the method of action research as recurrent cycles of four phases in which the knowledge of one cycle informs the strategic action of the next cycle. The four phases in a cycle are :

Figure III. (After Robottom 1982).



This method was favoured as a *modus operandi* for this research project because it leads to improvement of practice, is collaborative and participatory, and it can lead to professional development of the participants. Another important factor considered was that it leads to teacher empowerment: "it engenders in teachers the belief that they have a meaningful contribution to make to their situation, and that the teacher is capable of finding solutions to problems faced", Pillay and Naidoo (1991).

3.2 RESEARCH TOOLS

3.2.1 THE INTERVIEW

"Interviewing is a good way of finding out what the situation looks like from other points of view ", Elliott (1991).

This definition fits in with the notion that "qualitative researchers want those who are studied to speak for themselves" (Sherman et al 1988). Interviews are varied in their application in the broader context of life, and are used in a variety of situations. All forms of interview, in whatever context, has the common denominator

of one person seeking information and another providing information (Cohen and Manion 1979).

In the context of this research, the semi-structured interview schedule was employed as a means of gathering data from teachers. This involved the use of an schedule of questions which served as a guide during the actual interview session but which was flexible enough to adapt to varying responses of the interviewees. The interview questions included mainly open ended items which Kerlinger in Cohen and Manion (1979) defined as "those that supply a frame of reference for respondents answers, but put a minimum of restraint on the answers and their expression". Some important advantages and features of open ended questions highlighted by Kerlinger are :

1. they are flexible and allow the interviewer to probe if necessary
2. help to clear up misconceptions
3. Allow the interviewer to test the limits of a respondents knowledge
4. Encourage co-operation and helps to establish rapport
5. Allow the interviewer to make a truer assessment of what the respondent really believes.
6. May result in unanticipated or thought of responses which may suggest unthought of relationships or hypotheses.

These features were strongly considered when the interview questions were drawn up because they suit the type of enquiry required for the research.

Moses and Khan in Bell (1979), describe the survey interview as "a conversation between the interviewer and respondent with the purpose of eliciting certain information from the respondent". This they continue, might

appear to be a straight forward matter, but the attainment of a successful interview is much more complex than this statement might suggest. Many factors, notably bias, influence interviews, and can cast reflections on the validity of the results.

Cohen and Manion (1979) define bias as, "A systemic or persistent tendency to make errors in the same direction, that is, to overstate or understate the true value of an attribute." There is always the danger of bias creeping into interview thus distorting the findings.

Many factors serve as sources of bias and are difficult to eliminate altogether. These include the characteristics of the interviewer and characteristics of the respondent. Selltiz (1951) in Bell (1979) points out: "interviewers are human beings and not machines and their manner may have an effect on the respondents." Eagerness of the respondent to please the interviewer and an antagonism that sometimes arises between the interviewer and the respondent Borg 1981 in Bell (1979). Cohen and Manion (1979) further include, attitudes and opinions of the interviewer, a tendency for the interviewer to seek answers that support his preconceived notions, misconceptions on the part of the interviewer of what the respondent is saying, misunderstanding on the part of the respondent of what is being asked. Gavron (1966) in Bell was conscious of the danger of bias when she wrote " It is difficult to see how this (i.e bias) can be avoided completely, but awareness of the problem and constant self control can help."

The possibility of bias creeping in was always a consideration in this project and uppermost in the mind of the researcher at all times. In attempting to avoid this, the interview schedule was piloted with teachers before

hand so as to eliminate any ambiguity in the questions and the interview schedule remained as flexible as possible. The entire interview was recorded on audio cassette, so as not to loose any information. The fact that the survey needed to know the "feelings" of teachers with a view to seeking answers to the perceived problems, also helped to avoid too much possibility of personal bias creeping in.

Data collection by the method of interviews represented only one phase of the project and was therefore not pivotal to the research. The entire research project is only one cycle or spiral of the research, the data and recommendations of which will be subjected to later evaluation and revision.

The sample consisted of 18 teachers in senior secondary schools in the Cape Peninsula. The teachers were personally approached at schools in various locations and the sample consisted of teachers selected for their "typicality", (Std 8 Biology teachers), described as "purposive" sampling in Cohen and Manion (1979). The small sample is defended by the fact that the researcher sought answers in a specific context and was not looking for generalisable knowledge.

The interviews were conducted at school venues, in locations free from disturbances and noise. All interviews were conducted at times set by the respondents as the researcher is mindful of the demands made on teachers both professionally and in their private lives.

3.2.2 **WORKSHOP**

The second phase of data collection took place at a teachers workshop held at Oaklands High school on the 8 October 1993. Teachers were informed about the intended workshop during the interview sessions and those who agreed to attend were sent a letter detailing the arrangements

(Appendices VII,VIII,IX). The purpose of the workshop was to create a forum for teachers to collectively discuss and attempt to find solutions to common problems experienced. The workshop focused on the constraints inhibiting arranging of marine field trips, expressed by the teachers during the interviews.

The workshop method was chosen because of its suitability to the aims of the research. One positive aspect of workshops is that people engage and interact with each other more freely in smaller groups, facilitating the exchange and flow of ideas. Workshops also bring together people from different backgrounds, with different areas of expertise together and thus facilitate "cross pollination" of viewpoints and ideas.

After a brief introduction, participants were divided into groups of six each, and a facilitator was designated in each group. The role of the facilitator was to co-ordinate the group and to keep discussion as relevant as possible. The discussions of each group were recorded on audio tape. After approximately ninety minutes of discussion a general report back (plenary) session was held, during which the different groups presented a summary of their discussion. The proceedings were again recorded on audio tape.

Workshops have many positive features but also have some drawbacks. One of the problems experienced during the workshop was the limited time available for discussion. All the groups however managed to cover all the points set out for discussion, although some were not discussed in great detail. There is always the possibility of one person dominating the discussion or the facilitator may steer the discussion in a direction which favours his/her viewpoint. The results seem to reflect that the above fears are unfounded.

3.2.3 **EXCURSION**

An excursion, which took place 10 October 1993, was arranged for two important reasons :

1. to test recommendations emanating from the workshop through of a planned activity at the seashore.
2. to discuss the activity and plan possible future strategy using the seashore for ecology teaching.

The excursion served an important role of providing those teachers who have never gone to the seashore on a field trip, with first hand experience of the intertidal zone. Resource materials relating to field trips and the marine environment were on display in the hall during the workshop which followed immediately after the excursion. Teachers could browse through these and discuss field trips with those who had experience of it.

Discussion at this workshop concentrated on what could be done to make marine field trips a reality and future strategies for the research project. The proceedings were recorded on audio tape and are summarised together with all the other data in the next chapter.

CHAPTER 4: PRESENTATION OF DATA

As explained earlier, the project involved a three step process of data collection : Interviews, workshop, excursion and report back discussion. The research data of each stage will be dealt with individually.

4.1 INTERVIEWS.

4.1.1 INFORMATION OF SAMPLE GROUP.

The sample group consisted of 18 teachers from schools in the Western Cape. The teachers are employed in different education departments and have varying years of teaching experience. The composition of the sample and some biographical data of the participants (compiled from questionnaire) are summarised in Figures IV, V and VI

FIGURE IV: GRAPH OF SPREAD OF YEARS OF EXPERIENCE OF PARTICIPANTS.

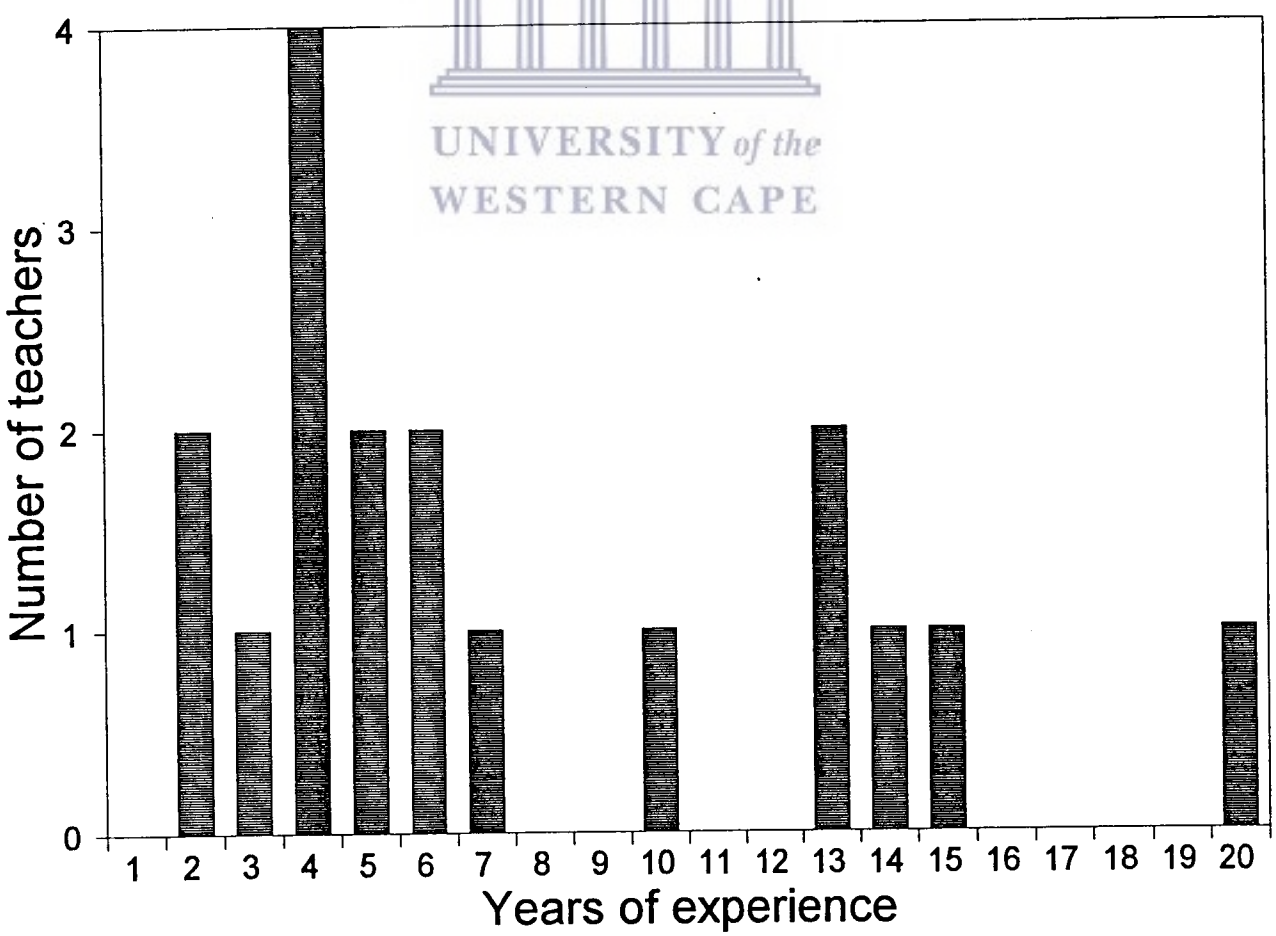
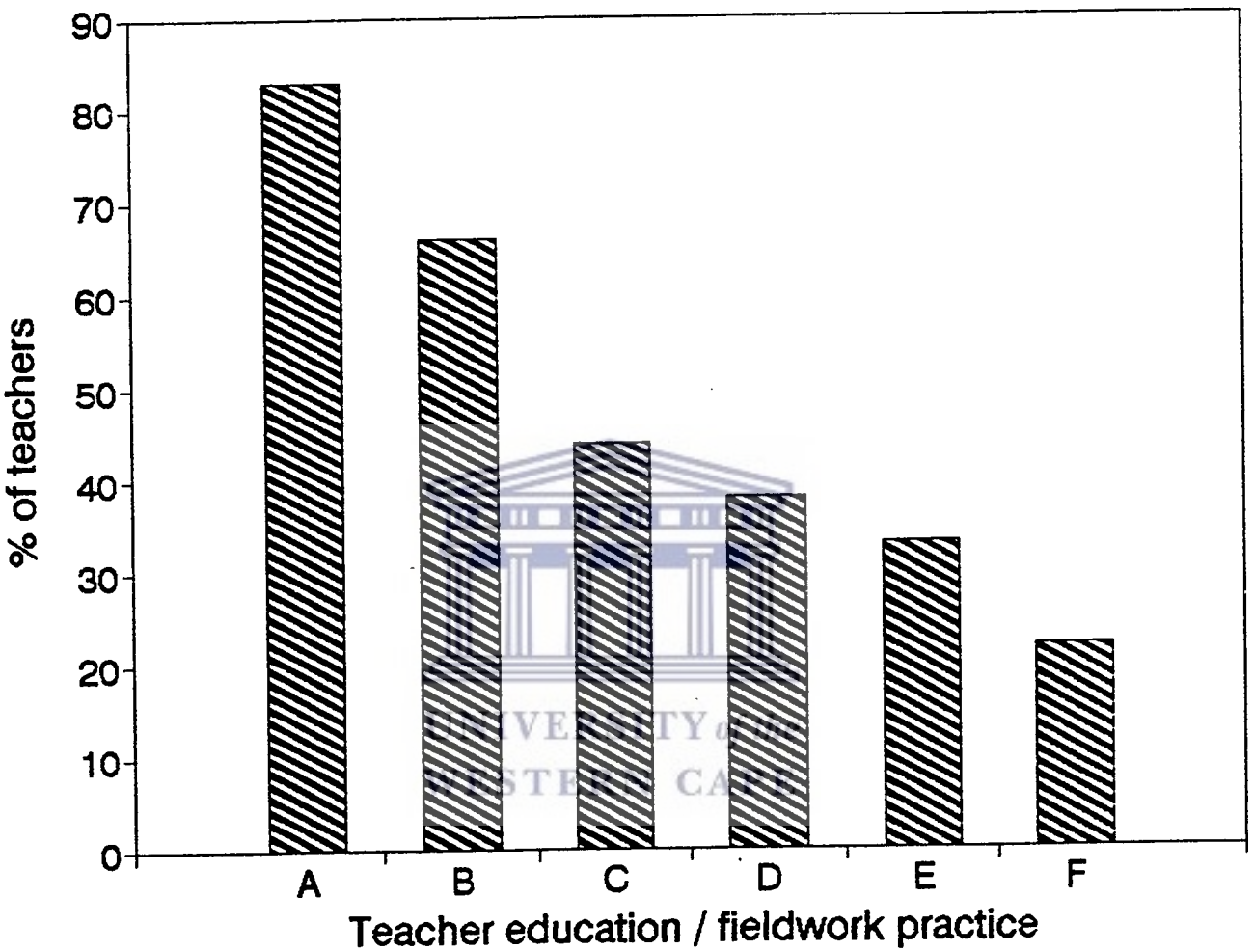
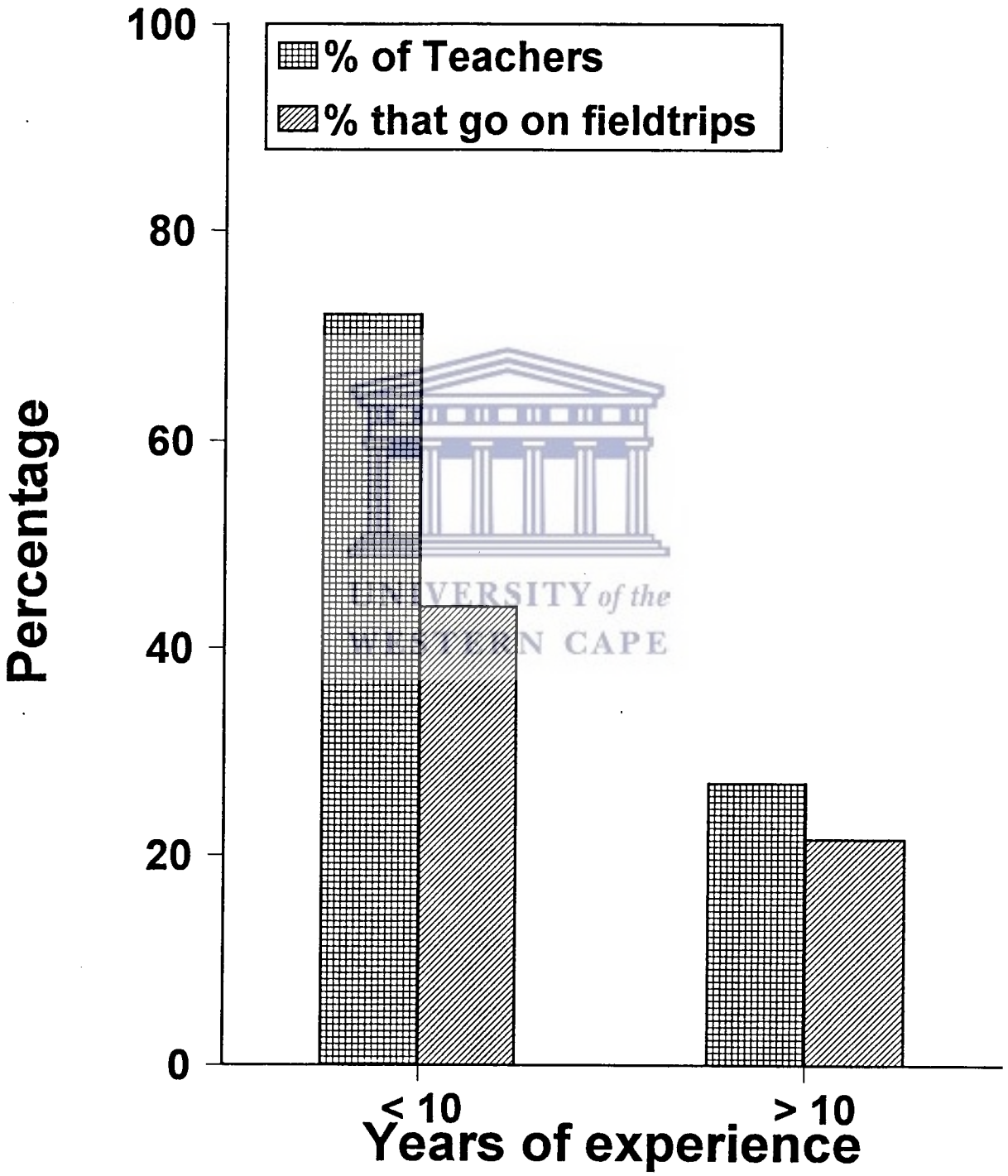


