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**A PILOT STUDY OF SECONDARY  
TEACHERS' UNDERSTANDING  
OF POPULATION DYNAMICS**

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THESIS

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by

**ATHOL JAMES TEMLETT HOCKEY**

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## **Abstract**

Population dynamics is a South African secondary school biology syllabus topic which deals specifically with ecology or concepts within the realm of ecology. It is currently taught in a way which largely emphasises the teaching and learning of facts and concepts, often out of any context to which students can relate. While it is important to convey scientific concepts, it is just as important to address social and political issues regarding overpopulation and the environment.

This research involved the administration of a questionnaire to Std 10 biology teachers in the Department of Education and Training (DET), which sought to obtain information about various aspects of teachers' teaching of population dynamics. These included their feelings toward the teaching of the specific sections of the population dynamics syllabus, and their knowledge and views of environmental issues and human population expansion.

The findings of the research suggest that population dynamics is an important topic for students to learn about. The traditional teacher-centred approach to teaching is used by the teachers in the research sample. The sections considered by the teachers to be most important for learning were also considered the most interesting and the easiest to teach. The majority of the teachers in the research sample recognised that human population growth is a global and local problem and that South Africa cannot sustain its present population growth. The teachers in the sample show a diversity of opinions about sustainable development, and have a limited understanding of the links between population, poverty and consumption.

Important information gained from the research will be significant in the development of a teaching and learning module on population dynamics that reflects the aims and purpose of environmental education.

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## **Preface**

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I would like to pay tribute to my parents for the life skills they have imparted and record the tragic and unfortunate death of my father during the last year.



## **Context of the study**

### **1.1 Introduction**

We live in a world where reports of environmental problems appear daily in the media. Occasionally, we hear or read about the culling of elephants in the Kruger National Park and the controversies surrounding this practice (Sunday Times, 1995). Effluent and pollution problems, other more pressing issues like food and housing shortages, and the rising price of petrol are topics that are high on the environmental agenda. Some of these may affect people in different ways and some may be closer to our hearts than others. With these and all the other innumerable environmental problems that are facing the globe at present, it is curious to note that very seldom is the connection made between these problems and the human population. It is almost as if "environmental issues could be addressed in isolation from the numbers of people who are generating them" (Grant, 1992). This statement, which was made with reference to the high population growth in the United States of America in the 20th century, applies equally on a global scale. How then should methods for solving these problems be addressed? Education, and in particular environmental education, takes a more critical view of these problems and through its policies and practice, attempts to seek solutions that will address them:

The rhetoric of environmental education focuses on improving the quality of life on the planet. Therefore environmental education has a revolutionary purpose of transforming the values that underlie our decision making from those that aid and abet environmental degradation to those that support a sustainable planet in which all organisms can live with dignity. This contrasts with traditional purposes of schools which have been charged with preserving the existing social order by reproducing the norms and values that currently dominate political, hence environmental, decision making. These contradictions between environmental education and schooling have not seriously been engaged by environmental educators (Hart, 1993: 117).

In the light of this quotation, there is a critical need for the reassessment of traditional education which serves the dominant social paradigm, and the adoption of environmental education philosophies which reflect the new environmental paradigm.

### **1.2 Environmental education and formal education in South Africa**

Until recently, environmental education was not part of the formal curriculum in schools in South Africa, although the need for integrating the objectives of environmental education in a core syllabus has been recognised (RSA, 1989). This issue has also been addressed by the Environmental Education Policy Initiative (EEPI, 1994a; 1994b). The

latest progress in this debate is that the new national Department of Education has identified environmental education as a priority within national curriculum development and that a proposal for an environmental education research project was submitted to the Heads of Department Committee (HEDCOM) and has subsequently been approved (Clacherty, 1995). Until recommendations from such an initiative are accepted fully and incorporated into the formal education system, aspects of environmental education can be implemented by teachers in most subjects at school level, as is being attempted by the *Enviroteach* programme, and the introduction of a subject called *Life Science* in Namibia (Myburgh, 1994). In the 1995 interim syllabus for biology, a new section, directly concerned with environmental education, has been added at Std 6 level.

One of the major challenges that we face in this country is that of relevant teacher education that reflects the thinking of environmental education. Early recommendations about teacher training were made in the White Paper on Environmental Education (RSA, 1989). Recommendations and outlines of content and skills to be taught in pre-service and in-service teacher education were recently made to the education authorities through EEASA and the Environmental Education Policy Initiative (EEPI, 1994b), and are presently in the process of being implemented (Irwin 1995 pers com).

There does, however, seem to be wide support for the incorporation of environmental education into the South African formal education curriculum. This is evident in the following extract from the RDP :

Strategies should include: environmental education programmes to rekindle our people's love for the land, to increase environmental consciousness amongst our youth, to co-ordinate environmental education with education policy at all levels, and to empower communities to act on environmental issues and to promote an environmental ethic (RDP, 1994: 40).

The most significant change regarding environmental education in terms of the formal education policy in South Africa is reflected in the White Paper on education and training in the chapter which deals with values and principles of education:

Environmental education, involving an interdisciplinary, integrated and active approach to learning, must be a vital element of all levels and programmes of the education and training system, in order to create *environmentally literate and active citizens* and ensure that all South Africans, present and future, enjoy a decent quality of life through the sustainable use of resources (RSA, 1995a: 21).

One of the most recent developments in environmental education in formal education, is the release of a discussion document (Joubert & Steenkamp, 1995) in which a set of guidelines for curriculum developers, education departments, teacher education institutions and student teachers is outlined. At the first Consultative Conference on Environmental Policy (CONNEP) held in Johannesburg, environmental education was highlighted in the additions made to the proposals which include the "right to environmental education and capacity building for effective and responsible participation by the public and in environmental management" (Klevansky, 1995:21).

### **1.3 Environmental education in South African school biology: an overview**

The teaching of biology and other scientific subjects at secondary-school level in South Africa has not been overtly concerned with environmental education. Certain aspects of the biology syllabus deal with the environment in terms of ecology and, to a lesser degree, environmental conservation, but not in a way that reflects the concept and philosophy of environmental education as it has evolved in recent years. This philosophy evolved after the Conference at Tbilisi and is well documented (UNESCO-UNEP, 1978; Irwin, 1990; Fien, 1992; Greenhall-Gough, & Robottom, 1993; UNESCO-UNEP, 1993).

A number of suggestions about the inclusion of environmental education in the school curriculum and particularly in relation to the biology syllabus have been proposed. Degenaar (1988b: 46) postulates an approach to environmental education that is strongly behavioural and, with reference to the topic 'ecology', suggests that the objectives and approach of the present biology syllabus "if truly applied, give ample opportunity for environmental education". He suggests that environmental education could be offered as an optional choice in a 'core-plus-options' curriculum with a multi- and interdisciplinary approach, and not attached to a particular subject (Degenaar, 1988b). Using the human population increase as a theme, Degenaar (1989) argues further that since environmental education deals with humans and their relationship with the environment, it is fundamentally biological and therefore worthy of being incorporated into biological education.

Loubser (1989) recognises the importance of the inclusion of environmental education at the tertiary education level. As part of the biological curriculum the teacher should plan the teaching around excursions in which learners are exposed to the environment. This is seen as an important teaching strategy within environmental education. Clacherty (1990), on the other hand, argues that this is problematic in terms of an environmental education approach to teaching and stresses the holistic view of the environment and the interdisciplinary nature of environmental education. In a subsequent publication, Loubser

(1993) recognises that a key teaching concept for environmental education is that it is in fact an 'approach'. Fraser (1993), from the results of a survey of subject specialists' ideas on an emphasis on environmental education in the teaching of biology at secondary school level, reports that most biologists favour a more integrated holistic approach, while others prefer an environmental approach, and yet others suggest that environmental education belongs in the junior secondary or junior level. Seaman (1993: 44), views the teaching of ecology as a dynamic system, and the importance of "ecological theory to ensure a better world" . Although Seaman shows good intentions in the article, it is poorly argued and contains numerous misconceptions. For example; "population growth is only a problem in the third world..." (Seaman, 1993: 41), "population increase in our cities is tapering off drastically but not so in rural areas" (Seaman, 1993: 42). In two recently published articles by Spargo (1995a; 1995b), there is a hint that science education has a role to play in addressing environmental problems. He suggests (1995a) that solutions to environmental problems are scientific, but recognises the importance of sensitising individuals to ways of changing their consumerist lifestyles, and stresses the importance of education in achieving this. In the second article (Spargo, 1995b: 31), he proposes the introduction of a subject called 'senior general science' at the senior secondary level, which will serve to inform all learners no matter what their vocational pursuits are. This will ensure scientific literacy for all in what he calls our "science-based society". Furthermore he sees this course as being issue-based, dealing with mainly science-related environmental issues. Although not overtly stated, this new proposal reflects an environmental education philosophy.

#### **1.4 Population Dynamics**

In this study, environmental education through formal education and, in particular, the biology syllabus is researched. The secondary school syllabus for biology in South Africa deals with ecology, or ecology-related topics in different standards. In Std 6, these are; *Dependence of plants and animals on the soil*, *Interdependence of organisms*, and the recently included section entitled *Interaction of people with the environment*. The latter is an attempt at including environmental education in a socially critical way. *Ecology* as a pure topic is taught in Std 8 and *Population dynamics* in Std 10. The research in this study focuses on population dynamics, which is listed as the final topic in the Std 10 Biology syllabus in South Africa. It was introduced in 1985 and examined for the first time in November, 1987. Since population dynamics is an important topic in terms of environmental issues, the teaching of it is a concern in environmental education. From this point of view, teachers have an opportunity to become engaged in the debate which deals with problems relating to human population growth, as well as some of the negative effects of the human impact, on the environment and ecology of the earth.

The topic deals with the definition of population, the parameters that affect population growth and the graphical representations of these, as well as the different methods of determining the size of a population. These concepts, which although important from an academic point of view, are theoretical in nature and mathematically complex. The development of these theories and concepts may require skills of graphing, interpretation of data and other higher-order cognitive skills which may have limited practical application beyond the classroom unless the student intends to apply them in a job situation such as nature conservation.

Other areas of the topic deal with population regulation in terms of carrying capacity, density-dependent and -independent parameters, competition and predation. The final section on survival strategies approaches some environmental problems facing humans and includes issues which are potentially highly contentious. In general, the biology text books used in South African schools present these sections in an unproblematic way (see section 2.3). A possible reason for this is the avoidance of sensitive issues that highlight the social inequalities that prevail in South Africa. For example, the promotion of lower population growth for the disadvantaged sector of the South African society could be construed as a ploy by the elites to further their own well-being. These and other issues which relate to the human population are dealt with in greater detail in Chapters 5 and 6.

Population dynamics is also important in terms of its potential to convey scientific and social concepts and concerns within environmental education. Not only does it deal with the factors that affect the growth of populations in natural ecosystems as well as the effect that human population growth and development have on these (Ehrlich & Ehrlich, 1990), but it also has the potential to address social and political issues regarding overpopulation and the environment (Lappé & Schurman, 1989). Issues of population, poverty and consumption as highlighted at the Earth Summit have implications that all South Africans need to be made aware of (Wynberg, 1993). These include problems relating to the inequitable distribution of resources, poverty and consumption. (These aspects are discussed in greater detail in section 2.4).

Since population dynamics also has the potential to raise important social issues, teachers could use these as vehicles not only to raise the students' awareness, but also to facilitate the development of critical thinking skills in the students. An important principle that could be promoted is that of considering the broader picture by examining multiple cause and effect, and in doing so, simplistic or dualistic thinking is discouraged (Chiras, 1992). The highly complex question of overpopulation and its perceived effects on the

environment (for example; pollution, ecosystem destruction, land degradation, resource utilisation, technology, economic and social inequalities and food shortages) has been explained in very different ways by differing schools of thought, as in Malthusian vs. Marxist thinking on population. It is only by stimulating critical thinking that some of these differing viewpoints are adequately explored and potentially resolved. This can also be facilitated through a process of critical pedagogy as espoused by Freire (1971). This process demands a dialogic relationship between the student and teacher which links theory and practice, and thoughts and actions through teacher facilitation, rather than instruction (Quinlan, 1993).

This type of approach in the teaching of population dynamics may assist in uncovering the social and cultural factors in environmental issues and may help to build in the students a sense of value and an environmental ethic. This will ultimately enable students to reflect on their own actions and attitudes in such a way that they can become meaningful agents of change, and thereby contribute to future sustainability.

### **1.5 Science Education Project**

At the time that the research was undertaken, the author was employed by the Science Education Project (SEP), which is a national NGO working in secondary schools in order to improve the quality of science education in South Africa (Rogan, 1985). The organisation is also concerned with introducing environmental education into science classrooms (Macdonald, 1993). In recent years, SEP has instituted a Curriculum Development Unit (CDU) which has the task of developing learning and teaching materials for Physical Science and Biology at secondary school level. Materials' development in SEP takes place along the lines of a 'participatory problem solving model' of curriculum development (Havelock and Huberman, 1977), in which teachers and students are involved in the various stages of development (Keogh, 1987).

The CDU produces learning materials in the form of worksheets for students, which are supported by teacher guides. The philosophy underpinning the development of these materials draws heavily on the educational theory of constructivism which urges teachers to draw on students' prior knowledge and to build on it through classroom interaction in order to arrive at socially constructed, scientifically acceptable explanations (Osborne & Freyberg, 1985; Bodner, 1986; Driver *et al.*, 1994). According to Driver and Leach (1992), a key feature of constructivism is that teachers also bring prior conceptions in terms of their subject knowledge and views of teaching into their classrooms. Hence in order to develop effective teaching and learning materials, it is necessary to establish the nature and extent of this knowledge. SEP recognises that scientific knowledge is both

personally and socially constructed and that it should not be isolated from the social concerns of the wider community and the environment (SEP, 1994). Robertson (1994) has argued that since environmental problems are also in reality social constructs, constructivism has an important place in the research aspect of environmental education.

In the light of the extent of continuing environmental degradation, there is an urgency to move away from the modernistic world view of education. In this world view, education does not promote ecological literacy, lacks knowledge of how actions disrupt the earth, promotes the conquest of nature, and promotes industrialisation within its unbalanced society. It is therefore essential to move to a postmodern view of education which must heal, correct, liberate, empower, create and celebrate. In postmodern education, schooling and learning ideally are integrated, and the students are ecologically literate (Orr, 1992).

### **1.6 Aims of the research**

Syllabus construction, examination demands, poor teacher education and reliance on text books as the only resource, are some contributing factors to teachers' inability to engage in innovative teaching methods and to adopt meaningful environmental education approaches in their teaching. In addition, the existing syllabus structure is strongly scientific in approach with topics being presented as value-free and non-problematic. With these as focal points, this pilot study was aimed at establishing secondary school biology teachers' views about the teaching of population dynamics and gauging their perceived needs in this field. Teachers' views and understanding of selected related environmental concepts were also sought. The use of a questionnaire which provided qualitative data was seen as the appropriate method to achieve this. The research sample in this pilot study comprised the teachers in the former DET schools in the Cape Town metropolitan area.

Although this is not an aim of this pilot study, the information gained here, and the information gained in a future nation-wide survey, will be used to establish guidelines for the development of a teaching and learning module on population dynamics through critical analysis of the conceptual demands of the syllabus, and through fieldwork with potential users. The completed module will take into account all the relevant findings of this and the future research. In the intended module, key aspects of environmental education dealing with populations, will be addressed. The module will include a section on human population dynamics, which will follow along the lines of socially critical environmental education.

Chapter 2 presents a review of literature pertaining to the study, and looks at text books and relevant research in population dynamics and related human population issues. Chapter 3 describes the research methodology and the research sample. The research findings and an account of the analysis and interpretation of these are presented in Chapters 4, 5 and 6. Chapter 7 deals with the conclusions, critical evaluation and recommendations that have emerged from this research.