FIGURE V: GRAPH OF TEACHER EDUCATION AND FIELDWORK PRACTICE.



A. Teachers who studied ecology
B. Teachers who do fieldwork
C. Teachers who studied marine biology
D. Teachers who do marine field trips
E. Teachers who studied fieldwork management
F. Teachers who attended in-service programmes

FIGURE VI: THE PERCENTAGE OF TEACHERS WITH MORE THAN AND LESS THAN 10 YEARS EXPERIENCE AND THE PERCENTAGE WITHIN EACH CATEGORY THAT GO ON FIELD TRIPS



4.1.2 **SUMMARY OF INTERVIEWS**

The summary was compiled from audio tapes of the interviews conducted with 18 teachers. The questions of the interview schedule (in bold italics) and a summary of the answers of the participants to each question are presented. The duration of the interviews ranged from fifteen to thirty minutes.

Q. ***What is your main reference or resource for teaching ecology?***

Most teachers use the school text book and syllabus as a guide. Those who did course work in ecology often use their student notes and text books as a resource and the school text book as a guide to the range that needs to be covered.

Many teachers indicated that they digress from the syllabus considerably, when dealing with the ecology section.

Q. ***Do you take students on field trips ?***

12 of the 18 participants take their students on field trips when teaching ecology. All the participants consider field trips important and would like to take students more often. Locations visited included, Kirstenbosch, Rondevlei Nature Reserve, mountain walks, Dalebrook and Clovelly beaches and De Hoop Nature Reserve.

Q. ***Have you ever used the seashore for field trips ?***

Seven of the eighteen participants undertake field trips to the seashore. Six of the seven emphasise basic ecological principles when visiting the seashore. One member of this group concentrates on

12. Human resource shortages : too few teachers available to go.
13. Varying pupil motivation in groups

Q. *Are you aware of any resources regarding the seashore, available to teachers ?*

1. Natsoc (Naturalist society) work sheet package. Two participants from the group assisted with testing this package at Dalebrook beach.
2. U.W.C. slide tape packages
3. De Hoop Nature reserve : Koppie Alleen marine organism guide which it was felt could be adapted for the local shores.
4. Video : Lets look at the seashore.
5. Margo Branch : Seashore activities.

The interviews confirmed that many teachers were not doing field trips to the seashore and highlighted some important problems experienced by teachers. A discussion of the implications of these data follows in Chapter 5.

4.2 WORKSHOP

4.2.1 INTRODUCTION

The workshop took place on the 8 October 1993 at Oaklands High School and was attended by 15 individuals who all arrived on time. On arrival teachers completed the registration, and were then free to interact and socialise while tea was served. Despite the fact that most teachers met here for the first time, discussion was brisk and conducted in a convivial atmosphere. After a brief introduction to the research project, the participants were split into three groups randomly. Each group however included one individual who had already taken students or had been part of a group who takes students to the seashore. The groups each had a facilitator who assisted

with the flow of proceedings of the discussions.

What follows are the transcriptions of the discussions which took place at the teacher workshop. Ross in Sherman and Webb state: "Qualitative descriptions should transport the reader to the scene, convey the pervasive qualities or characteristics of the phenomenon and evoke the feeling and nature of the educational experience." In reporting the discussions which took place at the workshop, the researcher has tried to stick to this recommendation as far as possible.

The groups were asked to discuss the perceived constraints teachers felt were inhibiting them from engaging in field trips to the seashore. The proceedings were recorded for each group and for the plenary (report-back) session. This method ensured that a fairly comprehensive recording of the proceedings of the workshop was captured on audio tape. During the report-back session, the summary was compiled as follows : A spokesperson for a group reported on the discussions of that group and spokespersons for the other groups then only added the points which were not mentioned, or which they stated or saw differently. This method prevented unnecessary duplication and expedited matters considerably.

The summary of the proceedings which follows was compiled from the audio recordings of the individual groups, as well as the report-back session.

4.2.2 WORKSHOP DISCUSSIONS

The approach was to discuss the perceived constraints with a view to finding solutions to them. The answers to each constraint mentioned are summarised separately. As

there are similarities among some of the problems, some of the suggested solutions are repeated where it is appropriate to do so.

1. Large numbers of students

The general suggestion here was to involve more staff members and others to assist with discipline and student control on excursions. This could be teachers from any subject, not just the Biology department. Even parents could assist on excursions involving large numbers of students. The participants also felt that where numbers are large, the students should be taken on excursions in smaller groups spread over more days. With effective planning of dates of trips this could be done with a minimum of disruption to the school programme. There was general agreement in all the groups that large classes are a fact of life and fears were expressed that this could become even worse if the current rationalisation initiatives of the education authorities are pursued further.

2. School programme inflexible.

There was general consensus reached on the fact that this is an internal school problem and that it has to be settled at school level. Suggestions included:

1) Convincing the principal of the school of the importance of field trips and getting him to incorporate time for such activities into the school programme.
2) The Biology departments of schools must develop a policy of excursions and field trips. Biology teachers of the school, should make a strong case for excursions and "sell" the idea to other staff members, hopefully winning their support. Excursions have to be well planned and the other staff members

must be informed of such activities well in advance. Planning should include trying to keep disruption of school programme to a minimum.

The education departments which govern school policy should include field trips into the formal curriculum, thus forcing schools to accommodate it in their timetables and programmes.

3. Financial constraints

Fundraising by the pupils involved featured in all the group discussions. Suggestions included film shows, cake sales at school, and involving local communities and businesses in fund raising and sponsorship.

Another suggestion was that schools should allocate a certain amount of the school fees payed by students to a transport fund. The school can then either pay the full cost or subsidise students for field trips and other outings. In less affluent schools, students should be offered easy payment schemes which start long before the actual field trip.

Subject departments should submit plans and budgets for field trips early in the year so that financial planning and fundraising can be planned accordingly.

4. Accessibility and distance from seashore.

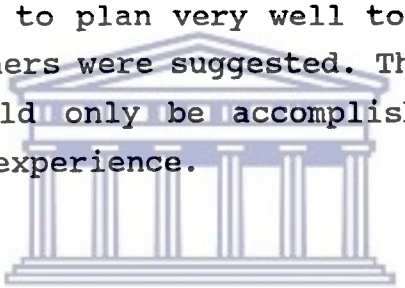
It was generally agreed that this problem tied in with the previous one. Suitable transport has to organised and this requires money. Good organisation and sound financial planning are essential to overcome this problem.

5. Weather and tides

This problem was considered to be beyond human control but some suggestions were made. Tide tables must be consulted when planning field trips to the seashore. It should be borne in mind that spring low tides are ideal for seashore field trips and that these occur every fortnight. It was mentioned that summer drizzles and rains should not be seen as a deterrent, as it is normally temporary, and that it is quite pleasant at the seashore despite the apparently adverse weather conditions.

6. Synchronising theory work with ideal outing times

Teachers have to plan very well to accomplish this. Year and term planners were suggested. The overall feeling was that this could only be accomplished by long term planning and with experience.



7. No co-operation from other staff members

It was recommended that field trips be cross curricular i.e it should include sections of other subjects such as history and geography. In this way teachers of other subjects can be included in the planning and running of excursions. This would ensure their co-operation in these ventures. Teachers of other subjects could be taken along to assist with Biology excursions. This would have the effect of solving the human resource problem and also make the teachers aware of the potential of field trips.

Excursions and field trips should become school policy. Suggestions included convincing the principal of their value and then relying on his influence to get the idea implemented as school policy. The biology departments at schools should make regular excursions part of their

policy and inform other staff members of their plans well in advance.

The biology teachers must argue the educational value of field trips convincingly at staff level. Post excursion projects can be used as tangible evidence of the value of field trips, and could facilitate future activities. This can be used to promote the ethos of excursions at the school and negate the idea that field trips are glorified picnics.

Young teachers who experience problems introducing field trips at established schools where no policy or activity of this kind exists, can start in the holidays or over weekends. Once they are more established at the schools, they can introduce the ideas and request more regular trips and even funding.

It was further recommended that parents be involved in the excursions. They will help to alleviate the management problems related to staff shortages on the excursion. Because fewer teachers are needed on the excursion, parents reduce the disruptive effect at the school. Parents who accompany teachers on field trips can also be used as a pressure group to promote the ethos of field trips at the school through parent, and parent - teacher organisations.

A short term solution can be reached if the education department includes field trips in the curriculum and makes them mandatory activities at school. This would almost force teachers to arrange trips and the school to accommodate this kind of activity in its programme.

8. Limited knowledge of the marine environment

One group made the following suggestion :"Teachers must not be scared to admit limited knowledge." This could provide an excellent opportunity for students and teachers to become co-learners and develop resources collaboratively.

Teachers must network to share knowledge. Networking of teachers can help to spread resources and also assist with refining existing resources or developing new packages. Teachers should get in touch with people who go to the seashore regularly. They could accompany these people on trips and so become familiar with the environment. Teachers could also work with people who have been to a place where they intend going and teachers should get on site experiences and test resources on site.

It was also recommended that teachers go to the seashore regularly to get the feel of environment. They should conduct their own research (collect shells and identify) and in the process develop themselves as a resource. People should go regularly, make mistakes but learn in the process.

Education authorities should have in-service projects which address this kind of problem. Workshops and guided field trips can be conducted on a regional basis to encourage teachers to become involved in field trips to the seashore. It was mentioned that such a system of regional workshops already exists and is working well in the schools in the Education department of the House of Delegates.

Teacher organisations can also play an important role. This can take the form formal structures, subject groups or regional and geographic forums. Get togethers should be arranged to discuss and address the lack of knowledge and resources concerning the marine environment.

Experienced teachers can be freed from school duties and substituted for by other teachers. They would visit schools and advise on issues like field trips, problem areas of the subject matter. The costs should carried by sponsors such as FRD (Foundation for research and development). One group mentioned an Australian example implemented for school based curriculum development. A teacher attends workshops at a University or other institution. This teacher must then run refresher courses at his or her own school and share the expertise at home base. This is a promotion post, but the teacher remains in the school situation and is not lost to an administrative position.

9. Lack or ignorance of available resources

It was suggested that Universities and libraries should inform schools of new books and publications by means of fliers and other information leaflets. These could be posted to schools and other educational institutions.

Teacher forums should be initiated at which resources can be shared. Organisations such as the National Association of Biology Teachers can spread the resources nationally through its newsletters and so make resources accessible to many people. Similar localised subject forums could assist with making resources available to teachers locally. Forums are however hamstrung by a lack of funds, time constraints and the heavy work loads of teachers. Teachers have difficulty in fitting these extramural activities into their crowded normal work schedules. Structures that can ensure the sustainable existence of teacher forums on regional, national or any other basis should be brought into existence.

Workshops and meetings can be arranged for teachers by the education authorities where information can be

disseminated. The system in the house of Assembly Education Department was used as an example. Workshops were held at Stellenbosch University and were attended by selected teachers from various regions. The selected individuals have to carry over the proceedings to the teachers in their regions. These meetings are organised by the education authorities and normally cover topics such as syllabus changes and problem areas in the syllabus. It was felt that topics such as marine ecology resource availability could easily be included on such an agenda.

10. How to make resources useful and relevant.

This could be done by a special salaried person who can collate and distribute available resources to the teachers and other educational institutions. The Education Departments of the Houses of Delegates and Representatives have special resource centres where resources such as videos, slides, and charts are available. These are by all accounts not well used.

An interesting point mentioned, was that teachers have to be educated how to do things. The example of a resource development programme at a Scottish College of Education was highlighted to qualify this point. The resource development programme is run over 4 years. Basic skills are taught in year one and the programme becomes more involved over the next three years as outlined below:

Year 1. How to have access to resources: where.
Year 2. Analysing resources: what is good and what is bad.
Year 3. Developing resources of their own.
Year 4. Running in service programmes with teachers in the field.

In this course students are taken on a progression through resource development. Basic skills are developed at pre-

service levels already.

11. Lack of experience in fieldwork management.

Preservice teacher education should involve field trip management and taking students on field trips. Students teachers can assist in-service teachers with taking school students on field trips. This will afford trainee teachers with first hand experience of taking children into the field.

Skills need to be taught and teacher education institutions need to include fieldwork management in their courses. Presently the theory of field trips is taught, but actual student management of school students is not done.

Teachers can also learn from the student teachers and vice versa. A project at the University of Durban-Westville advocates close co-operation between student teachers and in-service teachers at schools. In this way ideas are fed from the school situation and not passed down from the University to the schools. The school is therefore the site of learning and not the Universities.

12. The shortage of human resources

This issue and solutions to it was dealt with in two previous discussions i.e 1) Large student numbers and 7) Co-operation from other staff members.

13. Varying Motivation.

Teachers recommended the involvement of students in the planning of the excursion to shift the emphasis from a teacher trip to one in which the students also have a stake or even ownership. Students are more motivated to make the project succeed under these circumstances. Fund

raising and organisation should be left up to the students.

Pre-excursion preparation of the pupils must be well done. This must include videos, slide shows and theoretical preparation, to focus students as to the activities and requirements of the field trip.

Post excursion follow up is important. It should be emphasised to the pupils that the visit to the beach is part of a broader project which continues after the field trip. Students must write up a report and be evaluated formally, the marks counting towards year marks and term projects. This will give the venture a more formal feel and students often take such events more seriously.

Work sheets and activities must be designed to keep pupils active.The activities must be of relevance to the students and include topics such as human impact, as pollution, mention food sources or animals commonly eaten and uses of algae in industry.

The important issues emerging from the workshop discussions are discussed in Chapter 5.

4.3 EXCURSION / WORKSHOP

4.3.1 INTRODUCTION

The excursion took place on the 14 October 1992 to Dalebrook Marine Reserve. Participating teachers met at Oaklands High School and were transported by bus to Dalebrook. Some teachers used their own transport and met the group at the site. In all 15 teachers attended the field trip.

The motivation for the excursion was that we could test some suggestions emanating from the discussions first hand in the marine environment. It was felt that this would add a touch of reality to our discussions conducted thus

far. This would also give more meaning to the discussion of possibilities, especially to those teachers who had never been to the seashore on a field trip.

The programme for the day included a hands on activity conducted by one of the participants. Ashley Patience agreed to take the group through aspects of the work sheet he had devised for his own field trips. It should be mentioned the worksheet had gone through a series of modifications and evolved into its present form over a number of years. An impromptu suggestion resulted in us being given a guided walk and talk down the shore by Dr D. Keats. This amendment to our original programme was readily accepted as it afforded us with the opportunity to experience one of the recommendations of teachers i.e that they would like to shown around and taught about the seashore by an "expert".

As we neared our destination we experienced some rain which proved to be a blessing rather than a problem. The rain provided us with an opportunity to experience one of those unforseen problems that could arise, no matter how well an outing is planned. This lead to a short discussion on precautions and tricks to get around the problem of rain which proved very informative.

The fieldwork was abandoned when the rain persisted. After investigating the viability of another site further up the coast, we entered the hall for some tea and biscuits before starting the discussion. During this period teachers could browse through the resource materials on display, exchange ideas, and generally get to know each other.

4.3.2 REPORT ON DISCUSSION

The discussion was facilitated by one of the participants.

The proceedings opened with a general session during which discussion was allowed on any matters the participants felt were relevant. The rain experienced at the seashore, featured on the agenda during this open time. Discussion revolved around precautions that can be taken to avoid the field trip from being washed out. It was firstly suggested that students have black refuse bags, which serve as rain coats, as part of their standard field trip equipment. Sandwhich bags can be used to keep papers water proof and clip boards can be made from cheap wood, by the woodwork department at schools. Another suggestion was that the planned worksheets and activities be printed in small blocks on an A4 sheet and folded into a smaller size for easier handling. In this way more information can be fitted onto one sheet obviating the need for cumbersome pages.

Other management tips for seashore field trips were also mentioned. It was recommended that excursion groups should arrive one hour before the scheduled low tide time in order to derive the maximum benefit of the low tide. It was further recommended that teachers obtain the tide tables from Engen garages, as these are crammed full of useful information regarding the sea. One participant mentioned the variation in seasonal states of the sea along the Cape coast, related to changing in wind direction, and recommended that field trips be conducted to False Bay in Winter and to the west coast shores in summer.

Many participants expressed the need for a teacher focused booklet to assist teachers with planning and management of their seashore trips. During this exchange,

one of the participants mentioned that teachers are an important resource to be developed and that teachers should be compiling their own resources from their own experiences and by adapting other booklets and resources already available, to suit their own needs. The request for the booklet was passed on to the committee of volunteers who will be taking the project further (See later discussion). This general discussion produced some important dialogue and raised many useful points.

Further discussion revolved around the evaluation of the morning's activities. Teachers were requested to articulate their views in the light of the discussion at the workshop on Thursday 8 October.

One of the suggestions to overcome the problem of limited knowledge of the marine environment suggested by the groups at the workshop, was that we should visit the seashore initially with someone who is familiar with the area. The "expert" can then show the way, and the teacher will gain confidence to go on their own later. This was put to the test on the excursion and the feelings of some teachers are reported. One teacher called the demonstration "a stimulating exercise which certainly made me want to know more about the marine environment. I am going to make an effort to learn more". Another stated that she wants to "go and read up, to get to know more" in order to prepare for a field trip with her own classes. One participant however found the "new terms" and names "intimidating". It was felt that the "expert" can act as a stimulus, which will motivate people to want to learn more.

A method was suggested whereby the so-called expert could break it to newcomers gently. The idea is to give people an "outline, an impression and they then fill in the details. First the impression then the details." This was recommended as a less intimidating introduction to the

complex marine environment, because people get the information in small doses and, are then encouraged to do further research on their own. The "expert" in this method, serves as an important and necessary spark to further developments.

In some of the further discussion which followed teachers articulated their needs more clearly. It was mentioned that teachers would like structured in-service training projects which cater to their specific needs, in particular projects which will assist teachers in acquiring more knowledge about the marine environment. The skills required to adapt resources could also form part of an in-service training project. Teachers indicated that "we need to learn continuously" and want the opportunities and infrastructure to do so. Teachers also requested that institutions and organisations involved with marine biology assist them by producing "user friendly" resource materials for ecology teaching at the seashore.

Teachers prefer the collective input of networking and see this as a means of solving problems experienced currently. This includes networking between teachers who had the theoretical training in marine biology with those who have not. Teacher networks could link up with Universities and other education institutions and spread resource materials. It was felt that teacher organisations could facilitate the formation of networks on a regional level. Networking and working with other teachers on a trial and error basis could be provide opportunities for testing and refining work sheets to be used for field trips to the seashore.

As a short term solution it was recommended that teachers use their skills to solve the problems they can manage. They should make the experience part of the students real life existence, use the language familiar to

the children and adopt an "interactive approach" as this involves more students and keeps their attention. Teachers were encouraged to "adapt available resources and make them relevant to your needs." It was suggested that two resources that should be given attention are "a positive attitude and love of your subject." It was also mentioned that teachers must be enthusiastic and sell their subject to their students.

Networking, pooling resources, visits to the seashore with knowledgeable people seem to be important areas to consider to solve the constraints teachers perceive are restricting them from conducting marine field trips at the moment. It is important to note that teachers are an important resource to be developed.

Further discussion which followed concentrated on the way ahead. Suggestions were made for ways in which this project could become a continuous endeavour which could carry out the suggestions and become useful to teachers. The main points are summarised below.

There was a strong suggestion for a network of teachers to be formed. This network could start with the participants of this project and then be broadened to include all teachers who are interested. The group of teachers in this project is to form a network in which teachers will continuously interact with each other and look at ways of working towards developing a resource which can be used in the marine environment. The network of teachers could then interact with universities and other educational institutions and further spread available resources and inform teachers of latest developments in the subject. It is envisaged that the teachers will liaise with each other and maintain contact.

Three teachers agreed to run a committee which will co-ordinate the activities of the network. It was mentioned that this was a good idea for short term but that for the longer term it would be better if some teachers should be released to do this kind of work in order for it to become a sustainable venture. Funding for this kind of structure could be obtained from the FRD (Foundation for research and development), Wildlife Society, Cape Town Museum and the Sea Fisheries Institute. Major oil companies and private sector corporations could also be approached.

The discussion was followed by a lunch break after which we departed from the hall and returned to Oaklands High School. The mood was positive and many new friendships and bonds were formed in a short space of time.

CHAPTER 5: DISCUSSION

5.1 INTERVIEWS

The purpose of the interview was to survey teachers with regard to teaching of ecology and field trips to the marine environment. Questions were structured to shed light on a variety of topics which would inform later aspects of the project. Some answers and trends which emerged from the biographical questionnaire and interview data are discussed in this section.

An analysis of the sample group shows similarities to other projects conducted locally. The majority of participants (15 of the 18, 83%) had some exposure to theory of ecology during their teacher education which is similar to that expressed in Wagiet (1991) where 71% of the respondents had pre-service contact with ecology theory. This seems to indicate that ecology is now widely taught in teacher education institutions. In contrast to Wagiet (1991) where 87% teachers indicated that they used only the text book, participants indicate that they digress beyond the text book and syllabus requirements, often using other resources to supplement the text book. This seems to indicate that a more positive attitude is developing in teachers towards teaching ecology. This could also be related to the particular group of teachers sampled in this project.

The relationship between years of experience as a teacher and fieldwork activity does appear to have some correlation. Fewer (44% of the 72% who do fieldwork), of the recently qualified teachers (less than 10 years experience) who formed the majority of the group, were doing fieldwork than the older teachers [80% of 27%), with more than ten years of teaching experience. In contrast, the findings of Fido and Gayford (1982) suggested that years of experience as a biology teacher appeared to be of

dominant importance in the relationships with the fieldwork undertaken in A level schools. They found that older teachers (with more than 19 years experience) were less likely to have undertaken fieldwork, but even if they had done some, they tended to do significantly less than less experienced teachers. Wether, in their case, this is purely a function of age or wether it is related to the type of training available at the time is unclear. In contrast to their findings, one of the oldest participants in this project, with more than twenty years experience as a biology teacher, was one of the teachers most active in marine fieldwork, constantly evolving and developing new resource materials.

The lack of, or inadequate training in fieldwork does not appear to be a significant factor influencing general field teaching in the Western Cape. Despite the fact that only eight teachers (33%) in the group had some training in fieldwork management (most only in theory), many take pupils on field trips regularly (66%). This is probably because of better theoretical preparation in ecology principles during preservice teacher education mentioned earlier. Fido and Gayford (1982) however found that teachers with a field qualification, interpreted to be similar to field studies during preservice education, were found to have a significantly more "favourable attitude" towards fieldwork than teachers who did not claim such a qualification.

The situation with regards to fieldwork in the marine environment, seems to be in tune with the findings of Fido and Gayford (1982). Only eight teachers (44%) indicated that they studied the marine environment during their teacher education, and seven (38%) indicated that they take pupils on field trips to the seashore. It appears that only teachers with some background knowledge of marine biology are confident enough to take pupils to the seashore

suggesting a relationship between the those who have background knowledge of and those who go on field trips to the marine environment.

The response to the question concerning where teachers go on field trips indicated that teachers use a variety of locations (Botanical gardens, Nature reserves etc.) which include different habitats. This seems to be in keeping with the results of similar research conducted in other countries. A survey by Kinchin (1993) of 200 biology departments in England and Wales, revealed that many schools visit field centres or natural habitats in close proximity to the school during ecology field trips. An outstanding feature, which contrasts with the data in this survey, is that a large number of schools (68%), prefer coastal habitats for ecology teaching and that many schools are prepared to travel long distances to study specific coastal sites. Research by Openshaw and Whittle (1993) in England indicated a similar trend with 60% teachers showing a preference for marine sites for field teaching.