## **Review of teaching materials and literature pertinent to the study**

### **2.1 Introduction**

In this chapter a number of text books and other teaching aids which are in use, locally and in other parts of the world are reviewed. The review of the text books is done within a framework of the teaching approaches evident in the text, and the treatment of the subject matter in terms of the concerns of environmental education. In addition to this, journal articles that deal with teaching aspects of population dynamics, are also under review. Section 2.5 is a review of the literature which deals with various aspects of the human population including environmental issues relating to human populations and the social, political and educational dimensions of human population dynamics. The final part of this chapter (section 2.6) looks at aspects of the South African population.

### **2.2 Approaches to the teaching of population dynamics in UK and USA school texts**

This section is a review of population dynamics as presented in three British text books, and a self instruction module from the USA. The first text, book by Mackean (1988), has been written for the GCSE for age 16+ in Britain. In the foreword "to the student" some idea of the educational aims and objectives is expressed. The emphasis is on learning for the use and understanding of biological knowledge, and not purely for committing to memory. The book is described as being important for the acquisition of facts and information which would then enable the student to demonstrate understanding or apply biological principles. The text in the book consists of core and extension materials. In the section which deals with populations, short sections on population growth and fluctuations, a brief explanation of population dynamics, and a section on human populations are presented. In general, the sections are very superficially dealt with, and the text is interspersed with questions from specimen GCSE examinations. Some of the questions require the student to refer to the information in the text and diagrams, and to answer questions specifically related to this. The importance of studying population dynamics, according to Mackean (1988), lies in acquiring understanding of the interrelationships between living creatures in order to maximise the exploitation of certain fish, whales and other species without endangering the economic viability of these populations. Although the term 'sustainability' is not mentioned, the overt message in a sense portrays the concept of sustainable utilisation of resources by humans. A knowledge of population dynamics is also seen as important for combating animals and plants which are regarded as pests. The importance of biological control, pesticide usage, and high density cultivation as strategies for pest control, is mentioned. In the short section on the

human population, the alarming rate of human population expansion is pointed out, and the demand for resources noted, but little mention is made of the environmental consequences. Mackean (1988) does recognise the importance of family planning in limiting the rate of population growth.

In Britain, in addition to the GCSE curriculum, there are also the more advanced A-levels. At this level, population dynamics is a separate topic within the section on ecology and evolution. In the *Revised Nuffield Advanced Science* series edited by Monger (1986), the section on population dynamics is dealt with in a highly academic way, using a strictly scientific approach, presumably to prepare students for tertiary education. The main text is accompanied by a teachers' guide as well as a students' practical guide. There is also an emphasis on practical work and the application of practical techniques. Data-response questions are included as study items. The course is highly detailed and treats the topic in a way which one would expect from education at the tertiary level. The section on human populations, which is potentially emotive and significant in terms of environmental education, is also treated in a scientific manner. The text does not mention the first-world population and its definitive role in the exploitation of the environment, but generalises the effects of global human population increase in terms of soil erosion, desertification, pollution, deforestation, over-fishing and the effects these are having on the atmosphere and the oceans (Monger, 1986).

In the text book by James Torrance (1993), written for the Scottish Certificate of Education (SCE), population dynamics is treated in a purely scientific way as in the case of the other books reviewed. In discussing population stability, Torrance (1993) does mention the fact that other populations in an ecosystem are stable unless there is human intervention. In the sub-section dealing with factors that influence population change, a few examples are used for explanatory purposes, e.g. the springtail population and soil conditions. A variety of questions is included to test the student's knowledge, recall and ability to interpret data. Torrance has a second section which deals specifically with the monitoring of populations in terms of food, endangered species and indicators of environmental health. Examples of populations in terms of sustainable yields in the fishing industry, and the conservation of wild life species of birds, plants and large mammals are discussed. Pollution indicator species, e.g. Stonefly and Mayfly larvae for fresh water quality, and lichens for air pollution, the effect of pesticides on birds of prey, and phytoplankton as indicators of the state of our oceans, are given as specific examples for monitoring the health of the environment. The third section on population dynamics deals with plant succession. In it, mention is made of how human intervention has literally

changed the landscape of Britain from a climax deciduous forest to agricultural farmland, human settlement areas and conifer forests (Torrance, 1993).

These books from the UK are written within a scientific paradigm, and none of the texts make reference to attitudes and values with respect to the environment and environmental issues. The social, political and economic factors relating to the human population problems, whether they pertain to developed or developing countries, is not mentioned. Environmental education was clearly not an intention of the authors.

An interesting and innovative approach to population dynamics is presented in a study unit from the USA on population dynamics produced by the *Wards Solo-learn System* (1974). This consists of an audio-cassette tape which explains the concepts and theories, a colour filmstrip which complements and illustrates graphically the concepts presented in the audio tape, and a set of review sheets which the student can use for revision. The producers recognise that because of the human population explosion, and the impact that it will have on our way of life, there is a need for people to have knowledge of factors involved in population dynamics. An important point made by this study unit is the need for the control of the human birth-rate, but the various opposing arguments against birth control (for example religious, moral, ethical, psychological and political) are also presented. This study unit is notably different from the other text books in that it approaches the teaching of the various aspects of population dynamics with the human population being used as the main example. The significance of this is that learners are able to relate more readily with the reality of human populations rather than having to cope with examples of populations of other species which may not be of concern to them.

### **2.3 The approach to the teaching of population dynamics in South African school texts.**

This section is a review of five school texts and one revision aid in use in South Africa. These have been written in accordance with the syllabus, which can generally be accepted as a set of intentions or guidelines which are to be followed in the teaching of a topic. Since it is doubtful whether any teachers in South Africa use the syllabus exclusively as a guide, it can be assumed that in most cases the teacher relies on the text book which is available at the school, as the source of content for the subject as well as for curricular guidance. There are some teachers however, who do not rely on only one book, but make use of supplementary materials and different texts to enhance their coverage of the subject matter. The authors of the school text books under review have interpreted the South African National Biology syllabus as they see appropriate, and have written them accordingly. Some text books are detailed and comprehensive (Du Toit, *et al*, 1987;

Ayerst, *et al.*, 1987; Smit, *et al.*, 1987), while others cover the syllabus exclusively with little in the way of explanation or enrichment exercises (Scholtz, *et al.*, 1991; Austoker & Eloff, 1988; Grogan & Suter, 1993). In the review of the sections dealing with population dynamics in the various school texts, cognisance was taken of the objectives and philosophies of the authors. These may be stated in the preface or foreword to the book, or may be gleaned from the text and treatment of content in the book. Ayerst *et al.* (1987) and Du Toit *et al.* (1987) do not offer a foreword or preface.

In the foreword of Smit *et al.* (1987) the authors pride themselves on scientific accuracy, comprehensive summaries, practical investigations and comprehensive self-assessment items. The section on population dynamics, and especially the theoretical and scientific aspects thereof, fulfils these criteria in that it covers all the syllabus requirements comprehensively and accurately, with extensive practical activities. Difficult concepts are clearly explained and reinforced with enrichment exercises. The section dealing with human populations and problems is well researched, and accurately presented. Issues of a political, social and economic nature are also dealt with, but with minimal elaboration. For example the comparison is made between populations of developed and developing countries in terms of utilisation and distribution of resources. In this argument the reasons given for starvation in Africa and Asia include "a shortage of technical know-how and knowledge of agricultural methods" (Smit *et al.*, 1987: 491), the unavailability of first world mechanised equipment and agricultural methods, and malnutrition (as a reason for not being able to engage in manual labour in fields). These views are questionable and short-sighted and do not explore the real underlying political, social and economic causes of the problem. These causes are discussed in the latter part of this chapter (see section 2.5). Comparisons of birth- and death-rates of populations in first world and developing countries are made, and reasons for the high population growth rate in developing countries is explained in terms of declining death rates due to the introduction of health measures. The authors speculate about solutions to the population problem, but limit their arguments to family planning and birth control. Although some hint of the importance of education to promote family planning is evident in the text, it is said that this should occur "during their school years when the principles of ecology in a subject such as biology are discussed" (Smit *et al.*, 1987: 493).

The book by Ayerst *et al.* (1987), deals with the theoretical aspects of population dynamics in a scientifically accurate manner, complying with syllabus requirements. Relevant practical activities are included, and assessment questions conclude the two chapters on population dynamics. The growth of the human population is described as an epidemic, caused by rising natality (birth-rate) and declining mortality. Human tragedies,

including the Black Death, the influenza epidemic of 1918 and the two World Wars, are given as examples of instances of large declines in the human population, that have had no impact on the rate of population growth in the world. References are made to Malthusian prophecies of mass starvation and suffering, but the attainment of demographic transition (the change from large to small families when mortality is reduced), is given as a solution to the present population growth. Improvement of family income, high educational standards and high national productivity are cited as catalysts for demographic transition. The authors state that biology, and therefore population dynamics, is an important subject to learn about because "many of the most important problems that threaten humankind are biological", making references to "the control of pests and weeds" and "most efficient use of fisheries and conservation..." (Ayerst, *et al.*, 1987: 392). Other problems caused by humans, for example monoculture with its associated fertiliser and pesticide usage and the related ecological hazards, are discussed and contrasted against effective biological control. Problems of food production in Africa are attributed to deforestation, soil erosion and desertification, but the true underlying socio-politico-economic reasons for these occurrences in Africa and problems in other developing countries is not alluded to. The over-exploitation of natural resources like fish and wild life is mentioned in terms of the superior predatory abilities of humans, but the study of the population dynamics in terms of these resources is seen as important by the authors. In order to "harvest them forever..." [sustainable utilisation?], "sensible controlled use of the worlds resources would enable us to feed our growing population more effectively" (Ayerst, *et al.*, 1987: 403). The environmental education contribution made by Ayerst *et al.* (1987) can be classified as education *about* the environment since issues are raised and problems are highlighted but there is a generally negative attitude about the workability of the possible solutions offered. The book also contains colour plates depicting various environmentally destructive aspects of populations, including overgrazing by domestic livestock, and habitat destruction by elephants in a game reserve. The use of these could serve to raise students' awareness of these problems.

Du Toit *et al.* (1987) treat population dynamics in a highly academic fashion, and it is clear that the book was written with final examinations in mind. The content, as with the previous two books, is scientifically accurate and closely follows the syllabus. Practical activities are included in the form of assignments, which may create the impression that they are not necessarily important. Very few assessment items are included. Human population trends, and a recognition that war and disease no longer pose a threat to human population expansion, are discussed. Famine is described as a problem in the developing countries and it is said to relate to the high population growth, but underlying social and political influences are not discussed. Problems of food shortages in developing

countries are glibly ascribed to lack of natural resources and failure to utilise them correctly. Reduction in birth rate is seen as the only solution to the population growth problem in the developing countries. Family planning is not mentioned. From the types of statements made by the authors, it is clear that they are not fully aware of all the highly complex socio-political and economic aspects of the so-called third world countries.

The books by Smit *et al.* (1987), Ayerst *et al.* (1987) and Du Toit *et al.* (1987) are three of the texts that are generally in use in the former 'White' schools. Potentially sensitive socio-cultural and economic problems are ignored or at best very superficially dealt with. It almost seems like the truth is being hidden from the learners. The reason for this could very probably be linked to the prevailing political climate of the late 1980's coupled with its culture of non-transparency, or possibly the authors of the books were unaware of the real underlying problems especially in the developing countries.

The following three books reviewed here are used exclusively in the former DET schools, although it is not certain that they were actually written with that particular readership in mind. There is a vastly different approach not only in the writing styles adopted by the authors in these books, but also in the coverage and treatment of the subject matter. Scholtz *et al.* (1991), and Austoker & Eloff (1988), are both text books in the true sense of the word, but Grogan & Suter (1993) is a book written primarily as a study guide designed to coach the learners into passing the final external examination. The preface in Austoker & Eloff (1988) states specifically that the book was written to meet the requirements of the then Department of Education and Training. The overt intentions of Scholtz *et al.* (1991) are stated in the preface as complying with the requirements and objectives of the national syllabus. This book is almost exclusively used in the former DET schools.

The style of information dissemination in Scholtz *et al.* (1991) is peculiar in that it is given in numbered point form, with each numbered item representing one fact or concept, sometimes out of context and without logical progression. This approach therefore encourages rote learning with little or no understanding. The section on population dynamics was previously published in a separate booklet by Degenaar (1988a) in which he states in the preface that "many practising biology teachers do not have the basic training in theory and /or practical experience...", and that the objective of the publication was to provide teachers with the necessary knowledge and theoretical background to population dynamics. These objectives as stated must be questioned in the light of a paucity of in- depth explanations of concepts, and omission of some important practical aspects of the topic. The practical exercises are all of the same type, and few assessment

items are provided. The content is dealt with in a skeletal fashion. Empty and meaningless statements are made and the general tone of the text is condescending. The following unsubstantiated quote illustrates this point:

Man must make important decisions about the use of chemical insecticides and herbicides to control populations of pests and weeds. The biological control of these elements should be thoroughly investigated (Scholtz *et al.*, 1991: 361).

The sections dealing with wildlife and agricultural management are basically recommendations, but are stated as a set of instructions. From an environmental education point of view this text book is hopelessly inadequate. Few points of environmental concern are raised, and no discussions are presented if and when such concerns are mentioned.

As mentioned earlier, the text by Grogan & Suter (1993) is written as if its objective is to prepare the aspiring matriculant for the final examination. The facts, concepts and definitions are clearly stated and in most cases adequately explained. They are, however, also presented in point form for ease of memorisation. There are no practical activities, but the assessment is thorough. After each section, a series of self-assessment tests is provided for the learner to answer. The answers for these tests are provided at the end of the chapter. The text is punctuated by graphic characters which give hints about details which are important for the examinations. The section dealing with human populations is adequately and accurately presented as scientific fact, but the social, cultural and economic aspects of these problems are ignored. The impact of human population growth on the natural environment is also not mentioned. The environmental education aspect of population dynamics is consequently not addressed.

The final book reviewed here, (Austoker and Eloff, 1988) was written and edited specifically for use in the former DET schools. A work programme identical to the one issued to the DET schools appears in the introduction to the book. The concepts and principles of population dynamics are presented in a less scientific manner. The authors have researched the topic well, and provide a reading list of books and articles that would be beneficial to the learners in terms of understanding the social, political and economic aspects of human population dynamics. The authors have given a balanced view of the environmental problems and issues revolving around the human population. Numerous examples of human intervention in natural habitats are listed. These include resource exploitation, deforestation, desertification, pollution, disruptions of wildlife migratory patterns through habitat destruction and the erection of fences, as well as the problems of

pesticide resistance, and increases in pests associated with the practice of monoculture. Social factors affecting fertility in humans are discussed in terms of standards of living, education, urbanisation, birth-control, poverty and hunger. Although the authors allude to all these factors, they are only briefly discussed.

One notable difference between this book and the others reviewed here is that a number of probing questions are asked and learners are encouraged to debate social issues which are important in terms of the environment. Some of these questions deal with issues such as rural wood usage, use of natural resources, human impact on the environment, population expansion in developing countries, consequences of human population increase, and many other important environmental issues. These features make this book more inclined towards environmental education than do the other texts that have been reviewed.

One major characteristic of all these school text books is that, more often than not, they are written for the sole purpose of disseminating information in a manner which is value-free, non-threatening, scientific in nature, and is not necessarily concerned with environmental education. The issues that are a concern of environmental education are presented in a non problematic way, and rarely, if ever, is more than one side of an argument presented.

#### **2.4 Research in population dynamics education**

Since population dynamics forms an integral part of ecology, there are a number of practical activities that can be done that clarify certain of the concepts mentioned in the text books. These include mathematical calculations, computer simulations of population-growth numbers, and the use of different survey methods for enumerating populations. Some of these form the basis of research which has been done in other countries, and are worth reviewing. The study of cockroach populations (Cowles, 1984) as a means of gathering data for the ultimate control of them, teaches some very basic principles of population dynamics in terms of growth and natality. The value of similar studies using food pests (like the domestic book louse) have been described by Turner (1988), as important for the development of the study of population dynamics. Gilhooley (1985), suggests that the 'mark-recapture' technique, for the estimation of population numbers, can be taught by using a 'population' of supermarket shopping trolleys.