The majority of participants who do not go on field trips to the seashore cite a number of constraints (13 in all) as reasons for this state of affairs. Results of research by Booth (1979), Ham et al 1988, Harper (1982), O'Donaghue (1989), Oppenshaw and Whittle (1993) and Wagiet (1993), concerning the undertaking of field trips, reveal similar problems which validate the problems teachers experience in the Western Cape. An interesting feature of the results of Booth (1979) which is similar to the findings in many local schools is time organisation. Inflexable school organisation, heads who do not allow time out of classroom or allow occasional longer periods of time to study one subject, present teachers with daunting obstacles which often dampens their enthusiasm. Ham and Sewing (1988), in a survey on Environmental Education, regard the problems expressed by teachers as barriers which

not only hamper teachers but also affect their confidence.

Teacher confidence (lack of) has been indicated as a major inhibiting factor in current fieldwork practice by many researchers (Booth 1979, Ham et al 1988, Harper 1982) who indicate various reasons for this. Wagiet (1991) indicated that teachers were not always confident because they often felt that their theoretical knowledge did not prepare them adequately for the task of teaching ecology. In his investigations of fieldwork problems with a view to developing materials that would make teachers more self reliant in natural areas, O'Donaghue (1989) discovered that; "teachers tended to lack confidence in their ability to teach outside the classroom owing to a lack of knowledge about ecology, conservation and nature". Other problems mentioned in this regard included little or no experience in fieldwork techniques, and little or no resource materials available (Booth and Sinker 1979, O'Donaghue 1989). The confidence argument is carried further by Harper (1982) who, while agreeing with Booth (1979) concerning lack of knowledge, does not see this as the principal reason for teacher lack of confidence. He states that teachers lack confidence because ecology fieldwork is in fact difficult and demands an expertise one can reasonably expect to find in a university lecturer specialising in ecology. He also feels that there are few practical exercises which can be used in the field by teachers not expert in identification of organisms. He concludes by saying that employers have no right to expect ordinary biology teachers to possess the exceptional skills required for teaching field ecology. From the results concerning fieldwork practice (66%) and knowledge of fieldwork management (33%), it appears as though teachers are able to learn about, and cope with the demands of fieldwork, and it is the opinion of the researcher that the problem is overstated by Harper (1982).

The constraints or barriers indicated by the teachers in this project are well documented and common to many other research projects. O'Donaghue (1989) found that "the verbal and written reasons given by teachers tended to be a defensive justification for not taking excursions, an avoidance reaction that obscured other more deep seated ideological issues". Having experienced the same working conditions for a long time, the researcher feels that many of the problems mentioned by the teachers are legitimate, but certainly not insurmountable. The researcher accepts the point made by O'Donaghue, and acknowledges the lack of personal and professional commitment amongst some teachers, but feels it is difficult to decide wether it is in fact the case here as evidence of this was not seen in the results.

The researcher suspects that some of the reasons for the responses of some teachers to interview questions can be traced to the education policy and system. Teachers indicated a number of problems and constraints which were making field trips to the seashore difficult or impossible, but many realistic solutions and suggestions to the problems mentioned emerged from the workshop discussions. The lack of or limited participation by teachers in the RDDA model has lead to teachers having misconceptions about their own abilities making them reluctant to seek solutions or innovations because they feel they lack the skills or knowledge. Naidoo (1992) feels over a period of time, teachers have become deskilled and disempowered as a result of limited participation in the RDDA model and the imposed centralised Bureaucratic control of education. He adds that in this system teachers see themselves as implementors of the curriculum and victims of a system which they are powerless to change. The lively and meaningful discussions in the workshops indicated that the teachers in this group were keen to find solutions to the problems they experienced in their practice daily.

5.2 WORKSHOPS

These were essentially small group "brain storming" sessions among participating teachers. The discussions involved teachers collectively seeking solutions to their own perceived problems and revolved around the solving of constraints (barriers) teachers felt were inhibiting them from conducting marine field trips as expressed during the interviews.

The workshop held at the school was characterised by many positive aspects which augur well for future projects of this kind. The first is the fact that so many teachers attended the workshop voluntarily and in their own time. Secondly it should be noted that teachers had no problem in getting off school early even in the absence of an official policy. The research was unofficial i.e not commissioned by the education authorities, and principals are often wary of such initiatives and do not allow teachers to go easily. The almost instant rapport between teachers and the fact that most teachers were not known to the researcher before the initial contact was made, indicates that teachers are clearly amenable to this kind of innovation and appear to want to improve their own practice. The positive attitude displayed and perceived during the interviews was carried into the brisk discussions which took place during the workshop.

The constraints in using the marine environment for teaching ecology fall into two main categories:

1. Logistical: Numbers in classes, inflexable school programme, finance, transport, attitudes of other staff members, and weather and tides, and varying motivation of pupils.
2. Educational: lack of resources, limited knowledge, lack of fieldwork experience and fieldwork management problems. The discussions of the workshop held at the school and the one

which followed the excursion to the seashore, are discussed together as some of the topics and issues overlap.

1. LOGISTICAL PROBLEMS

It is clear that most of the logistical problems manifest themselves, and can be solved, at school level. It is important that biology teachers discuss the problems with their fellow teachers at their own schools as the solutions to many of the problems mentioned require the co-operation of staff members (eg.lack of funds, timetabling, etc). Other problems such as the attitudes of teachers of other subjects, which stem from the fragmentalist approach of the present education system, need to be addressed at a higher level. The suggestions made by the respondents to solving school based problems accord well with the problems experienced at school level.

The cross curricular approach, mentioned as a solution to the problem of inadequate human resources, has many positive effects for this problem, but also has other benefits for ecology teaching. This approach allows ecology, with its essentially multidiciplinary, sometimes interdisciplinary nature, Hale (1991) to be taught across the curriculum. As a holistic science which has its own theories, but which draws on other disciplines to a large extent, (Hale 1986), ecology serves as a linking theme between the subjects. Ecological science provides the scientific basis for discussion of many topics and issues that could arise from such an approach. This approach is also favoured by Harper (1982) who feels that ecological topics should be integrated into other topics or subjects as ecology is better taught as a theme than as a separate subject entity.

Another positive aspect of the cross-curricular approach is that a range of skills may be incorporated in

or lead on from field investigations. By involving other subjects, students can research topics and issues in a broader sense than just by pure scientific investigations. Hale (1986) states that programmes based on this approach have "additional educational benefits in terms of extending the range of applications of mathematics, history, art as well as the subjects traditionally associated with fieldwork, such as Biology and Geography". The cross curricular approach to ecology teaching is very much in line with the philosophies of environmental education which are currently in vogue and being debated in South Africa as an alternative approach (Dhikollolo document 1993).

Another suggestion from the workshop at the excursion called for greater student involvement in the field trip planning and management. Podrez (1993) documents the use of students to teach other students, "peer teaching", as a means of solving human resource shortages at the North Grade school, Fort Worth, Florida. This became necessary because of a lack of motivated teachers to introduce a marine based biology course at the school. The only realistic option open to them was to involve students as "teachers" in the implementation of the programme. This programme had the added benefit of solving the problem of student motivation since the students responded much better to the coursework when they saw how well their fellow students managed the project.

2. EDUCATIONAL PROBLEMS

Lack of resources is a well documented problem in ecology teaching. This may be due to insufficient supplies of equipment, text books or teaching resources for field and laboratory work. The overall request from teachers is for teacher centred, needs based, resource materials that would assist them in using the marine environment for ecology teaching.

The benefits of supplying resource materials to teachers has been demonstrated in many research projects. Ham et al (1988) demonstrated a marked increase in the implementation of environmental education programme directives after in-service teacher workshops and demonstrations of resource materials. Moss and Theobald (1979) and Uma (1982) also indicate positive responses to ecology teaching after the development of resource materials and teacher guide books for class teaching and fieldwork. In these situations positive results have been achieved, but problems are often encountered when schools are supplied with "pre-packed" and tested resources.

Many organisations found that resources developed for teachers to solve the problem of shortages are often poorly used. Science packages provided to schools in the course of the Natal Primary Science Project were often found unopened years later, (Keogh et al 1990). The Natal Parks Board and the WildLife Society of Southern Africa, have been supporting teachers for many years by developing resource materials. These teachers have been given fully developed and tested materials, but these have either overwhelmed them or dissempowered them in other ways. Collections of materials have on occasions become valued possession while being seldom used (McNaught et al 1990a). Moodie (1987) contends that "the approach of putting more materials in the classroom produces little change in either teaching or in learning." O'Donaghue (1989) reported similar results while developing resource materials on request for teachers for ecology field and classroom teaching. The teachers were enthusiastic at workshops, but the resources produced were often not used beyond the workshop. The method of providing packaged resource materials and training teachers in the use of these materials is not always successful, and clearly has some problems.

Another example of failed adoption and use of materials was experienced by facilitators in the Natal Primary Science Project (NPSP) (McNaught et al 1990b). Resources were produced in response to the need expressed for materials for science teaching. This model of the project, which provided pretested packaged resources, was called "structured intervention". It involved the production of materials for people, with the focus on provision of skills and knowledge to the teachers. One of the main problems encountered was that it encouraged "dependancy syndromes". Teachers did not grow intellectually or develop because other people were looking after their needs. This approach effectively deskilled teachers and was later replaced by a more participatory strategy in which teachers played a more active role (McNaught et al 1990b).

The new approach was termed "collaborative engagement" because it involved the teachers in the development of resources from the start. This method encourages independance as it assumes that competencies exist and that teachers can influence their practice. According the definitions of the Van Leer Foundation 1990, in (Mcnaught et al 1990b), structured intervention falls into the category of enablement which is described as "what one person does to another." The enabler passes on tools, knowledge and skills to the teacher, to enable the teacher to perform a specific task or role. "Collaborative engagement" on the other hand falls in the arena of empowerment which is "embedded in the belief that each teacher has a meaningful contribution to make to his / her situation and that the teacher is capable of finding solutions to problems faced." The people involved in the NPSP have reported much success in the areas of resource and curriculum development when employing this method (Mcnaught et al 1990b).

Clearly more than just resource materials are needed to solve teacher resource problems. The teacher also needs to be developed for success to be attained. Kinchin (1993) found that teacher attitudes made a big difference in the proportion of teachers who go on field trips and those who do not. Teachers have to be empowered so that they can assist in solving their own problems. Pillay and Naidoo (1991) state that when teachers are directly involved in solving their own problems this results in a sense of ownership, which leads to greater commitment to making things work and therefore a greater measure of successful implementation. In his recommendations for resource development, Friedel (1993) recommends that interested people should be invited to assist with the process from the start and that the resource being developed should be designed with the help and guidance of the eventual users. The experiences outlined above should be considered when addressing the need, expressed by teachers, for resource materials for teaching ecology in the marine environment.

Teacher education programmes were suggested as a solution to the knowledge deficit most teachers have concerning the marine environment. Loubser (1993) contends that the introduction of new subject (curriculum) content means that teachers will have to be trained to teach the new content. He mentions that new teachers can be taught at teacher education institutions but that existing teachers have to be trained in-service. Teacher education programmes have been successful in many countries when used to introduce new themes or when used to innovate current practices (Moss and Theobald 1979, Uma 1988).

Since all teachers undergo some form of training, institutions which educate teachers are the appropriate place to introduce new content (marine ecology) and approaches to teaching Biology (Loubser 1993). This would involve curriculum and syllabus innovations in pre-service

programmes at teacher education institutions. Hale (1986) states that while teachers recognise that ecology is a field-based subject, many provide few field experiences for pupils, teaching most of the ecology in the classroom. She ascribes the lack of fieldwork in schools to the fact that many teachers are inadequately trained. As a solution to this she recommends that the appropriate teaching methodology and techniques be included as part of the basic training of teachers to encourage a move out into the environment. Booth (1979) suggests that field centres (Environmental Education Centres, Nature Reserves) should play a bigger role in assisting with pre-service teacher education to encourage the use of fieldwork for ecology teaching in schools. The discussion document of the recently held Dikillolo conference on Environmental Education (EE) and the formal curriculum, recommended that new approaches such as EE should form a compulsory component of the curriculum of teacher education institutions. While the discussions concerned primarily EE, education in general can benefit from such an approach to pre-service education. The majority of teachers however have to be trained through in-service programmes.

In-service education programmes were strongly recommended, as a vehicle for introducing marine environmental education into the school curriculum by the participants in this survey. Such programmes, are employed world-wide to assist with the introduction of curricular innovations, and the implementation of new approaches to education in schools (Ham et al 1988, Moss and Theobold 1979, Loubser 1993, Uma 1988). Ham and Sewing (1988) indicate that many teachers rely on in-service workshops to update knowledge, obtain materials, share ideas and gain course credits. In-service programmes can be expensive, time consuming, and can often lead to disruptions in the school programme. Some in-service programmes used in similar situations in other countries are discussed briefly

and important aspects which contributed to their successes are highlighted.

Moss and Theobald (1979) conducted in-service education programmes to help improve the teaching of ecology in Kenyan schools with much success. In addition to providing resource materials and guide books they also ran classes and practical sessions for teachers, placing them in the learner situation and exposing them directly to the proposed methodologies intended for the learning situation. The strength of this approach is that it made teachers familiar with the approach and allowed them to make the changes which they deemed necessary. This familiarity with the innovations improved the confidence of teachers and led to more successful implementation and adoption of the programme.

A similar programme was initiated in Nigeria with the aim of improving the teaching of ecological principles (Uma 1988). The teacher education programmes were conducted during school holidays in order to reduce the disruptions to the school programme. The programmes were run by experienced teachers and college and university lecturers. These lecturers liaise with subject and examination committees consisting of members of the education ministry, representatives of professional teacher organisations, and experienced teachers. The inclusions of the different stake holders in these guiding committees has ensured good feed back into the system and helped to keep the in-service projects relevant and in context. These in-service programmes have helped to shed light on perceived difficulties experienced by teachers and have gone a long way to alleviate the problems associated with the teaching of ecology.