Population dynamics includes studies of aspects relating to density-dependent and density-independent factors which influence populations. In this respect, a study of flowering plants and their pollinating agents has been suggested by Sutherland and Watkinson



(1988) and the investigation of populations of magpies in Britain by Birkhead and Clarkson (1985). In the study of human populations, a degree of sensitivity is needed. Brouse (1990) proposes the use of various simulations which are sensitive to moral and ethical aspects of human populations, to create awareness about issues regarding human population growth.

Since population dynamics is about the fluctuations in growth of populations over time and under variable conditions, it is possible to use computer programs to simulate and ultimately predict population-growth patterns. In this regard a number of computer programs which simulate population processes have been described. Examples of overlapping and discrete generations and density-dependent and density-independent population regulation were demonstrated by using a programmable pocket calculator (Kidd, 1979). This model was later revamped and extended using a computer program (Kidd, 1984). Other computer programs have been written to illustrate the evolutionary strategy of honeybees ( McLellan & Rowland, 1983), and the effect that average family size will have on the population of the USA (Palmer, 1987). Although these computer simulation models are useful for teaching the principles of population dynamics, computer aided predictions of wild life populations in reserves have also been proposed. The use of a computer spreadsheet for the study of the population dynamics of mountain reedbuck has been illustrated by Norton, (1994). The application of a program like this for use in the field is an indication of the diversity of microcomputers, not only for demonstration purposes, but also in important environmental issues.

The study of population dynamics gives learners an insight into the parameters that play a role in the fluctuations and interrelatedness of natural populations. Learning about population dynamics as a subject in the school curriculum has useful applications when applied to situations in nature and in considering the commercial exploitation of populations of living resources. The words of Baird (1983: 53) clearly spell out a warning: " One of the greatest challenges in modern population ecology is to manage natural populations in such a way as to prevent extinction through commercial exploitation". Furthermore, he warns that humans are only able to harvest what nature provides, and that the management of the natural resources must be placed on a sound scientific basis through the application of biological, economic and social values (Baird, 1983). Brown (1995), alerts us to the proliferation of the human population and the devastating effects it has had on the populations of other species. This can be seen in the shrinking fish catches, the decline in natural populations due to the erection of fences, and the reduction of bird populations because of deforestation and the drainage of wetlands.

## 2.5 The human population - global perspectives

With a global increase of the human population in the region of a quarter of a million people per day, the question arises: for how long will the earth be able to sustain such a population increase, and at what cost to global resources and the habitats that populations of other species need for continued survival? It is common knowledge that a bacterial population living in a culture medium increase in number exponentially until it reaches a stationary phase where it will remain for a very short while until the build-up of metabolic waste products and lack of food causes it to crash, with few survivors. Since present human population growth is in the exponential phase of the logistic growth curve, a similar scenario may await humankind if measures are not taken to reduce resource usage, and curb growth (i.e. to live within the carrying-capacity of the earth).

A group of international scientists called the 'Club of Rome' (Meadows *et al.*, 1972), predicted that if humans continued to conduct their way of life along the trends of the late 1960's, there would be a dramatic increase in human death-rate around the year 2050. This will have been as a result of an over-utilisation of non-renewable mineral resources, an increase in levels of pollution, and a severe food shortage. The timely introduction of ideal population and pollution control, recycling of resources and restoration of production on infertile land, they claim, will result in stabilisation of the human population within the carrying capacity of the earth. According to Mackenzie (1994a), the 'Club of Rome' based their predictions amongst other things, on the Malthusian philosophy that human population increase is determined by the world's food supply. They did not, however, take into account technological developments (in this case the short lived Green Revolution) which seemingly averted world wide famine. In a counter argument, Karl Marx has blamed famine not on the world's inability to produce, but on the unequal distribution of food. Other neo-Malthusians (Ehrlich & Ehrlich, 1990; Brown, 1995), warn of impending disaster due to food shortages and other natural catastrophes. Besides the increasing need for grain as a food-source for humans, through increasing prosperity through industrialisation, there is an increased demand for meat in developing countries like China and Mexico (Mackenzie, 1994a). This requires additional grain for feeding livestock, thereby putting agricultural production under greater pressure. In China, with increased conversion of agricultural land in a drive for industrialisation, the need for importing grain will increase beyond the capability of the world to provide (Brown, 1995). The problem of food production is further exacerbated by falling water tables, increased soil erosion and an increase in production costs. With the present growth in the human population, and doubtful advances in agricultural technology, there will have to be increased support for rural development and agricultural research, or else, according to Mackenzie (1994a) the Malthusian prophesy may become a reality.

Bongaarts (1994), uses a similar argument to support a notion that the world will be capable of supporting a population of 10 billion by 2050. The notion is based on an improvement of agricultural technologies in developing countries, an increased food production since 1965 (by bringing more arable land under irrigation), dropping food prices, and a need for government policy reforms. New measures in food production however are expensive, and have a negative impact on the environment in terms of destruction of biodiversity, deforestation, soil erosion and pollution. A reduction in population growth rates will, however, make the task of feeding the world less difficult (Bongaarts, 1994).

Human population growth has been described as a planetary cancer and has been modelled on pathogenic processes (Hern, 1992). The most important parameters governing human population dynamics are natality and mortality. Population growth is exponential primarily because of a reduction in mortality. This has been attributed to improvements in medicine, hygiene and farming. Ehrlich (1989) regards the development of medical science as being the proverbial straw that broke the camel's back. He qualifies this statement by blaming the almost instantaneous importation of 'death control' (meaning public health programmes) into developing countries, for lowering death-rates and increasing birth-rates (Ehrlich, 1989). In a different argument (Mackenzie, 1994b), population growth has been attributed to increased immunity to disease since 1750 in the Far East due to the extensive migration of people at that time. According to McNeill, (quoted in Mackenzie, 1994b: 33), "It seems plausible to connect the modern surge of population growth with the changed incidence of exposure to lethal infections". In developed countries the reduction in mortality has been accompanied by a corresponding reduction in natality due to reduced infant mortality, and birth control. This demographic transition however has not reached the developing countries where most of the population increase is taking place. Demographic transition in these countries is more difficult to achieve due to problems relating to status of women and the traditionality of large families, and cultural values such as male egos in agrarian societies (Chesnais, 1994).

One very important factor that needs to be taken into account when discussing demographic transition is that of social power. When indigenous people in developing countries have been denied power through changes brought about by uneven development, they have depended on large families as their source of security and power. It has been argued this problem can be solved:

... convincing historical evidence suggests that when individuals and families are gaining power because their rights are protected - particularly the rights to education, medical care including contraception, old-age

security, and access to income-producing resources - they no longer have to depend only on their own families for survival (Lappé & Schurman (1989: 68).

A similar sentiment is echoed by Rowley (1994) in which she stresses the importance of increasing rural peoples' access to contraception and family planning. This should be accompanied by giving women a greater choice in their fertility through education and health care. It has been suggested by Speth (cited in Rowley, 1994) that this could be achieved if 20 per cent of developing countries' aid budgets are spent on health and family planning, education, and water supplies, and less spent on arms.

The study of human population and the effect it is having on the earth's natural resources and biological diversity, is critical in terms of environmental education. Economic pressures on developing countries has also had the effect of forcing people off their traditional land to make place for cash crops, cattle ranches and crops for export. Fertile land is being monopolised by the rich, leaving only marginal land for the masses. This has lead to overgrazing, over-cultivation, land degradation and soil erosion (Lappé & Collins, 1989). The problem is of course much more complex. It relates to the patterns of consumerism in the developed countries and their reliance on the developing countries for natural resources. In many cases, developing countries have inadvertently landed up in the almost irreversible situation of having to use their best lands for export and cash crops, and to export natural resources like wood to pay back development loans to the World Bank and ultimately to developed countries. This situation has been exacerbated by the actions of rich landlords and other elites in developing countries. In addition, much of the western industrialised societies rely on imports from the poor third world countries to fuel their need for consumption. The consumer society which makes up about one fifth of the world population is already using up 80 per cent of the world's resources. Durning (1992: 149-150) outlines consumerism and warns that if we are to leave a world "...as bountiful and as beautiful as we have enjoyed..." , then there is a need for us to change from our consumerist way of life to a lifestyle similar to that of the people "...on the middle rung of the world's economic ladder". A similar view is expressed with reference to the indigenous peoples of the world by Strong in the foreword to a book by Burger (1990):

They are the guardians of the extensive and fragile ecosystems that are vital to the well-being of the planet. ... The notion of sustainability, now recognised as the framework of our future development, is an integral part of most indigenous cultures. ... While no-one would suggest the remainder of the more than 5 billion people on our planet would live at the level of indigenous societies, it is equally clear that we cannot pursue our present course of development. Nor can we rely on technology to provide an easy answer (Burger, 1990: 6).

Rath (1993) argues that problems of poverty, population and environment are intertwined, and that the rate of population growth in poorer countries is making it impossible for such countries to get health services to all and to be in a position to provide employment for all its citizens. Increased urbanisation and squatter settlements create problems of social peace, and unwanted immigration, in search of better living conditions and more space. This could lead to a number of problems including xenophobia (Rath, 1993). The global migration patterns in modern times far outweigh those of the pioneers (Kane, 1995). Migration in modern times is due mainly to political, security, economic reasons, and population pressures. The recent refugee problem in Rwanda bears testimony to this. Other types of migrations like the "population transfer" of Chinese into neighbouring countries like Tibet and Mongolia are calculated strategies applied by the Chinese governments to alleviate the population pressures on the Chinese mainland (Kane, 1995). Ehrlich (1989) foresees two possible outcomes to the world's population problem: The 'birth-rate solution' in which the birth-rate must be reduced, or the 'death-rate solution' which will come upon us through increased mortality due to wars, famine, pestilence etc. Reduction in the birth rate is the preferable solution. The question is: what is the best way to achieve this? According to Rath (1993), education in the matters of population, and population as a topic should become an integral part of the socialisation process, and population issues should become part of the school curriculum. De Vargas (1993), in terms of lifelong education, is in favour of population topics becoming subjects of educational action in both formal and non-formal education. He also recognises the need for well grounded sexual education, which has a scientific basis and includes ethical values and culturally sensitive affective aspects, in his set of recommendations.

From the perspective of an educator, De Vargas (1993) describes population phenomena as varied and complex. They include factors relating to health, employment, food supply, housing and education. They are also affected by socio-demographic variables like fertility, morbidity, mortality, migration, lack of job opportunities, ageing populations, rural depopulation, status of women, etc. Education in population should include all these factors in a holistic approach encompassing the biological, psychological, social and spiritual domains of human reality. It should also include the cognitive and practical aspects of human rights, with a balance between humans, the environment and economic resources (De Vargas, 1993). Mahran (1993) postulates that population topics can form the subject of educational action. His view, based on studies done in developing countries, is that neither a socio-economic development plan which ignores population questions, nor population education in isolation, can succeed in order to help reduce population and improve living standards.

Mahran (1993) further states that:

The relationship between education and the population problem is two-way. The higher the population growth, the greater the burden on educational resources. Conversely, education is essential to development, and it has an impact on population growth (Mahran, 1993: 16).

This point is qualified by reference to educated peoples' greater sense of responsibility towards their children, and that educated people tend to have fewer children, and provide better education for them. Delaying marriage until education has been completed is also seen as a way of keeping the size of families smaller (Mahran, 1993).

## **2.6 The South African perspectives**

The dynamics of the South Africa population are complex due to the fact that there are a number of different population groups which are at different stages of demographic transition. The majority of the black population has a high population growth-rate, and are poor and illiterate, while the more affluent sector of our society, comprising mostly whites, have already passed through demographic transition (Klugman, 1991). In addition there is an inequitable distribution of resources and increased population of the land in the former homelands. This has all come about because of the removal policies of the apartheid government, which has upset the balance between population and environment, causing inequalities in resource usage and high population growth leading to environmental degradation. The high population growth amongst black South African people has been ascribed to the breakdown of traditional, social, and cultural controls over reproduction. The changes in traditional reproductive behaviour were brought about by industrialisation, contact with Christianity and migrant labour. Poverty, lack of security under an apartheid government, and inequitable access to health services also had the effect of increasing the birth-rate amongst blacks (Klugman, 1991). In the recent past there has been an increase of informal immigrants and refugees from the neighbouring countries. The prospects of rising per-capita income since the removal of apartheid may also result in increased migration from neighbouring countries (Simkins, 1993).

Mass urbanisation makes it easier to provide primary health care, and this may have the effect of eventually causing a decrease in population growth, eventually bringing population to a steady state (Clarke, 1991). A warning is sounded about the increasing AIDS epidemic and the negative effect this may have on the economy in the next decade (Huntley, Siegfried & Sunter, 1989; Clarke, 1991; Simkins, 1993; ). AIDS, however, is an unknown entity and there has been much speculation about the effect that it will have

on the control of population. According to Clarke (1991), AIDS could reduce population growth by up to 40 per cent in South Africa, while others argue that it could possibly cause an increase in population growth, and become another reason for poor people investing in the future by having more children (Preston & Rees, 1994).

One of the most important challenges facing South Africa, and in fact all developing countries is that of reducing the rate of population growth. Factors that would help this process include national stability, addressing the poverty problem, the pattern of settlement, economic equitability, education, status of women, primary health care and quality family planning (Preston & Rees, 1994). In the past, the Population and Development Programme set up in 1984, made attempts to influence the birth rate of the rural people. An outcome of the UN International Conference on Population and Development (ICPD) held in Cairo in 1994 has been the release of the Green Paper on population policy in South Africa (RSA, 1995b). This discussion document emphasises development and economic growth as being important for reducing population growth. The paper cites two extracts from the ICPD document.

From chapter 3.5:

Development strategies must realistically reflect the short-, medium-, and long-term implications of, and consequences for, population dynamics as well as patterns of production and consumption

From chapter 3.14:

Efforts to slow down population growth, to reduce poverty, to achieve economic progress, to improve environmental protection, and to reduce unsustainable consumption and production patterns are mutually reinforcing. (RSA, 1995b: 18).

The Reconstruction and Development Programme (RDP) is described in the Green Paper as having similar priorities as the PDP and the ICDP, and recognises that the lowering of the fertility rate may result from the interaction of factors which include the improvement of womens' social and economic status, improvement in employment, basic infrastructure, literacy, education and training, and access to primary health care. No reference to family planning programmes is made in the Green Paper.

The dilemma in terms of environmental education and the effect of the human population on the globe is a complex one. On the one hand there are the poor people who are bearing most of the children and destroying nature out of a need to survive, and on the other there are the people with far fewer children whose consumer lifestyle is creating immense

problems of resource wastage and pollution. The control of the human population in terms of growth, consumption and environmental destruction both globally and locally is essential for the future of the planet. Population dynamics in the school curriculum with a greater emphasis on environmental education and taught with an environmental education approach will be a positive step in attaining such a goal.



## Research Methodology

### 3.1 Introduction

In the process of developing teaching materials for school teachers, it is important to ascertain the levels of knowledge and understanding that the target population have of the topic that is to be developed. The information gathered can then be used as an important guide in the process of developing teaching and learning materials. In order to gather the information, a suitable research methodology, which takes into account the philosophical and epistemological dimensions of the research, needs to be adopted. Within a research methodology, the correct choice of suitable research methods is critical. In educational research there are a number of research paradigms and traditions that can be considered.

### 3.2 Research paradigms and traditions

The particular paradigm that underpins the process of educational research largely determines the methodology. Cohen and Manion, for the sake of convenience, divide educational enquiry into two research paradigms (or models) which they have termed "normative" or "interpretive" (1994: 36). The normative research paradigm is described as having a positivistic epistemology and encompasses methodologies which are essentially experimentalist and manipulative (Guba, 1990). Positivism assumes that human behaviour is both "rule-governed, and ... should be investigated by the methods of natural science" (Cohen and Manion, 1994: 36), and generalisable and can be "subjected to empirical tests under carefully controlled conditions" (Guba, 1990: 20). These tests are usually theory-dependent and designed to generate data which may be subjected to complex statistical manipulations for the purpose of validation. The types of methodological processes in which general laws are sought are referred to by Cohen and Manion (1994: 8), as 'nomothetic' (which can be interpreted as dealing with numbers) .

The interpretive paradigm follows an anti-positivist epistemology and is "characterised by a concern for the individual" (Cohen and Manion, 1994: 36). Interpretive research methodology generates data which is interpreted "subjectively by the values and purposes" of the researcher (Robottom and Hart, 1993: 9) and aims to understand the subjects being researched from within. In the types of methodological procedures used in interpretive research, the emphasis is on the unique and particular rather than on the universal and general, and are referred to as 'idiographic' by Cohen and Manion (1994).

Furthermore, they describe interpretive research as being future-oriented and theory-generating :

Thus theory becomes sets of meanings which yield insight and understanding of people's behaviour. These theories are likely to be as divergent as the sets of human meanings and understandings that they are to explain (Cohen and Manion, 1994: 37)

This quote clearly indicates the problematique within social research that sets it apart from scientific research where hypotheses are being tested against predetermined theories and laws. Since human beings are all distinctly different, the use of a purely scientific approach in social research and especially in environmental education research is questionable.

### **3.2.1 Environmental education research**

Although educational research in general has been described within four research paradigms, the view of research in environmental education is underpinned by three major images of environmental education as described by Robottom and Hart (1993). These are the 'positivist' (empiricist), 'interpretivist' (constructivist) and 'critical' paradigms. Each of these approaches to environmental education is "qualitatively different from each other in terms of their epistemology and ideology" (1993: 19) and because of the political nature of environmental education, these differences cannot be ignored. One unifying consideration in terms of the educational aspirations of environmental education is stated by Robottom (1993: 134), as the "development of independent critical thinking in relation to environmental issues".

The positivist paradigm in environmental education is concerned with the acquisition and dissemination of knowledge *about the environment*, in such a way that a disciplined awareness is fostered in the learners (Robottom & Hart, 1993). Knowledge is seen as being a value-free, preordinate, systematic commodity derived through an enquiry process which is carried out by experts in a non-interactive way. The research view in the positivist tradition is described as being scientific in orientation, objectivist, acontextual and individualistic in nature, instrumentalist and quantitative in execution, and deterministic in its outcomes. The research design is said to be preordinate or fixed, with the researchers being external experts (Robottom & Hart, 1993).

According to Robottom & Hart (1993), the view of environmental education in the interpretive paradigm is concerned with doing activities *in the environment*, where the principal underlying focus is on personal experience. Knowledge is seen as being value-laden, socially constructed, dynamic and derived subjectively through experience.

Research is viewed as being intrinsically concerned with interpretation, is subjectivist in approach, contextual and individualistic in nature, qualitative in execution and illuminative in its outcomes. The research design can either be preordinate or responsive and is often carried out by external experts (Robottom & Hart, 1993).

The third paradigm is described by Robottom and Hart (1993) as socially critical, and concerned with environmental education which is characterised by action *for the environment*, with environmental issues being the focus on which the research is based. The epistemology is dialectical, value-laden, generative and emergent, and derived through a process of enquiry which is openly ideological. Since the research is socially critical and concerned with transformation and reconstruction, it is described as emancipatory. In praxis, the primary methodology is seen to be that of a participatory action research through a negotiated design, in which all participants are involved. In critical research the theory is said to be emergent (Robottom and Hart, 1993).

In critique of the three paradigms discussed by Robottom and Hart, it must be noted that, although a particular research tradition may methodologically be concerned with a particular problem *about* the environment, the intentions of the research findings may well be concerned with action *for* the environment. This viewpoint may be argued for the research carried out in this study. In this case the research is not *about* or *in* the environment as described above, but deals with issues that impact directly on the environment. The research described in this pilot study, which follows essentially the interpretivistic paradigm, will assist in providing information and data which, together with information from a larger study will be important in the formation of a basis for the development of teaching and learning materials about population dynamics. These materials will then be developed at a later date in collaboration with practitioners, using a participatory process of curriculum development. The content matter of materials thus developed will ultimately reflect a socially critical educational purpose, and be emancipatory and transformative in its intent. In this light, it can be argued as providing a platform in which education for the environment is the prime consideration.

### **3.3 Survey research**

According to Kaplan, as summarised in Cohen and Manion (1994), the aim of research methodology is to assist in the understanding of "not the products of scientific enquiry, but the process itself" (1994: 39). Although research using quantitative methodology has been widely recognised as being suitable within the scientific paradigm, a combination of both quantitative and qualitative methods using the most valuable features of each is increasingly being seen as more legitimate for research in the social sciences (Cohen and

Manion, 1994). The choices that are made in adopting quantitative and/or qualitative methods in the process of social enquiry need to recognise the suitability of each during the research process.

Cohen and Manion (1994) argue that, as a research method, surveys are the most commonly used descriptive approach in educational research. They typify the intentions of data gathering through surveys as a process of "describing existing conditions or identifying standards against which existing conditions can be compared..." (p.83). According to Kerlinger, as cited in Robson (1994), surveys are typically used to collect data from a sample of a population to "assess the relative incidence, distribution and interrelationships of naturally occurring phenomena" ( Robson, 1994: 124). This can be more formally defined:

survey research entails the collection of data on a number of units and usually at a single juncture in time, with a view of collecting systematically a body of quantifiable data in respect of a number of variables which can then be examined to discern patterns of association. (Bryman, as quoted in Robson, 1994: 124)

A warning is made about taking the 'single juncture in time' too literally since data collection is often carried out over an extended period. It also assumes that the data collected will be quantitative and therefore subject to techniques of analysis which will show up generalisations. It is noted that this definition does not take into account or adequately describe the treatment of qualitative data, since this type of data is not readily systematised or quantified (Robson 1994).

Since the central aim of this research is to gather a body of information about teachers' knowledge and understanding of population dynamics, as well as their views on the teaching of it, it was decided that a survey was the most appropriate method to use. The use of a survey in this pilot study is further justified in that it serves as preparation for a nation-wide survey amongst SEP teachers, which will make use of the questionnaire. Saunders and Pinhey (1983) see the use of a survey as appropriate, when a large proportion of a population has to be reached that could not otherwise be observed directly. Furthermore, the use of a questionnaire has been described by Robson (1994: 243) as being "efficient in terms of researcher time and effort". In interpretive environmental education research, the process of data collection includes observation, interviews, and documentation with the emphasis being on qualitative data. The written response of participants is also very important, and although questionnaires in the formal

sense are not readily seen as falling within the interpretivist methodology, they are equally important and relevant in their use for the collection of qualitative data.

### **3.3.1 Focus groups**

The initial phase of the research consisted of a workshop in the form of a focus group (Anderson, 1993), which is generally composed of a number of stakeholders or practitioners. The focus group was carried out in order to create a framework for the development of the survey questionnaire. The focus group discussion, as an initial step was used to obtain some insight into the possible questions that would need to be asked of teachers in the questionnaire. Four teachers, who were active in former DET schools, and SEP CDU staff, were invited, but attended only by Edgar Fillies (teacher at a DET school), Zanu Patience (private teacher), Merle Hodges, (colleague from the Science Education Project's Curriculum Development Unit), and myself.

Anderson (1993: 244) suggests that a focus group should consist of between six and twelve participants, but since an in-depth discussion, drawing on the participants' experience was envisaged, a mini-focus group, as this turned out to be, was adequate for general discussion. An agenda (see Appendix 1) was handed out to each participant, but this was not rigidly adhered to. A number of general points regarding the teaching of population dynamics were raised and discussed. The participants shared some of their teaching strategies, methodologies and experiences, and some useful contributions regarding the development of a questionnaire were made. These included dividing the syllabus into sections and probing the prospective participants' knowledge and understanding in a systematic way.

In the discussion, a number of important and interesting points were made regarding the teaching of population dynamics. Both Patience and Fillies indicated that they did not have any problems in their teaching of the topic. Patience, however, was of the opinion that population dynamics should be excluded from the syllabus, before adding that it was essential that more environmental education be added to the topic. Fillies, on the other hand, described it as a topic that the students enjoyed doing. He ascribed this to the variety of practical activities and fieldwork that can be done in the teaching of the topic.

An important observation made by Hodges was that teachers with only a college education found it a difficult topic to teach because, it was alleged, that these teachers were not trained beyond the level of Std 6. The observation was made that most DET teachers had not specialised in teaching biology and that this further exacerbated the problem. The comment was made about the DET teachers who often were trained as

primary school teachers, but because of staffing problems, and lack of jobs in primary schools, ended up teaching in high schools.

A statement was made that population dynamics, because of the present state of the human population, was an important and relevant topic for students to learn about at this time. Knowledge of the global problems which relate to human population and the environment was seen as being of paramount importance. Students who were to become involved in agriculture also certainly needed population dynamics as a topic. It was also suggested that the use of human examples in the discussion of the different aspects of population dynamics would make it more relevant and easier for students to understand.

### **3.3.2 Questionnaire development**

The use of a questionnaire as a research instrument has been described as being popular because of its efficiency in terms of time and effort, but warning is made of the superficial nature of questionnaire data, and the lack of checks on the honesty or seriousness of the responses (Robson, 1994).

Questionnaires are usually administered to a predetermined set of respondents so that inferences about a known group of respondents can be made (Saunders & Pinhey, 1983). It is important that the instructions for the questions are clear and concise and that the questions themselves are carefully worded so that they are easily understood by the respondents. An ideal questionnaire can thus be compared with a good law:

It is clear, unambiguous and uniformly workable. Its design must minimise potential errors from respondents ... and coders. And since people's participation in surveys is voluntary, a questionnaire has to help in engaging their interest, encouraging their co-operation, and eliciting answers as close as possible to the truth. (Davidson, as quoted by Cohen & Manion, 1994: 93)

In striving for a questionnaire that encompasses such ideals, it is necessary to select the types of questions very carefully and make sure that the concepts which are being researched are "operationalised" to reduce any possible ambiguity and misunderstanding which could arise (McNeill, 1990: 23). It is also essential to ensure that the language and wording are simple and fully comprehensible to the respondents. Two different types of questions, namely closed and open-ended, can be asked in a questionnaire.

#### **3.3.2.1 Closed questions**

Closed questions require the respondents to choose one or more responses from a set number of choices. The questions can be constructed in such a way that they require

responses on the nominal or ordinal scale. Ordinal scales are usually used in attitudinal analysis (Saunders and Pinhey, 1983). Ordinal scales include the Likert scale, the semantic differential scale, the Thurstone scale and the Guttman scale (Gay, 1987: 146-147). Ranges in sensitive questions are advantageous in that respondents are given a greater choice. The problem with this, however, could be that the respondents could become confused if there are too many response categories. Closed questions limit the responses that a respondent can make and are usually employed when quantitative data are being analysed statistically. If however, a more in-depth investigation requiring qualitative data is being carried out, then closed questions on their own will not suffice. A number of closed questions were included in the questionnaire in order to focus the attention of the respondents in preparation for giving qualitative responses, and to gauge their attitudes to the particular theme of the question.

### **3.3.2.2 Open-ended questions**

In open-ended questions, no limit is set on the responses that the respondents can give. The respondents can use whatever language they are comfortable with and express their feelings freely. Since both quantitative and qualitative information was sought, a variety of questions was used. The types of questions included some that would elicit responses on the nominal scale, others on an ordinal scale, as well as selected open-ended questions. According to Saunders & Pinhey (1983), open-ended questions are advantageous in that they allow respondents to be self-expressive through the use of their own words. They are also more effective in dealing with complex issues that require detailed response (Saunders & Pinhey, 1983). Open ended questions yield qualitative data which are more meaningful in interpretive research.

Since it was essential that as much information in the form of qualitative data was obtained, in the cases where closed questions were asked, the respondents were required to give reasons, or qualify their responses by writing down their own thoughts and ideas. The advantage here was that the actual feelings of the respondents emerged, and this made it possible not only to validate their quantitative responses, but also to gain some insight on their reasoning. One drawback with open ended questions is that respondents are required to think carefully about their responses, and to spend some time formulating them.

The questionnaire (see appendix 2) was divided into separate areas of inquiry. It sought to obtain information about the teachers' qualifications and training in terms of teaching population dynamics, general aspects of their teaching (including the use of resources and texts relating to population dynamics) teachers' feelings toward the teaching of specific

syllabus sections relating to population dynamics, and the teachers' knowledge and views of environmental issues relating to the human population. The choice and relevance of each of the individual questions are discussed as they appear in Chapters 4, 5, and 6. The questionnaire layout was designed to make it user-friendly. In this regard, the front page bears illustrations and instructions, and the pages were printed on both sides in order to reduce the bulk.

### **3.4 Validity**

One of the most important concerns with any research is that of validity. In this case where a questionnaire has been used, the validity and the reliability of the individual questions need to be ensured. According to Robson (1994), internal validity is in danger if the questions are incomprehensible or ambiguous. In closed questions the responses are limited and this "may cast some doubt on the validity of the data collected" (McNeill, 1990: 26). The accuracy of the responses can, however, be tested later in an intensive interview with respondents.

In quantitative research, a number of types of validity are described. These include concurrent validity, criterion-related validity, external and internal validity. Maxwell (1992) discusses five different types of validity in qualitative research: descriptive validity, interpretive validity, theoretical validity, generalisability and evaluative validity. He argues that the concept of validity in qualitative research is not dependent on the existence of an absolute truth or reality against which an account can be compared, but on ways of assessing that are not entirely dependent on the features of the account itself, and can relate in some way to "those things that the account claims to be about" (Maxwell, 1992: 283). Furthermore, this approach to validity is presented as referring primarily to accounts, and not to data or methods.

The validity that is pertinent to this research is interpretive validity. Since the responses are in themselves the actual words of the participants, the interpretation of them becomes the important factor in terms of validity. "Interpretive validity is inherently a matter of inference from the words and actions of participants in the situations studied" (Maxwell, 1992: 290).

### **3.5 Analysis of Data**

The analysis of the data in a questionnaire is dependent on the types of data that are generated in it. The questionnaire used in this research generated both quantitative and qualitative data and the treatment of each is discussed separately.



### **3.5.1 Quantitative data**

Questions were posed in which the types of quantitative data that were generated consisted of general information regarding teacher qualifications, teaching experience and various aspects of their education in terms of population dynamics. The responses to these questions could be measured at the nominal level. The other questions were posed on the ordinal level, and these included Likert-scale questions and rudimentary ranking procedures.

The quantitative data that emanated from the Likert-scale questions were plotted graphically in order to create a visual display that is more easily interpreted. These data were required essentially for comparisons to be made. For the responses to the Likert-scale questions, no statistical manipulation was envisaged. A second set of questions was presented in which the participants were asked to choose three syllabus sections out of nine, according to certain criteria stipulated in the questions. The data obtained from these questions were then arranged in rank order and subjected to correlation using the Spearman's rank correlation coefficient. The correlation coefficients were used to compare the responses to certain pairs of questions (see section 5.1). It must be emphasised that the main focus of this study was on qualitative data and not statistical manipulation. The size of the sample, being small (see section 3.7), was another factor which lowered the statistical significance.