Teachers in this project suggested in-service education of teachers in co-operation with agencies such as non-governmental organisations (NGO's) should be encouraged. The recent Dikollolo conference on environmental education made similar recommendations and also suggested that education departments should make provision for in-service education in their operations and budgets. It was also recommended that serving teachers need to be strongly encouraged and motivated to attend in service training programmes by incentives such as salary increases, certificates and others. Wright and Govindarajan also suggest that the school system should "encourage and support (facilitate) teachers' attendance and participation in professional events and personal growth activities." They feel that this will enhance the teachers awareness in biology and education which they will pass on to their students.

In service education of teachers is expensive and can pose severe financial strain on cash-strapped education departments. Cheaper methods and new financial strategies will have to be devised to make such programmes a feature of the education system in South Africa in future. Loubser (1993) and the Dikollolo conference recommend a system of tutor teachers, where enthusiastic teachers are used to teach others new methods and innovations. In terms of funding, teachers in this project and the Dikollolo conference indicate that the private sector should be approached in this regard in the absence of state funding.

An excellent example of a successful in-service programme involving various sectors was documented by Podrez (1993). The aim of the programme was to use a state fund to introduce marine science to the school with a minimum of disruption to normal school operation. Marine biologists, marine patrol officers, and marine researchers gave talks at schools and trained teachers and students.

Excursions were arranged to marine sites and the school equipped with suitable equipment for teaching marine science. The programme met with immense success and stimulated much interest in the marine environment. These results indicate what can be done if the necessary funding is available to schools and ties in with the suggestion of teachers, that agencies such as the FRD (Foundation for Research and Development) should initiate and finance programmes to promote awareness of the marine environment amongst teachers and students.

The in-service education of teachers in marine environmental education is particularly important because of the historical inattention to this topic in preservice programmes and the failure of many existing in-service programmes. It is important to develop good attitudes and skills in teachers as they play a vital role in the success of any new innovations and programmes. Booth (1979) argues that teacher confidence can be encouraged by in service training which gives teachers good involvement in ecological study. For the majority of teachers this means good in-service teacher education in co-operation with colleges or non-governmental agencies.

The formation of networks of teachers to promote marine ecology amongst teachers was one of the main suggestions emanating from the participants during the workshop discussions. Such networks have many positive effects and are advocated by many educational researchers. It is felt that teachers need the support of those peers who have more experience and confidence than themselves, to help them develop. According to Fein (1991), networking promotes collective action which is usually more productive than individual efforts in controlling the influences that can act against improvements. He adds that working collaboratively with colleagues makes it easier to recognise institutional practices and false consciousness

that may be constraining transformative practices in education.

The broader network involving teachers, colleges, universities, agencies and institutions involved with marine activities, as recommended by teachers in the workshops also has many positive aspects. Networking between teachers and organisations involved with resource development promotes communication and assists with the production of relevant, needs- based resources. Communication between departments which are responsible for education and those which are responsible for the training of teachers is sometimes neglected (Loubser 1993). Networking as proposed by the teachers, can help to prevent this and ensure a cross flow of ideas which will keep the institutions in touch with what is happening on the ground. A similar network was proposed by Naidoo (1992). This three way network involved schools, the Durban teachers centre and the University of Durban Westville. The teachers centre acted as a resource centre and the university provided updated resources and information. The idea of teacher networks and networking between teachers, institutions and education departments is a sound one which will certainly benefit the teaching of marine ecology and education in general.

During the workshop discussion after the excursion, the issue of funding to assist with teacher education, and to address the lack of teaching resources was mentioned by many of the participants. Funding is an important factor influencing the success of any project or educational innovation and can make the difference between success and failure. Podrez (1993) outlines the successes of a project which was funded by the state. This certainly makes a strong case for the FRD (Foundation For Research and Development) type funding suggested by the teachers. It provides for in-service education of teachers and also

assists with resource development and follow up work for teachers. Appropriately managed funding can go a long way towards solving many of the problems experienced when introducing new innovations and curriculum content such as marine ecology into schools. It is hoped that the state, private sector and non-governmental agencies will give due consideration to funding of education projects in the changing education arena of South Africa.

Three teachers volunteered to form a committee to steer and co-ordinate further activities to continue this project. The future activities suggested include, reviewing and adapting of existing resources, formalising a network of teachers, organising visits to the seashore for teachers and the sharing of resources developed by peer teachers. It is envisaged that the network will broaden to include many more teachers, education institutions and other agencies involved marine environmental education.

An outstanding feature of the workshops was the enthusiasm and ingenuity expressed by teachers in solving problems. What came out clearly is the way teachers responded to the challenge of the constraints mentioned in the interviews, during the workshops. It is the opinion of the researcher that teachers will find solutions to many of their problems if given the circumstances and conditions in which to do so. Teachers can and will contribute to their own development and improve practice if given the opportunities.

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

From the results and discussions it is clear that teachers are indeed keen to use the marine environment for field trips to assist them with teaching ecological principles. The interviews highlighted many problem areas which are making the organisation of field trips to the seashore difficult. However many solutions which reduced the emphasis of the constraints to such activities have been suggested, and recommendations were made to make field trips to the seashore a reality for teachers.

Two primary hurdles which are currently hampering teachers in their attempts to organise seashore excursions are:

1) School based logistical problems which include, time organisation, attitudes of other teachers, lack of a policy or school ethos concerning field trips.
2) Teacher education problems such as, a lack of knowledge of the marine environment, unavailability of suitable resource materials, poor training in fieldwork management and a lack of experience in fieldwork.

Possible solutions to the above, and other problems which are undermining the confidence of teachers, can be addressed by three important role players in education: teachers, education departments and non-governmental organisations and governmental agencies involved with marine matters and education.

6.2 RECOMMENDATIONS - THE WAY AHEAD.

6.2.1 TEACHERS

The discussions indicate that participants consider teachers to be an important link which can make marine ecology part of the school system. Teacher apathy and lack of motivation, however, needs serious attention and must be addressed. It was suggested that teachers need to play a more active role and take the initiative in their own professional and academic development. Teachers should visit the seashore to improve their knowledge of this environment and try to adapt existing resources to their own needs. It is recommended that teachers initially visit the seashore with colleagues who are familiar with this environment to assist them with their own learning.

Teachers have an important role to play in the formation of informal and formal networks. The small network of teachers formed in this project can embark on collective action during which resources are shared and peer teaching takes place. The committee which emerged from the workshop should try to broaden the existing base, and link up with more teachers, teacher organisations, education institutions and other agencies involved with the marine environment. In this way available resource materials and information can be shared more widely and new needs-based resources can be developed. A network such as this can also serve a lobbying function, exerting pressure on the education departments for the inclusion of marine ecology into the school curriculum.

Teachers also have a vital role to play as communicators within networks of this kind. They would make valuable input concerning activities at grassroots level in schools. The results indicate that organisations involved with resource development, tertiary institutions and teachers in schools are often out of touch with each

other. This has resulted in teachers being unaware of what resource materials are available from institutions or that the resource materials produced are out of context with the teachers' needs. This would also provide an important link between teachers and teacher education institutions, allowing teachers to keep abreast of latest developments in education.

The committee of teachers which emerged from this project has undertaken to initiate a teacher network in the western cape to continue the activities initiated during this project.

6.2.2 EDUCATION DEPARTMENTS

Another important role player that can assist with making marine ecology a reality in schools is the Education department or controlling authority of schools. It was suggested that the education departments should include marine ecology theory and fieldwork courses in pre-service teacher education syllabi at colleges and universities. It was also suggested that education departments should develop an in-service education policy which could assist serving teachers with acquiring the skills and theory needed to teach new syllabus content such as marine ecology. Important guidelines for such a policy are found in the Dhikollolo document (1993). Wright and Govindarijan (1992) indicate that it is important for school boards to encourage teachers to attend courses and to facilitate their attendance of activities which promote professional development.

A system of tutor teachers and regional representatives were suggested as methods of in-service education. With this system, only certain teachers attend the workshops or programmes, and they then report the proceedings of these gatherings to their schools or regions. Fewer teachers thus attend and disruption of the

school programme is minimised. In-service workshops along the lines suggested by Ham and Sewing (1988), at which teachers can be introduced to new resource materials and at which new syllabus content can be introduced, will also be of assistance in reducing the knowledge deficit of teachers concerning the marine environment.

It was also recommended that education departments should develop firm policies regarding field trips in schools and possibly make them mandatory as a short term solution. This would obviate the problems with time organisation and teacher attitudes currently experienced in schools.

6.2.3 GOVERNMENTAL AND NON GOVERNMENTAL AGENCIES.

The third grouping which could assist with the introducing marine ecology into the school curriculum are the governmental and non-governmental agencies involved with education. It is firstly felt that these agencies have an important role to play in developing resources related to the marine environment. It is important that they take past mistakes and methods into account when embarking on such projects. It is recommended that resource development be done in a consultative way with teachers and all other users from the start, to avoid problems with adoption and to make sure that these are needs-based and relevant. These organisations are also in an ideal position to initiate and run in-service courses (workshops and field trips) for teachers as they have the financial means and available human resources. Personal from these agencies could assist with developing and sustaining broader networks consisting of teachers, colleges, universities and themselves.

In conclusion it must be mentioned that new curricular innovations and methods of teaching will only work in a more flexible democratic education system than the RDDA model. The success of any approach depends on the adoption

by the teachers, so it is strongly recommended that teachers be consulted and that they play a major role in the development of programmes and have an input in the introduction of any innovations into the education system. If a participatory approach, which involves teachers, education departments and NGO's is followed, the seashore environment could become an important asset to biology teaching which could lead to an improvement in teaching practice and learning opportunities for pupils.

Time and resource constraints prevented the researcher from involving larger sample in the research project. Replication of a similar study, in a larger geographic area, which involves a broader spectrum of teachers including primary school teachers and teachers working further inland, is recommended. This would remove the restrictions on external validity and provide a better picture of the situation investigated during this research. Further research is also recommended to ascertain the potential of the seashore for environmental education initiatives currently being debated in education in South Africa.

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APPENDIX I

H.G SYLLABUS FOR STANDARD 8

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
1. ECOLOGY	This study is intended primarily to acquaint pupils with the interrelationships among organisms and their environment	
1.1 Ecosystems		Continuous investigation of a selectec ecosystem on the school grounds or any other attainable ground; graphical representation of information, where possible (P)
1.1.1 The concept of an ecosystem	The naturally defined habitat in which there is a dynamic relationship between abiotic and biotic components	
1.1.2 The practical study of the structure of a selected ecosystem with emphasis on the relationships between its components.	A preliminary superficial survey of the chosen ecosystem should lead to the selection of one or more abiotic and/or biotic components for further investigation These selected components should lend themselves to quantitative measurement from which tentative inferences about the distribution and interrelationships of biotic components could be made	
Abiotic components physical factors edaphic factors physiographic factors	Abiotic components which might be investigated include: light; length of day; temperature; water, including water cycle; atmospheric gases, including winds; soil characteristics such as pH (acid content), humus content, texture, water-holding capacity and air content; aspect, slope and altitude	

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
Biotic components producers consumers (herbivores, carnivores and omnivores) decomposers	An investigation of a selected biotic component to include a study of adaptations to a habitat Involvement in succession and competition	
Biological rhythms	Examples of biological rhythms in the selected ecosystem caused by an abiotic factor/abiotic factors	
1.1.3 Symbiotic relationships	At least one example each of parasitism, mutualism and commensalism	
1.1.4 Trophic levels	Food chains, food webs and ecological pyramids	
1.1.5 Nutrient cycling	The significance and consequences of nutrient cycling Carbon and nitrogen cycles	
1.1.6 Biosphere	Brief outline only of the components: atmosphere, lithosphere, hydrosphere	
1.1.7 Terrestrial and aquatic ecosystem	Similarities and differences only	
1.2 Man and the ecosystem		
1.2.1 Pollution of air, water and land	At least one example of each type of pollution must be studied, and appropriate corrective measures should be considered	An investigation of at least one type of pollution in the environment with special reference to the effects of pollution and corrective measures (P)

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
1.2.2 Conservation of indigenous flora and fauna, and of other natural resources	Conservation as the wise use of natural resources A study of at least one programme of conservation that is being carried out	
2. THE CELL An introductory study of certain aspects of cellular structure and organisation	The main structural features of selected components of cells as revealed by the light microscope and by electron micrographs	An investigation of the sub-cellular structure of a plant cell and an animal cell by means of e.g. electron micrographs (D)
2.1 Biological importance of protoplasm	General appearance, physical characteristics and chemical composition; relevant functions of water and proteins	
2.2 Membranes enclosing cells and forming intracellular partitions: properties, structure and functions	Structure: simple fluid mosaic model only Properties Functions	
2.3 Nucleus: composition and functions	Composition: membranous envelope with pores; nucleoplasm containing chromatin and nucleoli; chromatin network composed of many chromosomes which, during cell division, became visible as strands bearing genes; nucleoli as dense regions consisting of nucleic acids Functions: overall controller of the structure and properties of the cell in that genes regulate the synthesis within the cell of structural proteins and of enzymes; role in heredity (No study of nucleic acid composition)	

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2.4 Ribosomes: Location and function	Location: in cytoplasmic matrix, often attached to membranes of E.R. Function: sites at which proteins are synthesised	
2.5 Plastids		
2.5.1 Chloroplasts: location, structure and function	Location: in cytoplasmic matrix of some cells, usually positioned to obtain adequate light Structure: variable shapes; enclosed by membranes; lamellae with grana containing chlorophyll; stroma Function: sites of photosynthesis	
2.5.2 Leucoplasts: location, mention of function		
2.5.3 Chromoplasts: location, mention of function		
2.6 Mitochondria: location, structure and mention of function	Location: in cytoplasmic matrix of most cells Structure: double membrane; cristae Function: site of final stages of respiration	