### **3.5.2 Qualitative data**

Qualitative data have been described as "attractive nuisance" (Miles, as cited by Robson (1994). Robson (1994) further describes collections of words as 'rich', 'real' or 'full' in comparison with numbers, which are in effect thin abstractions. According to Robson (1994), the analysis of qualitative data is very difficult and time-consuming, and the methodology applied to it is dependent on what the data are needed for. Various quantitative methods of analysing qualitative data have been described (Robson, 1994). These include the coding of responses, and the use of content analysis techniques (Kerlinger, 1986). Unless the questions are posed with some restrictions on responses so that they can be coded and analysed by quantitative methods, the analysis of the responses is very difficult and subjective. This problem is summarised as follows:

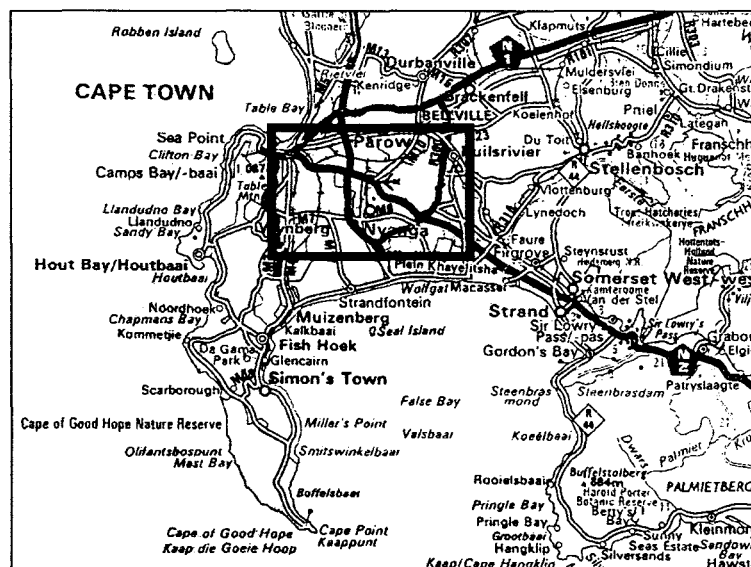
...there are no absolute rules except to do the very best with your full intellect to represent the data and communicate what the data reveals given the purpose of the study. ...Because qualitative inquiry depends, at every stage, on the skills, training, insights, and capabilities of the researcher, qualitative analysis ultimately depends on the analytical intellect and style of the analyst. The human factor is the great strength and the fundamental weakness of qualitative inquiry and analysis (Patton, as quoted by Cantrell, 1993: 97-98).

The qualitative data which emerged as a result of the open-ended questions reflected the participants' own feelings written in their own words. All the responses were transcribed in the exact words that were used, and tabulated accordingly. In the analysis of these data, common themes that emerged between the respondents were sought, but in most cases, because of the diversity of the responses, these common themes were not always evident.

### 3.6 Sampling

In this research, a survey with a questionnaire as the main instrument for data-gathering is described. The population on which the survey was focused comprised all the senior biology teachers in the Western Cape in schools in which SEP was contractually involved at the time. This type of sample, which is very specific, and principally selected for its typicality, is referred to as "purposive sampling" (Robson, 1994: 141; Cohen and Manion, 1994: 89).

At the time of the data gathering, SEP was active in 19 former DET schools in the Western Cape. Sixteen of these schools, in which the survey was done, lie within the boundaries of Cape Town and the surrounding metropolitan area (see Figure 3.1).



**Figure 3.1** Map showing the greater Cape Peninsula region. The area within the marked rectangle shows the area where the schools in which the survey was done are situated. The marked area is shown enlarged in Figure 3.2

### 3.7 Data collection

The questionnaires were administered to 20 Std 10 biology teachers from 16 schools in the Western Cape in which SEP had been active for a number of years.

Six are in the Khayelitsha area, six in the Guguletu area, three in the Langa area and one in Mowbray (see Figure 3.2). The school in Mowbray was a previously unused primary school and had been 'occupied' by the present staff and students because of a lack of accommodation in the townships. It must be emphasised that all the schools that formed part of the sample are former DET schools and that a large percentage of these teachers do not have degrees but are teaching with qualifications no higher than certificates and diplomas.

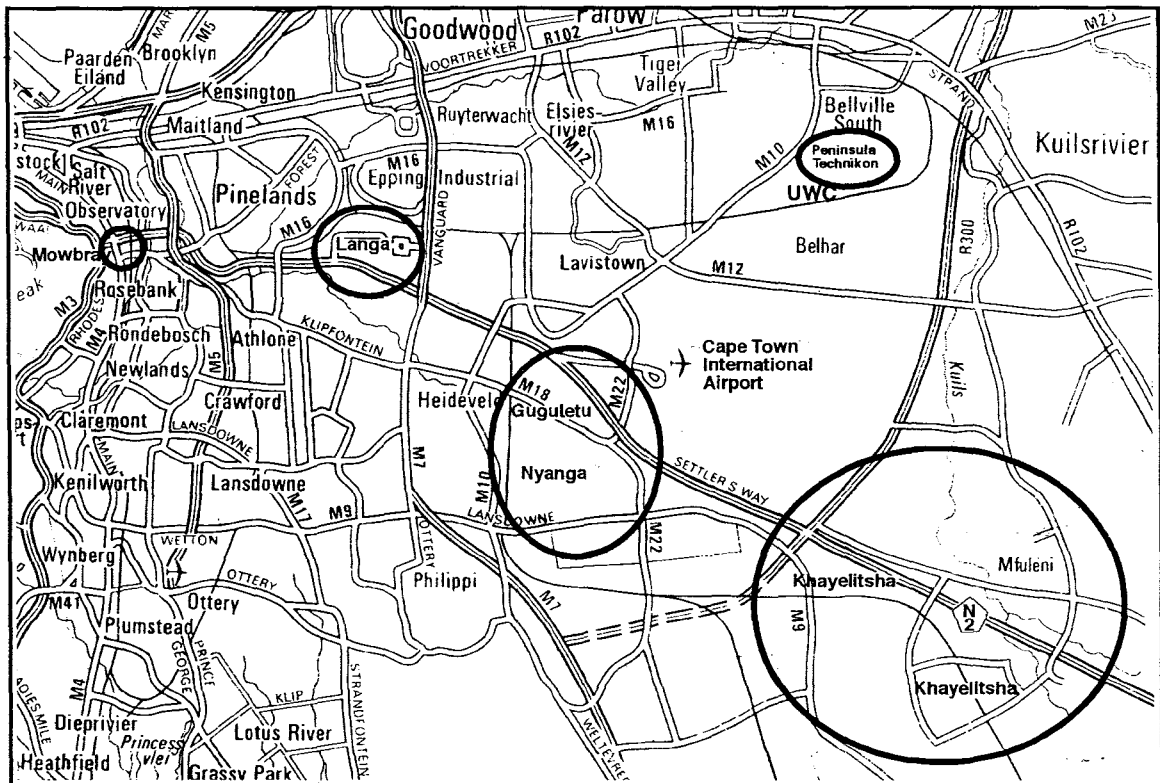


Figure 3.2 Map of the Cape metropolitan area indicating the areas in which the schools in the survey are situated. The SEP CDU is based at the Peninsula Technikon.

The questionnaires where possible were delivered personally to the teachers concerned, but in cases where the teachers were not immediately available, they were handed to the heads of department or principals of the schools concerned. The questionnaire format was explained and any problems were clarified. The completed questionnaires were personally collected after a period of between two and five days. During administration, a total of 18 questionnaires out of 20 was returned.

### 3.8 Teacher (sample) profile

According to the DET's 1990 statistics, only 2.7 per cent of teachers (in Soweto and Alexandra) were qualified to teach biology in Std 9 and 10 (DET, as cited in Reeves, 1994). Furthermore, the type of training that teachers receive at colleges and universities

does not adequately prepare them for their teaching responsibilities (Graham-Brown, 1993). There are many other types of problems that teachers need to deal with in the former DET schools, but these are discussed in more detail in section 4.2. With this as background information, it was deemed important, in order to understand the responses and to relate them to the teachers background and qualifications, that the questionnaire sought to establish the following general information about the respondents:

- their academic qualifications
- their professional (teaching ) qualifications
- their years of teaching experience
- whether they had studied population dynamics in their degree or diploma
- whether they had attended in-service courses on the teaching of population dynamics
- number of years that they had taught population dynamics
- average number of students in the classes they taught.

The details of the responses to these questions are shown in Table 3.1. The respondents ranged from teachers with two years of teaching experience to teachers who had taught for 22 years. Nine teachers reported that they had studied population dynamics in their training as teachers, and seven reported having attended in-service courses in population dynamics. Four teachers in the sample reported having neither studied population dynamics nor attended any in-service courses. Only three teachers reported having studied population dynamics in their training as teachers as well as having attended in-service courses in population dynamics.

**Table 3.1** Teacher details (responses to Questions 1, 2, 3, 4, 5, 6, & 8).

Resp.	1.Academic Qualification	2. Teaching Qualification	3. Teaching Experience	4. Studied Pop.Dyn.?	5.INSET in Pop.Dyn?	6. Yrs of Teaching Pop.Dyn.	8.Average Class size
1	BSc	HDE	2	yes	no	0	45
2	Std 10	STD	6	no	yes	0	45
3	BA	STD	3	yes	no	0	40
4	STD	STD	2	no	no	1	46
5	BSc. Ed	BEd.	9	yes	no	2	50
6	HDE(N/G)Sc	HDE	2	yes	no	2	50
7	B.Ped. Sc.	BEd.	13	no	yes	2	55
8	BA	JSTC	17	no	no	3	40
9	STD	STD	8	no	no	3	50
10	BSc. Ed	BSc. Ed	4	no	yes	3	60-70
11	Std 10	STD	10	no	no	4	56
12	BSc.	BEd.	4	yes	no	4	40
13	STD	STD	5	yes	no	5	60
14	BSc	UED	22	no	yes	5	40-50
15	Std 10	STD	11	yes	yes	6	45
16	STD	STD III	-	-	-	8?	45
17	-	S.E.D	14	yes	yes	9?	45
18	STD	STD	10	yes	yes	10?	55

Three of the teachers had not yet taught population dynamics and this was to be their first year of teaching it. The other teachers ranged from those who reported to having taught population dynamics for one year to those who had taught it for 10 years. Since the topic has been in the Std 10 syllabus only since 1987, one can assume that the maximum experience that a teacher could have had with teaching the topic, at the time of the research, was eight years. In this case, three teachers had 8 years' experience of teaching population dynamics. The minimum class-size reported was 40 students and the maximum was 60-70 students per class, with the average class-size calculated as being 48 students. An important general point about the teacher sample is that, with the exception of one respondent, all have English as a second language, and thus the responses are often not clearly articulated, and therefore difficult to interpret.

### **3.9 Evaluation of the methodology**

Due to a number of difficulties including teachers' timetables and other time constraints, it was not possible to pilot the questionnaire with practising teachers prior to administering it to the target population. The purpose of a piloting a questionnaire, is to identify any potential problems with wording, and if necessary, possible ambiguities so that once the survey has been completed, there are no additional problems with the analysis which may have resulted from poorly worded questions. The questionnaire was, however, extensively reviewed by other staff members in the CDU, the manager of the SEP Research and Development Unit as well as Prof. P.R. Irwin, prior to finalisation and administration.

Accounts can be validated through a process called triangulation. In triangulation, a combination of two or more different methods of obtaining the data is used. Cohen & Manion (1994) list a number of types of triangulation, of which the "methodological triangulation" would be the most useful in a study such as this. There are two types of methodological triangulation: using the same method on two separate occasions, or making use of two different methods on the same sample.

A method of triangulation which had been intended for use in this research, would have been to follow up the questionnaire with a set of interviews. This would have been useful for clarifying the data and obtaining in-depth insights from the respondents where needed. With the administration of any questionnaire, there are problems of respondents not taking the questionnaire seriously enough, not fully understanding questions, being pressed for time, and basically being apathetic. In order to cross-check the questionnaire results, therefore, follow-up interviews with respondents are critically important. It was however not possible to do follow-up interviews for a number of reasons. From a historical viewpoint, SEP had, until April 1995, had a contract to work in schools that fell

under the control of what was previously known as the Department of Education and Training (DET). Since all schools in South Africa are now under a single education department, the contract which was held by SEP with the former DET has fallen away, and new contracts in the separate provinces are in the process of being re-negotiated. During this period of negotiation, SEP staff were advised not to do school visitation. In addition, with the introduction of the new interim biology syllabus, the CDU, who were at the time involved in the development of Std 9 and 10 materials were instructed to switch to the urgent re-writing of Std 6 materials which would reflect the changes in the new syllabus. The newly appointed manager of the CDU was thus not in favour of any further involvement in Std 10 materials production, and subsequently put an end to further research on population dynamics.

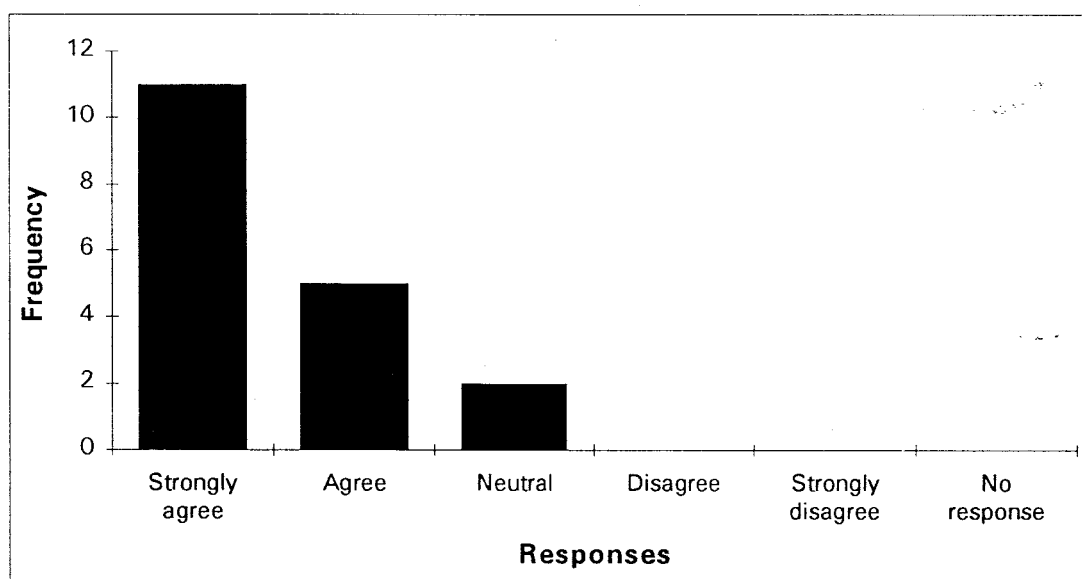
It has been argued (Robottom and Hart, 1993) that survey methodology falls within the dominant paradigm of environmental education research which follows an essentially positivist approach to educational enquiry. This approach is seen as being empirical-analytical in nature and closely related to traditional natural scientific research and is therefore antagonistic to the nature of environmental education. A participatory inquiry approach to environmental education research within the socially critical paradigm is therefore deemed to be as more acceptable as legitimate educational inquiry (Robottom and Hart, 1993). In defence of the methodological approach in this study and the intended future national survey, it must be said that SEP, being a national organisation believes in wide representation of the teaching body, and therefore any research being undertaken which would result in the development of teaching and learning materials should be widely representative of the SEP teachers. Although this initial research may not be participatory in terms of the socially critical research paradigms, the information gained from it will assist in paving the way for a better informed participatory approach to the development of a teaching and learning module of population dynamics.

## Teachers' insights to aspects of teaching population dynamics

This chapter examines teachers' perceptions of the importance of population dynamics as a topic for students to learn about. It explores the teaching strategies, perceptions of the text books and teaching materials used in classrooms, as well as teachers' interaction with other staff at their departments regarding planning strategies. The responses to question No's 7, 9, 10, 11, 12, 13, and 14 (see appendix 2) are presented and analysed in this chapter.