APPENDIX I

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2.7 Vacuoles: location, organisation and some functions	Location: in cytoplasmic matrix; often very large in cells of plants, seldom prominent in animal cells Organisation: liquid-filled cavity, bounded by membranes (tonoplast) Functions: storage of water, ions and soluble compounds; aids intra-cellular translocation; turgidity providing support for cell; mention of specialised vacuoles among others phagosomes, contractile vacuoles, lysosomes, dictyosomes	
2.8 Cell wall: location, composition, properties and functions	Location: outside cell membrane of most plant cells Composition: strand of insoluble cellulose, mostly interwoven, and impregnated with substances such as pectin and sometimes lignin; initial layers subsequently thickened Properties: rigid, comparatively non-elastic and usually permeable to water and most solutes Functions: e.g. support of cell; protection	
2.9 Other components of cells: endoplasmic reticulum Golgi body (dictyosomes) lysosomes centrioles	Recognition of these organelles as they may be seen in electron micrographs; awareness of their probable functions	

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
3. CELL DIVISION		
3.1 Only the significance of cell division for growth	It should be emphasised that additional cells are required by organisms for growth, repair, replacement, and in some cases reproduction (The process of mitosis need not be studied at this stage)	
4. PLANT TISSUES	Differentiation of cells illustrated by a study of angiosperm tissues, emphasis being placed continuously on the relationship between the structure of a tissue and its functions	The preparation of wet mounts of plant tissues Practical investigation of structure by means of a microscope and/or micrographs and/or photo-micrographic slides or transparencies (P or D)
4.1 Meristematic tissues	Structure and functions	
4.2 Permanent tissues epidermis parenchyma chlorenchyma collenchyma sclerenchyma xylem phloem	Structure and functions of components	

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
5.	ANGIOSPERM ANATOMY	Unless otherwise indicated, internal anatomical features as revealed by a light microscope should be recorded by plan diagrams as well as by drawings of small portions of tissues, representing their appearance Emphasis must be placed on the relationship between the structure of an organ and its functions	
5.1	Review of plant plan		
5.2	A young dicotyledonous root	External features; internal structure as seen in transverse section	Observation of the development of root hairs in a young seedling (P or D) Observation of a young dicotyledonous root as seen in a transverse section (P or D)
5.3	A young dicotyledonous stem and a monocotyledonous stem	External features; internal structure as seen in transverse sections Contrast between a young dicotyledonous and a young monocotyledonous stem as seen in a transverse section only	Observation of young stems of a dicotyledonous and a monocotyledonous plant as seen in a transverse section (P or D)
5.4	A dicotyledonous stem in which secondary thickening has occurred	Only a plan diagram, without cellular detail, is required Brief outline of the process of secondary thickening	Observation of annual rings (P or D)
5.5	A dorsiventral leaf	External features of a simple leaf Internal structure as seen in transverse section	Observation of a dorsiventral leaf as seen in a transverse section (P or D)

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
5.6	A dicotyledonous flower and a monocotyledonous flower	Composition of a complete, mature dicotyledonous flower and a monocotyledonous flower (Study of tissues is not required) Diagnostic criteria of the two families studied and comparison between the two types	Analysis of a flower of each of the families studied (P)
6.	MAMMALIAN TISSUES		Use slides and/or transparencies (D)
6.1	Epithelia	Main features and functions of columnar, squamous, ciliated and glandular epithelia	
6.2	Connective tissues	Main features and functions of areolar tissue, tendons, ligaments, cartilage, bone and blood	
6.3	Muscle	Main features and functions	
6.4	Nervous tissue	Main features and functions	
7.	SOME ASPECTS OF THE ANATOMY AND PHYSIOLOGY OF MAN		
7.1	Support and locomotion		For practical work a readily available small mammal or an available model of a skeleton may be used for observation and identification of the components of the skeleton
7.1.1	Axial skeleton	Skull: (Names of bones of skull not required) Teeth and jaws related to functions Vertebral column and rib cage: main regions of column; atlas and axis, with their functions; structure of a thoracic vertebra; interlocking of thoracic vertebrae and articulation of ribs;	

APPENDIX I

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
	flexible attachment of ribs to sternum	
7.1.2 Appendicular skeleton	Girdles: components of pectoral and pelvic girdles; attachment of girdles to axial skeleton Limbs: main components (names of individual carpals and tarsals not required)	
7.1.3 Joints	Structure of joints	Observation and identification of the different types of joints (P and D)
7.1.4 Skeletal muscles	Antagonistic arrangement and attachment to bones; functioning of muscles and skeleton to bring about locomotion	Observation by means of models (D)
	Levers: The three classes of levers	Observation of the functioning of the three classes of levers (D)
7.2 Transport		
7.2.1 Blood system		
7.2.1.1 Heart: structure and functioning	Suspension in thoracic cavity; pericardium; positions and functions of atria and ventricles, and the nature of their walls; position, attachment and functions of tricuspid, bicuspid and semi-lunar valves; main blood vessels to and from the heart	Observation and investigation of a mammalian heart (P or D)
	Cardiac cycle: systole and diastole; rhythm controlled by S-A node (Sino-Atrial node) and modified according	Determining of pulse rate before and after exercises; graphical representati (P)

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
7.2.1.2 Blood vessels: structure and functions of arteries, capillaries and veins	A comparative study, emphasising the structural suitability of each type of vessel for its particular role	
7.2.1.3 Circulation of the blood: closed, double systems; main blood vessels and their functions	Pulmonary circuit: pulmonary arteries and veins Systemic circuit: aorta supplying organs; venae cavae returning blood to heart Hepatic portal vein system Coronary circulation: coronary artery and veins	
7.2.2 Lymphatic system		
7.2.2.1 Origin and composition of lymph		
7.2.2.2 Plan of the system	Areas served by the thoracic and right lymphatic ducts; names of blood vessels into which they drain	
7.2.2.3 Functions of the system	Drainage of excess tissue fluid; return of plasma proteins to the blood; removal of bacteria and toxins; transport of absorbed fats from the villi; manufacture of lymphocytes	

APPENDIX II

S.G SYLLABUS FOR STANDARD 8

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
1.	ECOLOGY	This study is intended primarily to acquaint pupils with the inter-relationships among organisms and their environment	
1.1	Ecosystems		Continuous investigation of a selected ecosystem on the school grounds or any other attainable ground; graphical representation of information, where possible (P
1.1.1	The concept of an ecosystem	The naturally defined habitat in which there is a dynamic relationship between abiotic and biotic components	
1.1.2	The practical study of the structure of a selected ecosystem with emphasis on the relationships between its components	A preliminary superficial survey of the chosen ecosystem should lead to the selection of one or more abiotic and/or biotic components for further investigation These selected components should lend themselves to quantitative measurement from which tentative inferences about the distribution and inter-relationships of biotic components could be made	
	Abiotic components physical factors edaphic factors physiographic factors	Abiotic components which might be investigated include: light; length of day; temperature; water, including water cycle; atmospheric gases, including winds; soils characteristics such as pH (acid content), humus content, texture, water-holding capacity and air content; aspect, slope and altitude	
	Biotic components producers consumers (herbivores, carnivores and omnivores) decomposers	An investigation of selected biotic components to include a study of adaptations to habitat Involvement in succession and competition	

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
	Biological rhythms	Examples in the selected ecosystem caused by an abiotic factor/abiotic factors	
1.1.3	Symbiotic relationships	At least one example each of parasitism, mutualism and commensalism	
1.1.4	Trophic levels	Food chains, food webs and ecological pyramids	
1.1.5	Nutrient cycling	The significance and consequences of nutrient cycling (Details of carbon and nitrogen cycles NOT required)	
1.1.6	Biosphere	Brief outline only of the components: atmosphere, lithosphere, hydrosphere	
1.1.7	Terrestrial and aquatic ecosystems	Similarities and differences only	
1.2	Man and the ecosystem		
1.2.1	Pollution of air, water and land	At least one example of each type of pollution must be studied, and appropriate corrective measures should be considered	An investigation of at least one type of pollution in the environment with special reference to the effects of pollution and corrective measures (P)
1.2.2	Conservation of indigenous flora and fauna, and of other natural resources	Conservation as the wise use of natural resources A study of at least one programme of conservation that is being carried out	

APPENDIX II

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2. THE CELL An introductory study of certain aspects of cellular structure and organisation	The main structural features of selected components of cells as revealed by the light microscope and by electron micrographs	An investigation of the sub-cellular structure of a plant cell and an animal cell by means of e.g. electron micrographs (D)
2.1 Biological importance of protoplasm	General appearance, physical characteristics and chemical composition; relevant functions of water and proteins	
2.2 Membranes enclosing cells and forming intracellular partitions: properties, structure and functions	Structure: simple fluid mosaic model only Properties Functions	
2.3 Nucleus: location, identification and function	Functions: overall controller of cell; roll in heredity	
2.4 Ribosomes: location and function	Location: in cytoplasmic matrix, often attached to membranes of E.R. Function: sites at which proteins are synthesised	
2.5 Plastids		
2.5.1 Chloroplasts: location, identification and function	Location: in cytoplasmic matrix of some cells, usually positioned to obtain adequate light Function: sites of photosynthesis	
2.5.2 Leucoplasts: location, mention of function		
2.5.3 Chromoplasts: location, mention of function		

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2.6 Mitochondria: location, identification and mention of function	Location: in cytoplasmic matrix of most cells Function: site of final stages of respiration	
2.7 Vacuoles: location, identification and some functions	Location: in cytoplasmic matrix; often very large in cells of plants, seldom prominent in animal cells Function: storage of water, ions and soluble compounds; aids intracellular translocation; turgidity providing support for cell; mention of specialised vacuoles among others phagosomes, contractile vacuoles, lysosomes, dictyosomes	
2.8 Cell wall: location, properties and functions	Location: outside cell membrane of most plant cells Properties: rigid, comparatively non-elastic and usually permeable to water and most solutes Functions: e.g. support of cell; protection	
2.9 Other components of cells: endoplasmic reticulum Golgi bodies (dictyosomes) lysosomes centrioles	Recognition of these organelles as they may be seen in electron micrographs Awareness of their probable functions	
3. CELL DIVISION	It should be emphasised that additional cells are required by organisms for growth, repair, replacement, and in some cases reproduction	
3.1 Only the significance of cell division for growth	(The process of mitosis need not be studied at this stage)	

APPENDIX II

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
7.	SOME ASPECTS OF THE ANATOMY AND PHYSIOLOGY OF MAN		
7.1	Support and locomotion		For practical work a readily available small mammal or an available model of a skeleton may be used for observation and identification of the components of the skeleton
7.1.1	Axial skeleton	Skull: (Names of bones of skull not required) Teeth and jaws related to functions Vertebral column and rib cage: main regions of column; atlas and axis, with their functions; structure of a thoracic vertebra; interlocking of thoracic vertebrae and articulation of ribs; flexible attachment of ribs to sternum	
7.1.2	Appendicular skeleton	Girdles: components of pectoral and pelvic girdles; attachment of girdles to axial skeleton Limbs: main components (names of individual carpals and tarsals not required)	
7.1.3	Joints	Structure of joints	Observation and identification of the different types of joints (P and D)
7.1.4	Skeletal muscles	Antagonistic arrangement and attachment to bones	Observation by means of models (D
7.2	Transport		
7.2.1	Blood system		

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
7.2.1.1	Heart: structure and functioning	Suspension in thoracic cavity; pericardium; positions and functions of atria and ventricles, and the nature of their walls; position, attachment and functions of tricuspid, bicuspid and semilunar valves; main blood vessels to and from the heart	Observation and investigation of a mammalian heart (P or D)
		Cardiac cycle: systole and diastole	Determining of pulse rate before and after exercises; graphical representation (P.)
7.2.1.2	Blood vessels: structure and functions of arteries, capillaries and veins	A comparative study, emphasising the structural suitability of each type of vessel for its particular role	
7.2.1.3	Circulation of the blood: closed, double system; main blood vessels and their functions	Pulmonary circuit: pulmonary arteries and veins Systemic circuit: aorta supplying organs; venae cavae returning blood to heart; hepatic portal vein system Coronary circulation: Coronary artery and veins	
7.2.2	Lymphatic system		
7.2.2.1	Origin and composition of lymph		
7.2.2.2	Plan of the system	Areas served by the thoracic and right lymphatic ducts; names of blood vessels into which they drain	
7.2.2.3	Functions of the system	Drainage of excess tissue fluid; return of plasma proteins to the blood; removal of bacteria and toxins; transport of absorbed fats from the villi; manufacture of lymphocytes	

GUIDING PRINCIPLES FOR EFFECTIVE ENVIRONMENTAL EDUCATION PROGRAMMES

At the World Inter-governmental Conference on Environmental Education held at Tbilisi, in October 1977 ELEVEN guiding principles for effective environmental education programmes were adopted. These guidelines are still useful today.

An environmental education programme should:

1. Consider the environment in its **totality** - natural and built, technological and social, political, moral, cultural and historical, and aesthetic aspects;

2. Be a continuous **life-long process**; it should begin at pre-school level and continue through all formal and non-formal stages;

3. Be **interdisciplinary** in its approach, drawing on the specific content of each discipline in making possible an **holistic** and balanced perspective;

4. Emphasize **active participation** in preventing and solving **environmental problems** and working towards their solutions;

5. Examine major **environmental issues** from a **local, national, regional** and **international** point of view so that learners receive insights into environmental conditions in other geographical areas;

6. Focus on **current** and **future** environmental situation;

7. Emphasize the complexity of environmental problems and thus the need to develop **critical thinking and problem-solving skills**;

8. Utilize **diverse learning environments** and a **broad array of educational approaches;**

9. Focus on the learner's **own community** and relate topics being discussed state, regional, national and international issues and perspectives;

10. Relate environmental sensitivity, knowledge, problem-solving and value clarification at **every school level;**

11. Enable **learners to play a role in planning** their learning experiences and provide an opportunity for making decisions and accepting their consequences.

(Tbilisi Declaration, 1977)

SEMI-STRUCTURED INTERVIEW.

DATE OF INTERVIEW : _____

NAME OF INTERVIEWEE : _____

SCHOOL EMPLOYED AT : _____

DEPT.: _____

TIME STARTED : _____ TIME ENDED: _____

QUESTIONAIRE / SEMI-STRUCTURED INTERVIEW.