### 4.1 Teachers' perceptions of the importance of population dynamics

Question 7 was presented in order to determine the respondents' perceptions of the importance of population dynamics as a topic for students to learn about. In this question a Likert scale was used to establish the respondents' attitudes. The results of 7(a) are graphically represented in Figure 4.1, while the explanations requested in 7(b) are shown in Table 4.1



**Figure 4.1** Graphical representation of the responses to the statement presented in Question 7(a): *Population dynamics is an important topic for students to learn about.*

As the results indicate, all but two of the respondents who indicated neutral on the Likert scale, 'agreed' or 'strongly agreed' that it was an important topic for students to learn about. The neutral response and indication by respondent No.2 that she lacks knowledge of population dynamics is difficult to understand since from Table 3.1, there is an indication that she had done in-service training in population dynamics, and has had six years' experience as a biology teacher. Perhaps because this was to be this teacher's first

year of teaching population dynamics, she may have felt apprehensive about giving a reason. Respondent No.4 also gave a neutral response, but wrote "the topic is not very relevant to biology, i.e., a study of living organisms" (see Table 4.1). This statement calls into question this respondent's understanding of the place of population dynamics within biology education in particular, and environmental education in general.

**Table 4.1** Responses and views to the statement in Question 7: *Population dynamics is an important topic for students to learn about.*

Resp.	(a) responses	(b) views of the respondents
1	strongly agree	"Populations are always associated with other populations within the same area in which they live". Therefore, it is of utmost importance that students should learn about birth rate, death rate, dispersal and structures of other people and even other living organisms in their surroundings in order that they can know their surroundings holistically.
2	neutral	I haven't done population dynamics so I haven't got the background.
3	strongly agree	No response
4	neutral	the topic is not very relevant to biology, ie. a study of living organisms
5	strongly agree	Give students information about the environment they are living in. - How to live and survive in different environmental conditions, planning their families etc.
6	strongly agree	Population dynamics is important because it intensifies the ecological understanding of the students. It does not only serve for the latter aspect, but also equip the students to know the infrastructure of their surrounding communities as well as to control their capacities.
7	strongly agree	No response
8	agree	The human population explosion and dwindling certain species of wild life necessitates the knowledge of population dynamics.
9	strongly agree	It is socially important. It involves statics in relation to resources that are available
10	agree	Our resource are slowly drained. If pupils are not aware of this, the earth may not provide a life the generation to cope
11	agree	No response
12	agree	Some knowledge about population dynamics gives students greater insight into social problems. E.g. overutilisation of natural resources
13	strongly agree	It is more practical and population dynamics is in our everyday life Where pupils need to know how to take care of other aspects of life
14	agree	I think they need to be made aware of the problems that could arise from unchecked population (human) growth. But I also feel that most of work done in PD in std 10 tries to cover too wide a very specialised subject.
15	strongly agree	No response
16	strongly agree	It is very interesting and quite practical
17	Strongly agree	It is part of studies of demography (sic)
18	strongly agree	No response

Of the respondents who answered 'strongly agree' (No's. 1,3,5,6,7,9,13,15,16,17,18), four (No's. 3,7,15,18) did not give any reasons at all while the others did not give particularly perceptive reasons for their responses. Respondent No.1 however, seems to have a holistic view of populations in their environments. This respondent, not having previously taught population dynamics, does have a degree, and this may account for this particular response. One respondent, (No.5) made a reference to family planning even though this is not part of the syllabus requirements. None of the respondents referred specifically to any populations other than human, even though the study of population dynamics includes a variety of plant and animal populations. The respondents who chose the 'agree' option to



Question 7(a), and supplied reasons (No's. 8,10,12,14), seem to have a better perception of the types of problems facing the human population and the environment. This is evident by their reference to resource shortages and over utilisation of natural resources.

Respondent No. 8 showed concern for the environment by citing the explosive rise of the human population and the reduction in numbers of certain wild life species, as a reason for doing population dynamics. This is an interesting observation and one could relate this to the conservation of matter, but this is purely speculative. It is noteworthy that these respondents are all graduates (see Table 3.1).

## **4.2 The teaching of population dynamics**

Teaching practice in South African schools is largely driven by the examination system which contributed to an approach to teaching which emphasises the learning of facts for the purpose of preparation for the examination. According to Naidoo *et al.* (1990), this has manifested itself in "classroom scenarios of discipline- bound, uncritical, transmissive teaching practice aimed towards cognitive development and behaviour manipulation of pupils through the use of text books and rote learning". Hobden (1995), argues that the matriculation examination has a major influence on the classroom environment in that the relevance of classroom activities is judged exclusively in terms of its relevance to the examination. In my own experience as a teacher and curriculum development officer with SEP, with few exceptions, the pedagogy that teachers in South Africa tend to follow is predominantly teacher-centred, and traditional in its approach. This follows along the lines of the 'exposition model' as postulated and described by Brady (1985).

Population dynamics is taught in Std 10, and it is therefore logical to explore these notions further by asking teachers about their teaching practice. Questions 9, 10 and 11 (see Appendix 2) were included for this purpose. In Question 9, the respondents were asked if they normally teach population dynamics, Question 10 inquired about the time of year that they taught population dynamics, and in Question 11 they were asked to explain how they would go about teaching population dynamics. These questions were asked because, in the former DET schools, there were often disruptions of classes and schools which would have had an effect on the teaching time, and this in turn could adversely influence teaching styles and the timing of the teaching of certain topics in the biology syllabus.

Since all the respondents that were asked to complete the questionnaire were Std 10 teachers, it was assumed that they had all had experience of teaching population dynamics. Some of the respondents (No's.1,2&3) had never taught the topic, and were to teach it for the first time in 1995 (see Table 3.1). Of the 15 respondents who had taught

population dynamics before, 14 indicated that they taught population dynamics in the latter part of the year, usually in the third quarter (see Table 4.2). This is significant in terms of teaching time, because at this time of the year one of the greatest concerns of both teachers and students seems to be the impending final year national examinations. In addition to this, teaching time is often lost during the year due to pupil registrations and sports days. This loss of teaching time often results in sections of the syllabus being superficially covered, or in some cases not covered at all. Other constraints that teachers may experience in terms of teaching time include political disturbances, and other forms of student unrest which may occur sporadically during the year. One such example was the absence of students when schools in Khayelitsha were visited on 27 February 1995. On this day, all the students from these schools were in the centre of Cape Town demonstrating against the lack of accommodation at township schools. Socio-political inequalities, because of the historically different and separate education systems in South Africa, further exacerbate the problems that teachers have to face in their daily classroom encounters (Reeves, 1994).

Another problem that impedes the progress of students, is the lack of commitment of teachers in the former DET schools. It has been reported (Bavuma, 1993), that in many cases, teachers are often late in arriving for class, do not spend enough time in their classes, or may take leave at inopportune times during the academic year. At any time, a number of teachers may be involved in extramural studies at universities, and may consequently neglect students in their own academic pursuits. In other parts of the country, similar problems with teachers and within schools have been reported (City Press, 1995). Other problems include the carrying of dangerous weapons by tsotsis, the proliferation of pornography, the lack of adequate preparation by teachers, teachers spending school time at the education MEC's office, and teachers spending time in the staff room when they should be in classrooms. In addition, teachers are reported to be reluctant to submit to authority and control (City Press, 1995). In my own experience, when visiting schools, teachers were readily available for consultation even if they were teaching at the time. Heads of the schools and senior staff were often either unaware of intrusions, or did not try to discourage them when they occurred.

Being the last topic in a heavily laden Std 10 syllabus, and with problems in the classrooms, the teaching of population dynamics is in danger of not being afforded the appropriate proportion of time that is needed for adequate coverage. The mark allocation for population dynamics in the final assessment is usually less than 10 per cent, and this may also have an influence on the amount of time that teachers actually spend teaching

the topic. Two of the respondents (No's. 5 & 14) specifically mentioned the loss of time as a reason for not covering population dynamics adequately.

**Table 4.2 Responses to Questions 9, 10 and 11.**

Resp.	9(a)	9(b)reasons (if no)	10. time of year	11. Explain how you go about teaching population dynamics
1	no	First time	N/A	N/A
2	no	haven't studied it, - ask colleague to teach it	N/A	N/A
3	no	No response	No response	I will refer to ecology.
4	yes		3rd quarter	Following sub topics in the text book and explaining.
5	yes		Toward exam time	Not enough time given to do this aspect due to time constraints as a result, no detail only a brief summary of each aspect.
6	yes		Towards the end of the year	We normally engage in group discussions or else use ordinary instruction methods because the classes are so big and most of the kids have absolutely no background of the topic especially mathematical aspects.
7	yes		Sept/Oct	No response
8	yes		At the beginning	No response
9	yes		Towards the end	Making use of study guides and text books.
10	yes		Beginning or end	A video is shown to the pupils to familiarise them with the environment which is untouched by man. Pupils are then informed about their own environment before it was invaded by man and how it change up until the present moment.
11	yes		Usually 3rd quarter	I first teach them the introduction of what the word mean i.e. population dynamics Then I teach the aspects of population dynamics. I even teach it by applying practical work of having a graph with a questionnaire, using number of people in a country and years in which the people were affected For counting(capturing) using beans (marked and unmarked).
12	yes		End of year	By using as many graphic examples as possible.
13	yes		After June	First, if I have enough funds, I can take them out and start with the ecology and then introduce them to the topic.
14	yes		September	Mostly theoretic. For the past five years or so many hours were lost during the year. We could barely touch on the basic theory of pop. dyn.
15	yes		Sept/Oct	1. I refer to std 8 Ecology 2. Make use of our fish pond. 3. use beans for mark recapture. 4. use dice game for growth curves.
16	yes		Sept/Oct	I normally use charts and drawings with practical explanation E.g. on situations relevant to the students.
17	yes		DET work program	No response
18	yes		Sept/ Oct	No response

Question 11 sought to establish the teaching practice of the research sample. From the teaching methodologies described by the respondents (see Table 4.2), it can be inferred that they follow a mode of teaching that is suggestive of the traditionally teacher-centred approach. The use of the first person singular by five of the twelve respondents in describing their teaching methods indicates a self-centredness in their teaching styles and this could be interpreted as being indicative of a teacher-centred (traditional) approach.

In contrast, only one respondent reported that the class engaged in group discussions, but reported that "ordinary instruction" (which can be interpreted as traditional methods), was used because of large classes. The use of the traditional teaching approach is common in the former DET schools, and this may be influenced by the large numbers of students in their classes (see Table 3.1). In large classes like this it is not unusual for teachers to be more comfortable with the transmission mode of teaching. Three respondents made mention of practical work (see Table 4.2, No's. 11,15 and 16), while only one, (No. 10), reported the use of video materials. This shows some variation, but is no indication of a shift from traditional teaching styles in the research sample.

The teaching approach that seems to be reflected in the responses indicates the type of education that they had undergone as aspirant teachers. The STD course offered at teacher-training institutions deals mainly with the teaching of content, with very little emphasis on methodology. It is not surprising therefore, that very few teachers seem to progress beyond using a teaching style which is in any way different from the way in which they themselves were taught. This point needs to be investigated in follow-up interviews and further research.

### **4.3 Text books used by the teachers**

Teachers, especially those in the underprivileged sector of our society, rely on text books which have been written to reflect the syllabus as it stands, and often in ways that are inaccessible to these teachers (Wagiet, 1991). Reasons for this may be that the use of scientific language in these books is foreign to these teachers since for most of them, English is their second language. The readability of text books written for South African biology is also a source of concern in respect of teacher qualifications (Wagiet & McKenzie, 1991). Some of the local text books are reviewed in section 2.3.

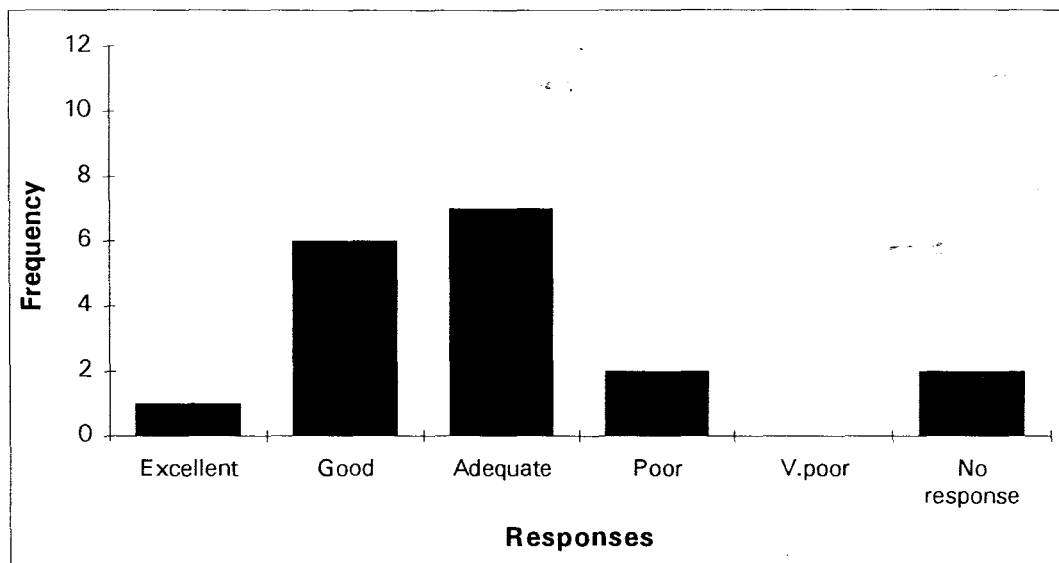
In Question 12(a) (see appendix 2), the respondents were asked to indicate which text books they used in their teaching. They were also asked in Question 12(b) to "describe the books" by indicating with a tick on a Likert-type scale from 'excellent' to 'very poor'. The respondents were asked to follow up their choices with reasons in Question 12(c)

(see Table 4.3) which were then analysed and interpreted in the light of their qualifications. The results are illustrated graphically in Figure 4.2.

The respondents with bachelor degrees gave indications of 'poor' or 'adequate' and were more critical of the texts that they were using. In contrast, all the ratings of 'good' came from the respondents without a degree. Only one respondent (No. 9), indicated 'excellent', but the reason, "more relevant" is meaningless. The non-graduate respondents gave their book(s) ratings of either good or adequate, but were uncritical in the reasons given for their choice. This seems to indicate that they were satisfied with the books.

**Table 4.3** Responses to Questions 12 and 13. Text books and additional materials.

Resp	12(a) Text book/s used	12(b) Description of book/s	12(c) Reasons for the descriptions given by the respondents	Q13 (a-b) Additional materials & sources of these
1	--	N/A	N/A	N/A
2	Ayerst <i>et al.</i> Austoker & Eloff	good	Enough info. and glossary.	
3	-	-	-	-
4	Ayerst <i>et al.</i> Grogan & Suter	good	Explain well gives examples and is brief.	-
5	Austoker & Eloff Du toit <i>et al.</i>	adequate	Textbooks used by student too skeletal	Sources from other text books Functional Approach-Roberts
6	Ayerst <i>et al.</i> Scholtz <i>et al.</i>	good	Discovering and exploring are almost the same - Good examples and explanations.	None
7	Scholtz <i>et al.</i>	adequate	It has got the sections required in the syllabus.	Booklet from subject advisor
8	No response	adequate	-	-
9	Du toit <i>et al.</i>	excellent	More relevant.	Study guides - Juta
10		poor	The text books do not concentrate on the pupils environment.	Videos, worksheets from resource centres
11	Austoker & Eloff Du toit <i>et al.</i>	adequate	They give the necessary and required information for this section (the two books complement each other).	Study aid - Kuhn - department ESST - book shops
12	Austoker & Eloff	poor	The text book we are currently using gives very little graphical representation, and students have problems reading graphs (which crop up very often in final exam papers) and do not get enough practical examples to guide them.	Study guides - other teachers, resource centre at UWC
13	Grogan & Suter	good	It can teach the child even in the absence of the teacher.	None
14	Scholtz <i>et al.</i> Austoker & Eloff	adequate	Materials in these books not always logically in an easily followed order.	None because of time constraints
15	(No response)	good	Because it is precise.	Beans, fish pond, dice-- at school
16	Austoker & Eloff	adequate	It is the most explanatory and has more information.	None
17	Austoker & Eloff	good	Clear and in good English for African students.	Advanced biology UWC
18	Austoker & Eloff	adequate	--	--



**Figure 4.2** Graphical representation of the responses to the statement presented in Question 12(b): *How would you describe the book/s?*

All the text books used by the respondents follow the syllabus closely (see section 2.3). One respondent (No. 7), overtly refers to this as being a reason for why the book is adequate. The book by Austoker & Eloff (1988), was described as 'poor' by respondent No.12 with the reason being that the book had "little graphical representation" (see Table 4.3). This book in fact has *only* graphs as illustrations in the chapter on population dynamics, so the origin of this respondent's reference to a paucity of graphical representation is rather dubious. A possible explanation for this is that the respondent was referring to a different book which was being used at the school (see Table 4.3) and that the book that she personally preferred to use was in fact Austoker & Eloff, (1988). A follow-up interview with the teacher concerned would have helped to clarify this contradictory finding. The same book is favoured by respondent No.17, and the reason given seems to be more in line with the findings of the review of this book (section 2,3). A book which needs some special mention is the one by Grogan & Suter, (1993). This is a very popular book with many of the biology teachers in the former DET schools. One of the main reasons is that it is a self instructional guide to passing the final examinations (see section 2.3). Respondent No.13 graciously confirms this in the statement: "It can teach the child even in the absence of the teacher" (see Table 4.3). It was very difficult to get in-depth indications of how the respondents felt about each of the particular books. Follow-up interviews would have been useful in this respect. In most cases, more than one book is listed, so it is impossible to ascribe a particular explanation to a specific book.

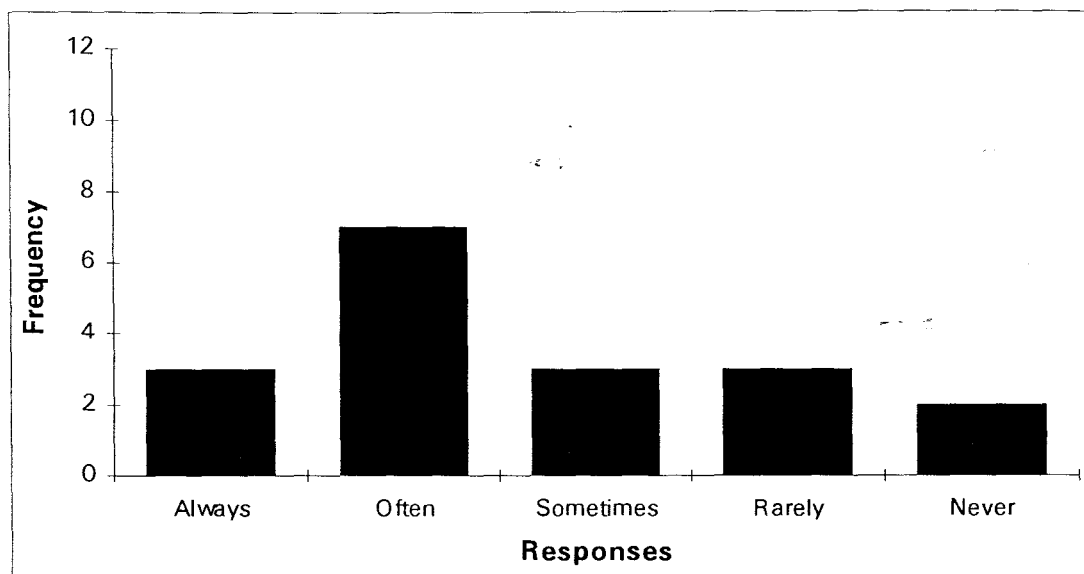
Only in cases where a single book was listed, has this been possible. Some respondents (No's. 10 & 15) did not in fact list any books, but nevertheless gave reasons for their descriptions.

Respondent No. 10 mentions the use of other teaching materials besides text books. Although this respondent does not name a particular book, the reason given shows the concern that this respondent has with the relevance of the textual material available from the education departments. This concern is not unfounded when one considers the limited range of text books available to teachers and students in South Africa. These books are generally all written within the scientific paradigm and do not reflect any environmental relevance (see reviews in section 2.3). In addition, they are written by authors who do not necessarily take into account the language constraints and cultural differences between themselves and their target readership. Other respondents also listed additional materials that they had used in teaching population dynamics (see Table 4.3). These included non-textual resources in the school grounds (fish pond). Only one teacher cited an overseas publication. Others listed study guides and worksheets which they had obtained from resource centres. Two teachers made mention of a booklet/study aid that was given to them by the subject advisor, but since this advisor no longer works for the department, it was not possible to obtain a copy for review.

In the light of teacher-training, syllabus content and the choice of texts available to the teachers in South Africa and especially those underqualified teachers, it is not surprising that the educational standards in the former DET schools are inferior to those in the historically more privileged schools. A comparison between quality of biology teaching practice, and environmental content presentation between the two different types of schools, would highlight some interesting and important contrasts in this regard.

#### **4.4 Teaching strategies**

Since a large number of teachers who teach biology in the former DET schools do not have degrees, one would expect that there would be a certain amount of collaboration and/or consultation with other members of staff and the heads of departments. In this way, sections that may be problematic could be discussed and planned with the more experienced or better qualified teachers in their departments. This sort of planning and collaboration could therefore assist struggling teachers and help to build up their confidence as teachers. In the light of this, Question 14 (a) sought to establish whether the respondents planned their teaching strategies and methods together with the others in their department. The responses to this question are graphically displayed in figure 4.3



**Figure 4.3** Graphical representation of the responses to the statement presented in Question 14(a): *Do you and other staff in your department ever plan teaching strategies and methods together?*

The respondents were then asked to describe how they went about this planning, in Question 14(b). The way in which this planning takes place is more informative of the teaching strategies of teachers than the frequency of planning. These responses appear in Table 4.4.

Only 10 respondents gave descriptions of their interactions with other teachers. Five of these (No's.2,6,8,15,16) referred only to matters relating to timing the sequence of topics in biology. While this is important in terms of the degree of difficulty of certain topics in as far as the final examinations are concerned, it does not really constitute an in-depth cognitive or methodological collaboration or exchange between teachers. Four respondents, (No's.1,7,12,14) showed some involvement in the improvement of teaching practice through their need to exchange information and consult with other teachers. This might be ascribed to the fact that each of these respondents are graduates. Two of these in fact have the degree of BEd. as well as another degree (see Table 3.1). The other two have postgraduate teaching diplomas. These observations lead one to question the quality of teacher education at colleges of education, where most non-degreed teachers from the underprivileged communities undergo their teacher education.



**Table 4.4** Responses to Question 14. Teaching strategies.

Resp	(a)planning	(b) Descriptions of how planning takes place
1	often	We often discuss strategies on certain chapters e.g. Std 8 ecology I taught std 8 in 1994 but no more this year. The teacher concerned did approach me on that chapter and we discussed ways and means of making it more practical through planning for an excursion to Kirstenbosch.
2	always	We check the most important aspects as from std 8 syllabus and are helpful for std 10 examination and we do those first before we run short of time.
3	rarely	No response
4	sometimes	No response
5	never	No response
6	always	We usually discuss what to teach when and why so as to cover as much work as possible in an effective way.
7	often	To be on par and better working relations we consult with one another. if one finds teaching a certain section difficult, then one seeks the help of another biology teacher.
8	often	We teach the same part of work at the same time and same available resources.
9	often	Relate Std 9 work to Std 10.
10	rarely	No response
11	often	No response
12	sometimes	We compare methods and exchange ideas.
13	never	No response
14	sometimes	This year I am alone. Previous years we were two. We used to discuss possible ways of making the topic clearer.
15	often	Plan which topic to tackle first.
16	often	The material to be covered at a certain time.
17	rarely	N/A
18	always	No response

The types of responses given for the different ratings do not reveal any pattern. It was expected that a response of 'always' would have been qualified by various reports of planning, collaborative teaching and a high degree of liaison with other staff in the same department. Respondent No. 7 did mention the need to consult with other teachers, but in general, the responses from this question did not indicate much beyond planning in relationship to time constraints and syllabus dynamics. The responses also lacked any substantial depth and no reference was made to population dynamics. It is not clear whether the respondents thought that the department being referred to was in fact science or biology, since in many schools there is only one head of department who deals with both. Conducting interviews with the respondents would have been able to shed more light on these aspects (see section 3.7).

#### 4.5 Conclusions

In this chapter, a number of important points have come to light. The quality of the reasons reflected generally correlate with the qualifications and teaching experience of the respondents. The lack of response in some cases, could in part be explained by the qualifications and /or education of the teachers in the sample. The indication is that population dynamics is an important topic for students to learn about. The recognition by the better qualified teachers that the earth has limited resources, which require careful management, indicate that there is some concern for the future of the environment. Time

constraints, teaching styles, and the fact that population dynamics is the last topic in the Std 10 syllabus, affects the quality of the teaching of population dynamics. A further constraint in effective teaching is the shortage of qualified teachers. The text books that are being used in the South African schools and more especially those used in the former DET schools approach the topic from a narrowly scientific viewpoint, and do not reflect the socio-political realities of population dynamics in terms of environmental education.

## Teachers' perceptions of sections in population dynamics

It is natural for any teacher to have particular preferences when it comes to the teaching of different topics in a syllabus and subsections within a syllabus topic. Individual teachers may or may not experience difficulties in dealing with the syllabus content. In addition, they may have certain perceptions of their students' abilities in learning these topics. In order to establish some of these preferences and perceptions, a number of questions were asked of the respondents. In this chapter the feelings that respondents had regarding the different sections of the population dynamics syllabus, and the analysis and discussion of the responses to these questions are presented.

### 5.1 Description and rationale of the question design

The teaching content of the sections in population dynamics is described in the national syllabus under separate sub-headings (see Figure 5.1). For the questionnaire, these were paraphrased and listed as nine separate options from which to choose in Questions 15(a) to 19(a) (see Appendix 2):

1. The parameters that affect population size e.g. growth, reproduction, immigration, mortality, emigration
2. The different types of growth forms e.g. geometric and logistic and the associated graphs
3. The various techniques for estimating population size e.g. census, mark-recapture
4. Carrying capacity : the meaning and importance of it
5. Density-dependent and -independent parameters that regulate population growth
6. Importance of the different types of competition e.g. inter- &-intra-specific, territoriality
7. Predator/prey interactions
8. The concept of energy flow and the parameters of the energy budget
9. Section dealing with human populations.

From these options, the respondents were asked to choose three according to each of the following criteria, which were expressed as follows in Questions 15 to 19:

- 15(a)...sections which you as a teacher find the **most difficult to teach.**
- 16(a)...sections which you as a teacher find the **easiest to teach.**
- 17(a)...sections which you as a teacher find the **most interesting to teach.**
- 18(a)...sections which you as a teacher think are the **most important for students to learn about.**
- 19(a)...sections which you think your students have the **most difficulty with.**

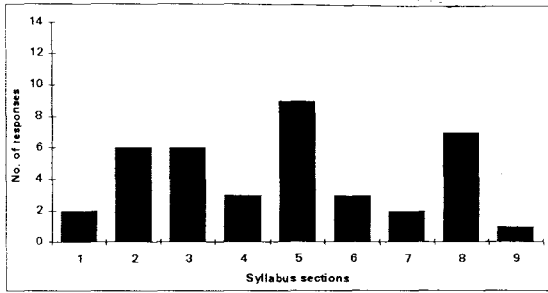
This would give some indication of how the respondents viewed their teaching abilities and interests, and their students' capabilities and benefits. By asking the respondents to make a choice of three sections for each question, it was possible to rank the sections in terms of the criteria in the list above. The respondents were not asked to rank the nine sections as this would have been time-consuming and would not have separated the sections as sharply. The syllabus sections were condensed for use in the questionnaire in

order to clearly separate them from each other, and to create more space in the layout for the respondents to fill in reasons for the choices they had made. In part (b) of each of these questions, the respondents were asked to give reasons for their choices.

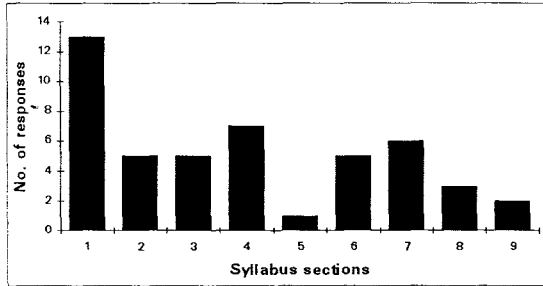
SYLLABUS CONTENT	ELABORATION
7.1 Definition of population	Concept of a population as a group of organisms of the same species inhabiting a more or less definable area in such a proximity that random interbreeding can occur.
7.2 Population parameters	The dynamic parameters affecting the size of the population, such as growth, reproduction, immigration, mortality, emigration
7.2.1 Population growth	Population growth forms such as geometric and logistic growth forms
7.2.2 Population decrease	For example mortality
7.3 Estimation of population size	Direct techniques e.g. census, and indirect techniques, e.g. mark-recapture
7.4 Population regulation - carrying capacity - density-dependent and density-independent parameters - competition - predation	Importance of carrying capacity of the environment in regulating population size  Naturally stable populations, mechanisms to ensure stability Naturally unstable populations  Importance of intra- and inter-specific competition amongst individuals for the resources of the environment Territoriality  Predator-prey interactions
7.5 Energy flow	Parameters of the energy budget (consumption, production, respiration, excretion, faeces)
7.6 Survival strategies	Identification of a problem facing mankind and some possible methods of solving the problem Some examples of problems:  (1) The necessity to regulate pest populations resulting from mono-culture  (2) Poverty and hunger resulting from the human population exceeding the food supplies either from maldistribution of resources and/or inefficient utilisation of natural resources  (3) The problem of declining fecundity in some localities as opposed to increasing fecundity in others

**Figure 5.1** Population dynamics in the Std 10 biology syllabus: *Certain Aspects Of Population Dynamics*.

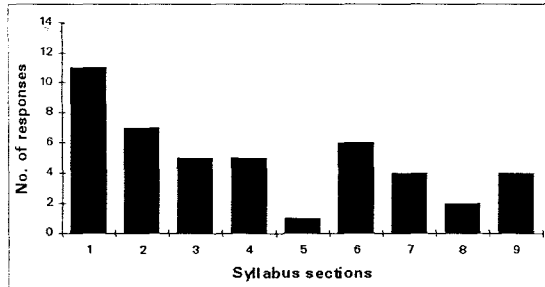
The frequencies of responses to Questions 15 to 19 were quantified and plotted as histograms, and are graphically displayed in Figures 5.2 to 5.6.



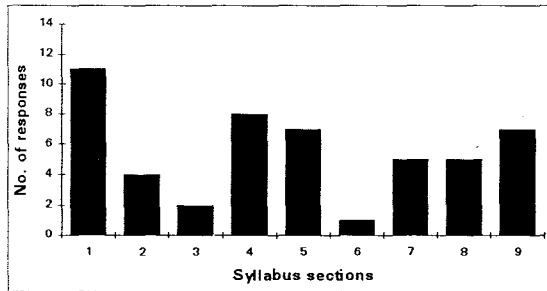
**Figure 5.2** Graphical representation of responses to Question 15(a): ...sections that you as teachers find the most difficult to teach.



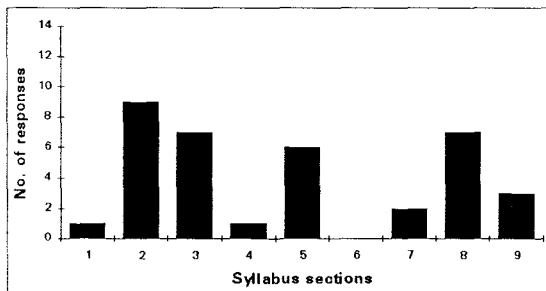
**Figure 5.3** Graphical representation of responses to Question 16(a): ...sections that you as a teacher find the easiest to teach.



**Figure 5.4** Graphical representation of responses to Question 17(a): ...sections that you as teacher find the most interesting to teach.