1. What is your main reference and guide for teaching ecology ?
2. Do you take students on field trips ?
   - 2.1 If yes, mention examples.
   - 2.2 If no why not ? Would you like to ?
3. Have you ever used the seashore for field trips ?
   - 3.1 If yes - which part of the seashore is used ? Why?
   - 3.2 Which concepts are taught ?
   - 3.3 Which resource materials do you use to teach these concepts ?
   - 3.4 Name some of the materials you use and the source.
   - 3.5 Are they readily usable or do they require adaptation to your needs ? (If sourced from outside).
   - 3.6 Do you do any form of evaluation of your field trips ? How is this done and what are your conclusions ?
   - 3.7 What, if any, problems do you experience when conducting excursions to the seashore ?

4. If no,
   - 4.1 Why not ?
   - 4.2 Would you like to use the seashore environment for teaching ecology principles ?
   - 4.3 If yes or no, why ?
   - 4.4 What would you like to have available to feel comfortable about going to seashore for excursions ?

5. Are you aware of any resource materials produced relating to the seashore, that are available to teachers ?
   If yes, mention some examples.

BIOGRAPHICAL INFORMATION SHEET.

1. How many years have you been teaching _____
   Which subjects ? _____
   Which standards ? _____

2. Where did you receive your teacher education ?
   (eg. Ed.college ,University etc)
   _____

3. To what extent did you study ecology during your teacher education ? (First year etc.)
   _____
   _____

4. To what extent did you study the seashore environment during your teacher education ?
   _____
   _____

5. To what extent did you study field work management during your teacher education.
   _____
   _____

6. Were you ever involved in any in-service training courses regarding ecology ?
   _____
   _____

The second part of my project involves exploring the opportunities of the seashore environment for teaching principles of Ecology with other teachers.

This will involve :

1. Attending a workshop at **OAKLANDS HIGH SCHOOL** on Thursday 14th October at 3.30 pm. to discuss some of the issues coming out of these interviews and to organise and prepare for a field trip to Dalebrook beach.

2. A field trip to Dalebrooke beach and a report back / discussion in the St. Andrews Church hall near the site on **the 16th October 1993** (Spring tide).

Transport and lunch will be provided for the field trip.

Are you willing to be part of project ? _____

STD. 8	ROCKY SHORE PRACTICAL	1993

RELAX ..... and welcome to the **Rocky Shore ecosystem**, where you are about to embark on an exciting, exhilirating and captivating period of ecological discovery.

EXERCISE C: ECOLOGICAL PYRAMIDS.

1. Mark off an area of 25cm by 25cm anywhere in the LOWER BALANOID ZONE.
2. Scrape off all the organisms inside of this area.
3. Divide the organisms into Producers (plants), herbivores (plant eaters), carnivores (meat eaters) and omnivores (meat and plant eaters).
4. Determine the mass of each of these groups, using the mass meter, and enter the values in the table below (sample 1). Get two more readings from other groups and enter them in the columns marked "sample2 and sample 3".
5. Since the omnivores are both carnivores and herbivores, add half their mass to the herbivores and half to the carnivores.
6. Calculate the average mass and enter it in the last column.

TROPHIC LEVEL	MASS OF ORGANISMS IN GRAMS			
	SAMPLE 1	SAMPLE 2	SAMPLE 3	AVERAGE
PRODUCER				
HERBIVORE				
CARNIVORE				

Enter the values from the "average" column into the diagram below.

TROPHIC LEVEL

CARNIVORE

HERBIVORE

PRODUCER

100 80 60 40 20 0 20 40 60 80 100

MASS IN GRAMS

EXERCISE D: INTERACTIONS ON THE ROCKY SHORE

The following exercises are designed to give you **hands on experience** with Rocky Shore ecology.

A. WHELKS: ROCK POOL SCAVENGERS

1. Choose a rock pool containing whelks.
2. Crush a periwinkle or small limpet and drop it into the pool, AWAY from the whelks.
3. For the next 3 to 5 minutes, record how the whelks react.....

.....

.....

4. How do you think the whelks were able to detect the food and move towards it?

.....

5. In view of your observations, why do you think that whelks form an important part of Rocky Shore ecosystems?

.....

.....

6. Compare the role of whelks in rock pools to the role of vultures in grassland ecosystems.

.....

.....

B. RED BAIT: THE HARD AND SOFT OF IT ALL.

1. Using a sharp tool (ask teachers) cut open one red bait, Pyura sp.
2. What is the colour of the animal's body? .....
3. Feel the animal's body. Is it hard or soft? .....
4. Use your ruler to measure the thickness of the coat (or test) that surrounds the animal. Record it. .....
5. Can you break the coat easily with your bare hands? .....

6. Why do you think the red bait has such a hard coat around itself? .....

.....

7. How many openings do you count on the coat? .....

8. Suggest three reasons why these openings are essential to the survival of the red bait. (Hint: imagine yourself in a thick, protective coat with no openings to the outside!)

.....

.....

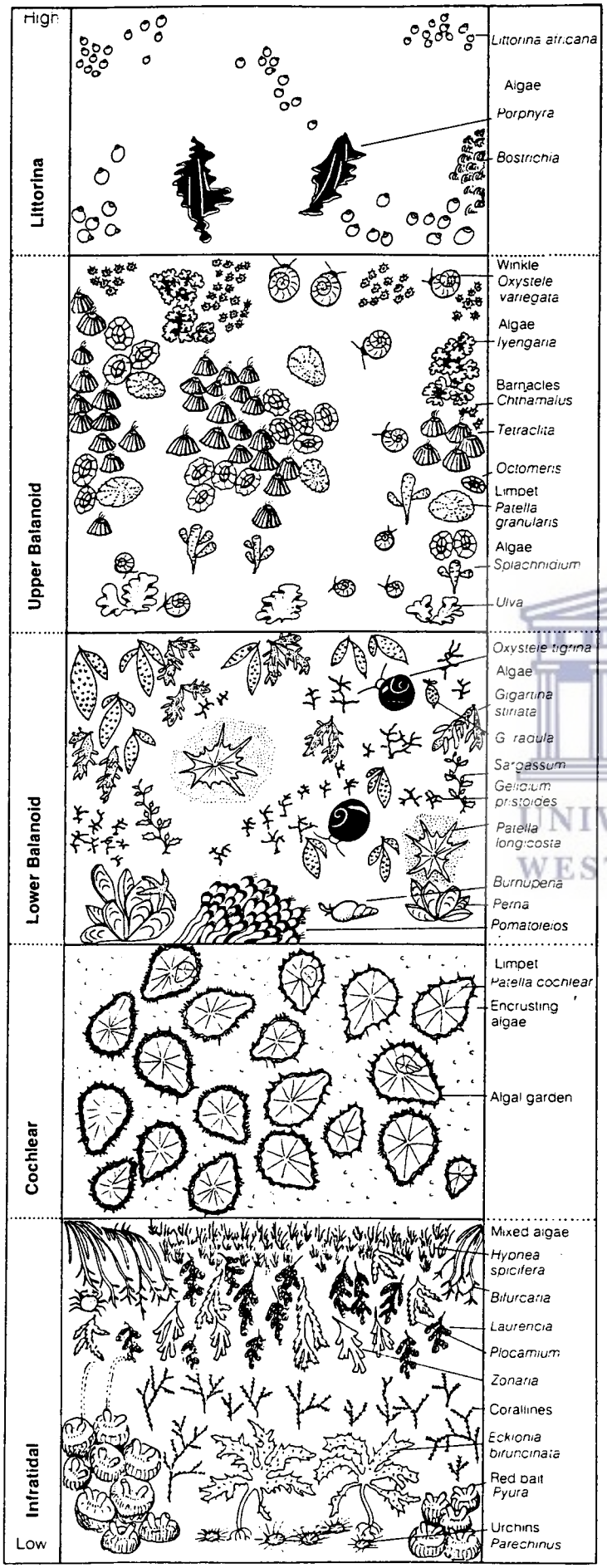
.....

9. Would you class red bait as a herbivore, carnivore or omnivore? Substantiate your answer.

.....

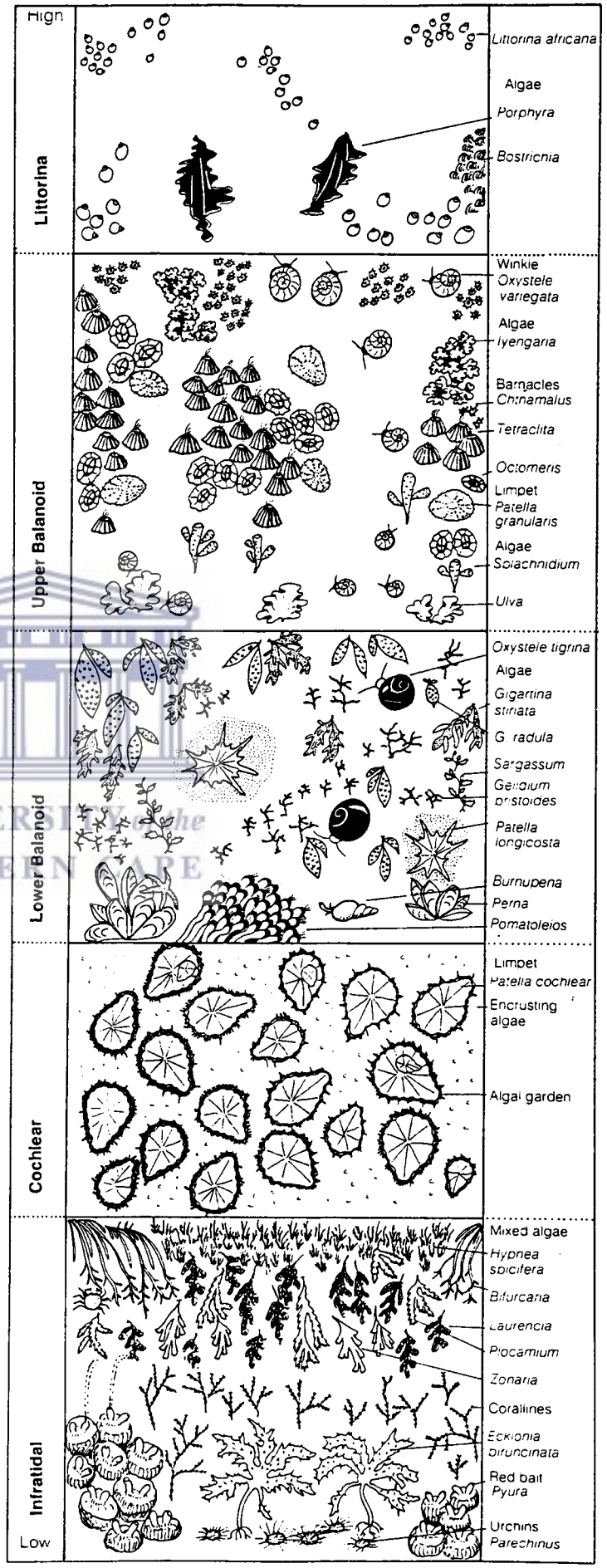
.....

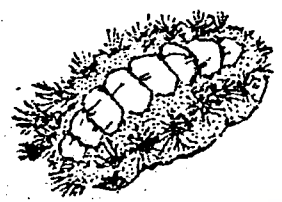
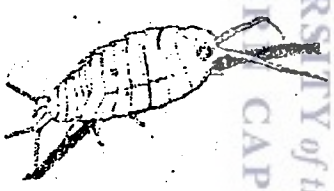
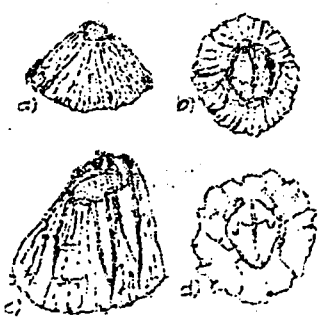
SOUTH COAST ZONATION

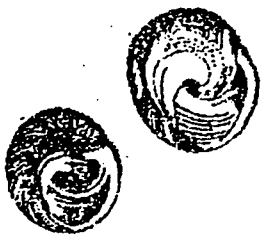
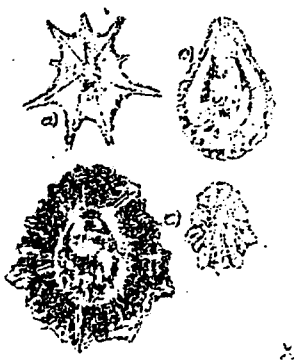


28 ROCKY SHORES

SOUTH COAST ZONATION



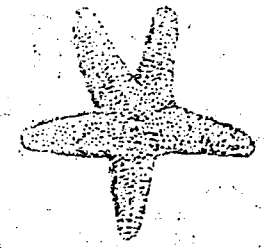
HALIOTIS ...	ONDER WATER 2. HERBIVORE HERBIVOOR	 x 0.75
ACANTHOCHITON	1. UNDER ROCKS ONDER ROTSE 2. HERBIVORE HERBIVOOR	 x 1.5
Sea cockroach LIGIA – Bamboesluis	1. AMONGST DECAYING SEA WEED TUSSEN VERROTTENDE PLANTE 2. HERBIVORE HERBIVOOR	 x 5
Barnacles a) TETRACLITA b) OCTOMERIS c) BALANUS d) CHTAMALLUS Mosselkrerels	1. ON BARE ROCKS BO-OP ROTSE 2. OMNIVORE OMNIVOOR	 x 3

Periwinkle OXYSTELE Taskulp	1. IN ROCK POOLS & ON BARE ROCKS IN POELETJIES & OP ROTSE. 2. HERBIVORE HERBIVOOR	 x 1.0
LITTORINA	1. ON BARE ROCKS BO-OP ROTSE 2. HERBIVORE HERBIVOOR	 x 7.0
Limpets PATELLA a) longicosta b) cochlear c) oculus Klipmossels	1. ON ROCKS & IN POOLS OP ROTSE & IN POELETJIES 2. HERBIVORE HERBIVOOR	 x 2

Sea Star
Seester

Rock Pools
ROTS POELETJIES

2. CARNIVORE
KARNIVOOR



X0.5

Starfish
HENRICIA
Seester

1. Rock Pools

2. CARNIVORE
KARNIVOOR

X0.5

Cushion-starfish
PATIRIELLA
Kussingseester

1. ROCK POOLS

2. CARNIVORE
KARNIVOR

X1.5

Blackmussel
CHLOROMYTILLUS
Swartmossel

1. ON ROCKS
OP ROTSE

2. OMNIVORE
OMNIVOOR

HALOLONA
Spons

ON ROCKS, IN
POOLS
OP ROTSE, IN
POELETJIES

2. OMNIVORE
OMNIVOOR

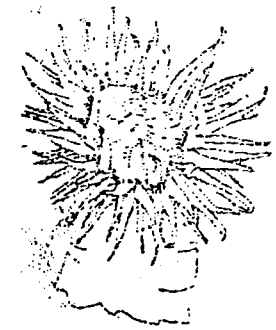
X1.0

Sea-anemone

See-anemoon

1. IN ROCK POOLS &
CREVICES
IN POELETJIES
& SLOTE

2. CARNIVORE
KARNIVOOR

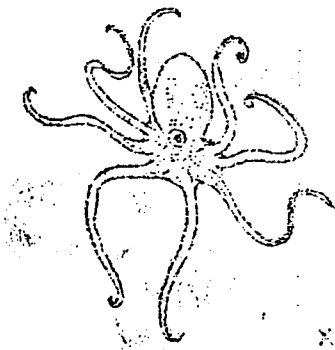


X0.5

Octopus
OCTOPUS
Seekat

1. IN POOLS
IN POELETJIES

2. CARNIVORE
KARNIVOOR



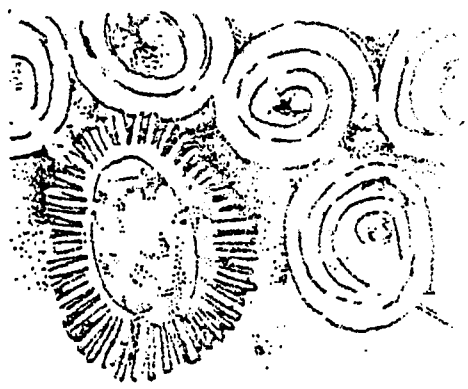
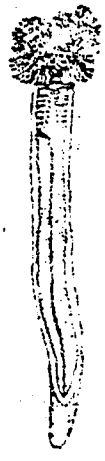
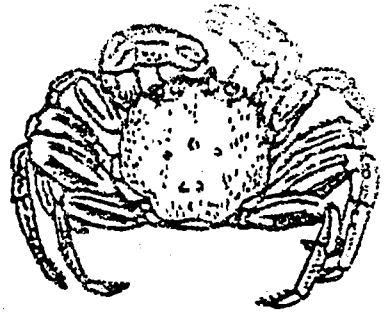
X0.

Starfish
MARTHASTERIAS
Seester

1. ROCK POOLS
ROTS POELETJIES

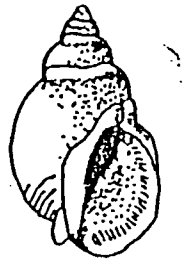
2. CARNIVORE
KARNIVOOR

X0.

False limpet SIPHONARIA Vals klipmoseel (With eggs/met eiers)	1. ON ROCKS, IN SMALL POOLS OP ROTSE, IN POELETJIES 2. HERBIVORE HERBIVOOR	
Fanworm SABELLASTARTE Waaierwurm (Part of the tube cut away/deel van die buis weggesny)	1. IN POOLS IN POELETJIES 2. OMNIVORE OMNIVOOR	
Rock crab PLAGUSIA Rotskrap	1. IN ROCK POOLS IN POELETJIES 2. OMNIVORE OMNIVOOR	
Sea urchin PARECHINUS Seekastaiing	1. IN POOLS & CREVICES IN POELETJIES & SLOTE 2. HERBIVORE HERBIVOOR	

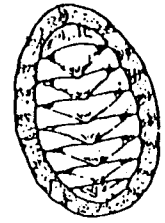
Oxystele variegata

Oxystele tigrina



Burnupena limbosa

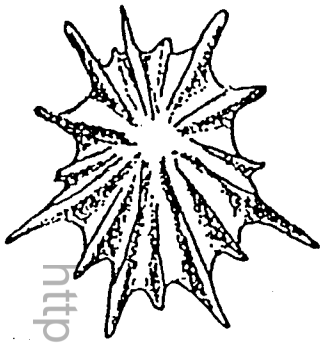
Littorina africana



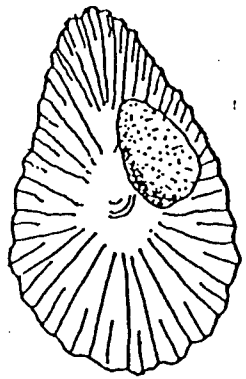
Chiton

CNIDARIA

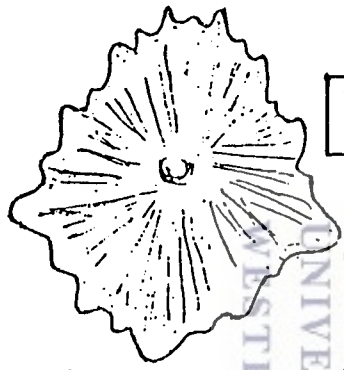
Sea anemone



Patella longicosta

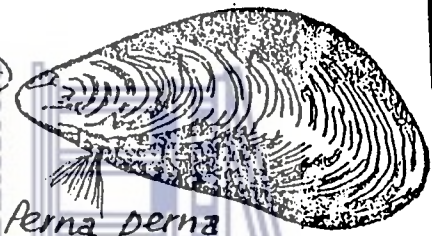


Patella cochlear

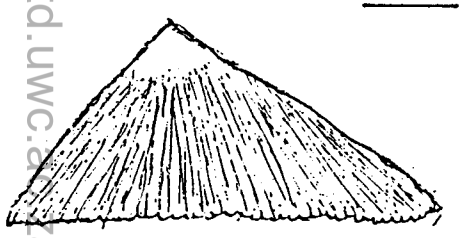


Patella oculus

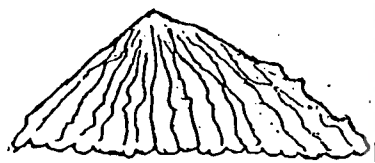
MOLLUSCA



Perna perna



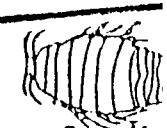
Patella argenvillei



Patella barbara

Octopus.

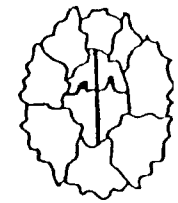
ARTHROPODA



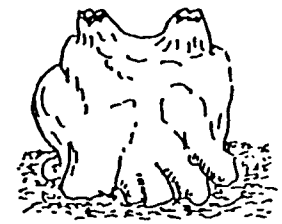
Sea lic

Tetraclita serrata

Ehthamalus dentatus



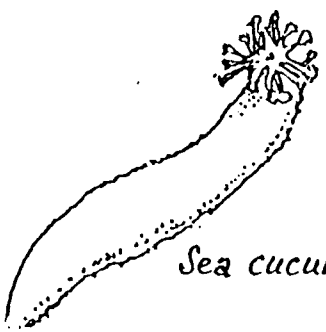
Octomeris angulosa



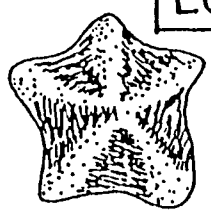
Pyura stolonifera.
(Red bait)

CHORDATA

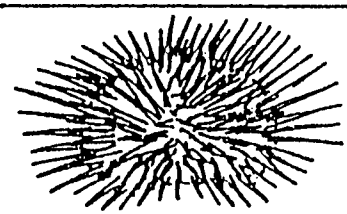
ECHINODERMATA



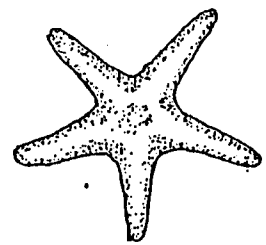
Sea cucumber



Sea cushion



Sea urchin



Sea star

ADDRESS LIST OF IMPORTANT INSTITUTIONS AND ORGANISATIONS INVOLVED WITH MARINE ENVIRONMENTAL EDUCATION AND MARINE RELATED EDUCATIONAL PROJECTS.

1. SEA WORLD

The Education Officer
Sea World
P.O. Box 10712
Marine Parade
DURBAN
4056

2. THE OCEANOGRAPHIC RESEARCH INSTITUTE

The Director
The Oceanographic Research Institute
P.O. Box 10712
Marine Parade
DURBAN
4056

3. TREASURE BEACH

The Director
Treasure Beach Project
835 Marine Drive
Bluff
4052
DURBAN

4. J.L.B SMITH INSTITUTE OF ICHTHYOLOGY

The Director
J.L.B Smith Institute of Ichthyology
Priv. Bag X1015
Grahamstown
6140

5. EAST LONDON MUSEUM

The Director
East London Museum
Upper Oxford Street
EAST LONDON
5200

6. SOUTH AFRICAN MUSEUM

The Director
South African Museum
Department of Marine Biology
P.O. Box 61
CAPE TOWN
8000

7. SEA FISHERIES RESEARCH INSTITUTE

The Public Relations Officer
Sea Fisheries Research Institute
Private Bag X2
Rogge Bay
8012

8. CSIR

CSIR
Earth, Marine, Atmospheric Science and Technology Division
P.O. Box 320
STELLENBOSCH
7599

9. ALBANY MUSEUM

The Director
Albany Museum
Somerset Street
GRAHAMSTOWN
6140

10. PORT ELIZABETH MUSEUM

The Director
Port Elizabeth Museum
Beach Road
Humewood
PORT ELIZABETH
6001

30 September 1993 **APPENDIX VII**

Dear Mrs Jacobs

NOTICE OF WORKSHOP AND FIELD TRIP.

This is to inform you of the dates and times of the workshop and field trip mentioned during our interview.

The time and date for the workshop was chosen to suit the majority of the people who agreed to be involved in the project. The date for the excursion is dependant on the tides and this date was chosen for its convenience. It is a spring tide which falls on a weekend and the time of the low tide (09h30) makes a visit the shore and a discussion and report back possible, in the morning session up to lunch.

WORKSHOP : Thursday 14 October at 13h30 at Oaklands High School Biology laboratory [Lab 3]. The agenda will be delivered early next week.

EXCURSION : Saturday 16 October 1993. Meet at Oaklands High School at 08h 30. Transport and lunch will be provided. [Low tide is at 09h 30].
Details of the excursion will be discussed and finalised at the workshop.

Please inform me if you are unable to attend so that the necessary arrangements can be made for transport and catering.

Thanks for your co-operation.

Yours faithfully

_____

[Chris Reddy - Project facilitator]
TELEPHONES : 7055581 (H)
7617302 (SCHOOL)

APPENDIX VIII

8 October 1993

Dear Mrs Jacobs

Herewith please find the following :

1. Proposed agenda for workshop.
2. Summary of interviews.
3. Map and directions to Oaklands High School.

PROPOSED AGENDA FOR WORKSHOP 14TH OCTOBER.

1. Welcome and Introduction.
2. Research questions and reasons for research.
3. Discussion of summary of the interviews.
4. Workshop : 4.1 Discussion of perceived constraints with a view to finding solutions
   4.2 Report back by groups
5. Planning of excursion : Saturday 16th October 1993.
6. Any other matters.

Thanks for your co-operation.
See you at the workshop.

Yours faithfully

_____

Chris Reddy [Project facilitator]

P.S. If time permits, please read the summary of the interviews, particularly the section on perceived constraints i.e why many teachers are not going to the seashore.

APPENDIX IX

TELEPHONE :7055581 (H)
:7617302 (W)

97 First Road
Grassy park
7945
30 September 1993

The Principal
Heathfield High School
HEATHFIELD

Dear Sir / Madam

RESEARCH PROJECT : MARINE ENVIRONMENT AND ECOLOGY TEACHING.

I am conducting a research project which involves an investigation into the possibilities and opportunities of the marine intertidal zone for ecology teaching in schools. The route I have chosen is to work with a group of Biology teachers from various schools in the Peninsula in order to obtain information concerning the needs, constraints, possibilities envisaged and the experiences of teachers in this regard. Teachers will be active participants throughout the project and it is hoped that the exercise will lead to an improvement in the practice of Biology teaching.

Part of the programme involves a teacher workshop at Oaklands High School on Thursday the 14th of October 1993 at 13h30 and an excursion to Dalebrook beach on Saturday the 16th October 1993 (08h30 to 13h00). The workshop has been arranged to provide a forum for discussion between teachers, to facilitate the exchange of ideas and to plan the excursion. On the excursion, two teachers will conduct activities which will be discussed and evaluated by the teachers present.

The aim of the project is to obtain information from and with teachers, first hand, so that a clear picture will emerge from the research. It is therefore important to draw on the expertise of as many teachers as possible in order to gain maximum insight into the opportunities of this exciting environment for Biology teaching.

I will appreciate it if the necessary arrangements could be made to make it possible for the teacher/s contacted at your school to attend the workshop and the excursion arranged for the above dates.

Thank you for your co-operation

Yours in education

[C.P.S. Reddy - Biology teacher Oaklands High School].

MARINE E. E. PROJECT

PROPOSED PROGRAMME FOR EXCURSION TO DALEBROOK BEACH - ROCKY SHORE.
16 OCTOBER 1993.

1. Rocky shore ecology exercise.- **Ashley Patience.**
2. Tea in Hall.
3. Discussion of activity on the shore in terms of some of the workshop discussions.
4. The way ahead.
5. Any other matters.
6. Lunch.

THANK YOU FOR MAKING THE EFFORT TO ATTEND THE EXCURSION AND FOR JOINING THE PROJECT.

Chris Reddy