**Figure 5.5** Graphical representation of responses to Question 18(a): ...sections that you as teacher think are the most important for students to learn about.



**Figure 5.6** Graphical representation of responses to Question 19(a): ...sections which you think your students have the most difficulty with.

None of these Questions (15-19), delivered a full set of responses for either the choices made or the reasons given. The respondents that defaulted in this respect were No's. 1, 2, 3, 15, 17 and 18 (see Tables 5.3 to 5.7). The non-response of respondents No's.1, 2 and 3 could be ascribed to their own revelation that they had not taught population dynamics before 1995 (see Figure 3.1). It is not possible to account for the lack of responses displayed by No's.15, 17 and 18.

## 5.2 Analysis of quantitative data

Questions 15(a) to 19(a) required the respondents to select three syllabus sections out of the possible nine that were offered. The sections that were chosen by the respondents for each question were quantified and ranked in order of choice. Spearman's Rank correlation coefficient was then calculated for each of the pairs of questions compared in Table 5.1.

**Table 5.1** Correlation of responses from Questions 15 to 19.

	Questions compared	Spearman's correlation coefficient
1	(Q15/16) ...sections most difficult / easiest to teach	-0.44
2	(Q16/17) ...sections easiest to teach / most interesting to teach	+0.70
3	(Q15/19) ...sections most difficult to teach / students find most difficulty with	+0.58
4	(Q17/18) ...sections most interesting to teach / most important for students to learn about	+0.01
5	(Q16/18) ...sections easiest to teach / most important for students to learn about	+0.26
6	(Q18/19) ...sections most important for students / students have most difficulty with	-0.25
7	Q(15/17) ...sections most difficult to teach / most interesting to teach	-0.31
8	Q(15/18) ...sections most difficult to teach / most important for students to learn about	-0.26
9	Q(16/19) ...sections easiest to teach / students have most difficulty with	-0.45
10	Q(17/18) ...sections most interesting to teach / students have most difficulty with	-0.25

Although all the questions were correlated with each other, only certain of them are discussed in detail as these were considered important for making some possibly useful inferences about the responses. One of the reasons why these correlations were done, was to check for consistency and reliability within the responses. For example, it was expected that if a respondent selected particular sections as difficult to teach, then the same sections logically would not be chosen as being easy to teach by the same respondent. One would therefore expect a negative correlation, and this would help to confirm the reliability of the responses. This was in fact the case, with a moderate negative correlation (-0.44) being found (see Table 5.1, No.1).

The relatively high positive correlation (+0.7) between the responses to the sections that were easiest to teach, with the responses from the sections that were the most interesting to teach (see Table 5.1, No.2), indicates that the respondents relate the ease with which a concept or topic is taught with how interesting they find it. This implies that the more interesting a section of teaching material is to the teacher, the less difficulty the teacher

will have in teaching it. In this case, both the most interesting and the easiest to teach was section 1 (the parameters that affect population size e.g. growth, reproduction, immigration, mortality, emigration). In contrast, section 5 (density dependent and - independent parameters that regulate population growth), had the lowest frequency of responses. This pattern shows a fairly close correlation and confirms reliability.

The moderate positive correlation (+ 0.58) between the sections that were indicated as being the most difficult to teach and the sections that the respondent perceived students to have the most difficulty with (see Table 5.1, No.3), suggests that there is a possibility that respondents regard content which they find difficult to teach as difficult for students to grasp. In order to test this more fully, the respondents would need to be interviewed.

A lack of correlation (0.01) between the responses to the sections that respondents found interesting to teach and those deemed to be important for students to learn about, (see Table 5.1, No.4 ), was expected since it is reasonable for teachers not to have any preference in terms of what they see as important for students to learn about and what they find interesting to teach.

The negative correlations for the comparisons displayed in nos. 6,7,8,9 and 10 (see Table 5.1), were expected, and these help to reinforce the premise that the respondents did in fact take the questionnaire seriously, and took care in answering the questions. An important consideration with correlational research is that, for the results to be truly significant, a large research sample is needed. In a small sample such as this one, correlations tend to be less important, whereas the qualitative data supplied in the form of reasons for the particular choices made by the respondents is of much greater value in terms of the analysis of the questionnaire.

### **5.3 Analysis of qualitative data from the teachers' responses**

In the analysis of the qualitative data from Questions 15(b) to 19(b), the responses are discussed separately in relation to the content of the syllabus sections. This task is complicated by the fact that very few respondents actually responded to specific sections, but gave collective responses to the choices that they had made in each of the questions. In the analysis of the data, each of the syllabus sections is treated under separate headings in terms of the five questions asked about them in the questionnaire (see Appendix 2), and the proportion of responses that each received. The discussion of each is preceded by a brief description of the syllabus section. The tables are placed at the end of the chapter.

### **5.3.1 The parameters that affect population size e.g. growth, reproduction, immigration, mortality, emigration**

This section of the syllabus deals with the various parameters that affect the size of populations. These are growth, reproduction, immigration, mortality and emigration. The influences on population size are also described. The concepts in this section are straightforward and relatively easy to understand.

The histograms in Figures 5.2 through 5.6 show that most of the respondents indicated this section to be easy, interesting to teach, and important for students to learn about. Thirteen out of the 15 who responded chose this section as being the easiest of all to teach. The principal reason given by the respondents who had chosen this section both as easy and interesting to teach, was that the students had no difficulty in understanding it. The number of responses to this section was also high in terms of being important for students to learn about (see Figure 5.5). The respondents who gave reasons all commented that it was important, in some way or another, in that it had an influence on the students' daily lives or lifestyles. Their reasons thus hinged around the relevance that they perceive this section to have in their students' lives. It could be speculated that the respondents and their students, most of them living in or in close proximity to informal settlements, realise what effect the population density in these places is having on their lives.

Only two respondents listed this section as being difficult. One gave no reason and the other (No. 9) answered "awareness in controlling birth rate" (see Table 5.2). It is possible that this respondent presupposed that this section dealt with issues of birth control and feels that teaching about birth control and related issues may be culturally sensitive and therefore difficult to teach. It is not unusual for teachers from the rural areas to be reluctant to discuss issues of population and birth control. This sentiment was expressed during workshops in the previous 'homelands' of the Ciskei, Transkei and Kwa-Zulu, on occasions where issues of sex education, birth control and AIDS were discussed. Many of the participant teachers at these workshops were against reference to these issues in their classrooms because it was not part of their culture to speak freely about matters pertaining to sex.

### **5.3.2 The different types of growth forms e.g. geometric and logistic, and the associated graphs**

Although the syllabus does not specifically state that graphs are required, all the text books and the examinations present graphs to explain this section. Because of this, students need to have an understanding of graphs and how to interpret different types of



graphs (e.g. geometric and logistic growth curves) as well as the shapes of the survival curves. These graphical representations are abstract, and teachers in the former DET schools have expressed difficulty with the teaching of them and the students could conceivably have difficulty understanding them.

The responses to this section of the syllabus were varied and the general perception, as expressed by the respondents, was that students had the most difficulty with this section. The reasons given by the respondents for this was that this section was abstract, complex and required mathematical skills which were beyond the capabilities of the students, most of whom do not do mathematics at Std 10 level. In contrast, two respondents (see Table 5.4) gave the graphical nature of this section as a reason why it was interesting to teach. It is noteworthy that one of these has a BSc degree. This could possibly account for a response of "interesting to handle graphs". The respondents who indicated that it was an important aspect for students to learn about, gave reasons that reflect a concern for the rate of population growth in South Africa. A reference to the students being aware of violence around them reflects a sense of awareness of the escalating violence which could be ascribed to high population density (see Table 5.5, No.11).

There was a time when SEP was running in-service workshops with teachers, and population dynamics is one of the topics that has been requested on numerous occasions by teachers to be the subject of a workshop. At one such workshop, this section was cited as the most difficult to teach, and one which the students had the most difficulty with. To some extent, the results of this questionnaire confirm this.

### **5.3.3 The various techniques for estimating population size e.g. census, mark-recapture**

The content of this section revolves around various practical investigations which can be done in this topic. These describe standard ways of estimating population size using simulation exercises. Whether some of these practical investigations are in fact done, often depends on the teacher's confidence in using them as well as the availability of time. This section requires that the students are able to use mathematical formulae and substitutions into these, which may be problematic for them considering their lack of mathematical skills (see section 5.3.2).

This section received the most responses for Question 19, although this is not really significant (see Table 5.6). Where reasons were given, they were linked to the section dealing with the graphs (see section 5.3.2). The reasons were the same, namely, that the section was abstract, complex and difficult in terms of the students' mathematical abilities.

Respondent No.11 stated that this section was difficult because, in terms of the actual investigation, students would be able to see the marked individuals, and would leave them out. It is possible that this respondent may have problems with explaining exactly how the technique works.

#### **5.3.4 Carrying capacity, the meaning and importance of it**

This is an easy principle to understand, since it states simply that the carrying capacity is the maximum population size that can be sustained by an ecosystem. This concept is often explained in text books through the use of graphical illustrations.

Seven respondents rated this section as easy to teach (see Table 5.3). Within this group, five rated it as interesting to teach. This suggests that the respondents are more comfortable with sections that they themselves find easy to explain. The reasons given by these respondents for it being both easy and interesting are expressed in terms of the use of everyday examples in explaining them to the students. Respondents No's.11 and 13 individually gave exactly the same responses for Question 16 and 17 (see Tables 5.3 and 5.4). Reference was also made to this section being realistic to their lives (see Table 5.4, No.16), but it is difficult to say whether this respondent is referring to the syllabus section in 5.3.1 or 5.3.4.

Eight respondents (see Table 5.5) indicated that this section was important for students to learn about, with seven giving reasons. The reasons that are given, however, do not relate directly to the subject material covered in the section. In general, the respondents have expressed the concept of carrying capacity in terms of the human population growth and the implications of this on the students' lives. It is also perceived that knowledge of this section will prepare students to play a role in future solutions to the problem of a growing human population (see Table 5.5, No.14).

#### **5.3.5 Density-dependent and -independent factors that regulate population growth**

The terminology used in this section may present problems of comprehension to students and teachers alike. 'Density' is an abstract concept and could lead to confusion when the various factors that affect population growth are described. Density in this context refers to the number of individuals per unit area in an ecosystem. The growth of populations in nature is influenced by certain factors that are dependent on the population density, and by others that are independent. This section also deals with complicated interactions between individuals and relates to other areas within the study of biology and biological principles. This could add to the difficulty that students and teachers might experience with this section of the syllabus.

Nine respondents rated this section as the most difficult to teach. Compared to the other sections listed, this is the most difficult (see Figure 5.2). Six of these respondents also listed this section as one with which the students have the most difficulty. In the cases where this section is specifically referred to, the terminology that is used in this section is cited as the reason why it is difficult to teach and difficult for students to understand (No's.12 and 13, Table 5.2). The concepts are perceived to be complex and not well explained in the text books. These reasons, given by respondent 14, reflect the language problem that may be experienced by both teachers and students in these schools. All the schools in this sample are former DET schools where the mother tongue of both students and teachers is Xhosa, and English is a second, or in many cases a third language.

Five respondents saw this section as important for students to learn about. They include this section as being important because knowledge of it will show students how their way of life, or standard of living is affected. It is possible that these respondents are referring to the effects that an increasing population density may affect people's living standards.

#### **5.3.6 Importance of the different types of competition e.g. inter- and intra-specific, territoriality**

The concepts in this section are fairly easy to grasp and easy to explain to students. They include the mechanisms of population regulation by competition within and between species.

This section was not a very popular choice for the respondents (see Figures 5.2 to 5.6). The greatest number of responses for this section was six, who found this section as the most interesting to teach. The reasons given generally state that it is easy to explain, easily understood by students and relates to the students' social background. A specific reference is made to "competition" (No.13, table 5.5), as a problem caused by overpopulation, and this could be interpreted as a recognition of the problems prevalent in townships and squatter settlements that are overcrowded. The types of problems that prevail in townships and squatter settlements include stealing, gang warfare, intimidation and indiscriminate killing of innocent people etc... The reference could also be to competition for resources which are needed by these people. Respondent No.13 was the only one who listed this section as being important for students to learn about.

#### **5.3.7 Predator/prey interactions**

This section is an extension of the previous section, adding to the parameters that were outlined under the different forms of competition. The fact that humans are the most

successful predator species on earth is also highlighted. This also has implications for the serious environmental problems which are at present being experienced on earth.

This section was best represented as being interesting (four responses, Figure 5.4)), easy to teach (six responses, Figure 5.3) and important for students to learn about (six responses, Figure 5.5). The only reasons that may have any bearing on this topic came from the responses in the "easy to teach" (see Table 5.3) and "interesting" (see Table 5.4) questions. Again these were linked to the students' relating it to their daily lives and everyday examples. The lack of calculations and abstract thinking in this section was also cited as why it was easy to teach. The pattern emerging here is that sections to which teachers can easily relate, are the easiest to teach.

### **5.3.8 The concept of energy flow and the parameters of the energy budget**

This section is meant to clarify the concept that energy is lost as food passes along a food chain. This can be quantified using a simple formula. The way in which these concepts of energy flow are portrayed in many text books is further complicated by the use of an energy formula and calculations which are based on it. Text books also deal with the concerns of energy in a fairly abstract way, and this could lead to problems of understanding.

Seven responses each for the sections "most difficult to teach" (see Table 5.2) and the sections "with which the students have the most difficulty" (see Table 5.6) were given for this section. No reasons which specifically refer to this section were given by the respondents except for respondent No.14 who classified them as "very abstract concepts" (see Table 5.6). Respondent No.7 classified the section in terms of data-related questions. This is an indication that the respondent thinks and teaches towards a final examination.

### **5.3.9 Section dealing with human populations**

This is not a difficult section to understand since most of the problems highlighted relate directly to humans, and the ways that humans have influenced the natural environment through their economically driven agricultural practices. It also addresses human population growth and issues of fecundity and demography.

This section showed the most responses (see Figure 5.5) as a section most important for students to learn about. The reasons given refer to the daily lives and experiences of the societies of which the students are part. The issue of overpopulation is highlighted by the respondents in their perception that knowledge of these matters will assist students in the future solutions to these problems. It is very difficult to infer from the reasons given what

the respondents are in fact referring to. It could be connected with ways of curbing the rapid growth of the human population.

The interpretation of the qualitative data from Questions 15 to 19 was a difficult task, which was further complicated because respondents were asked to choose more than one option, and to supply reasons for their choices. In most of the cases, the reason that was given by the respondents could logically apply to only one of the choices, and in rare cases to two of the choices which were made. In Questions 15 to 19, the respondents in most cases made three choices, but in very few cases did the respondents link the sections they had chosen with a specific reason which they had furnished. This accounts for some sections having been comprehensively discussed (5.3.1), while the interpretation of others may create the impression that they had had only superficial coverage.

#### **5.4 Conclusions**

The use of the correlation co-efficient served to confirm the reliability of the responses for this part of the questionnaire. From this it can be concluded that the respondents did not have difficulty with making choices concerning the various sections of the population dynamics syllabus, and were quite sure of the choices they had made.

The syllabus sections that carry graphical illustrations, and/or that require mathematical ability may be more difficult for the teachers to teach, and may present the greatest difficulty for the students. Sections that are easy and interesting to teach present the least difficulty for students, and the teachers are more comfortable with teaching them. These sections are seen to be important for students because they relate to their daily lives. Certain sections are indicated as presenting difficulty for students because of the use of terminology, which is foreign to them as English second language learners. There is evidence that the density of the human population (in the townships especially) is cause for concern. In general, the examples cited for the importance of population dynamics relate to the daily lives of the students, and are directly applicable to the people living in the townships. This has implications for the development of teaching and learning materials that cover issues that are seen as more relevant for the students' daily lives.

**Table 5.2** Responses to Question 15. Sections that teachers find most difficult to teach.

resp	(a) sections	(b) reasons
1	No response	Never taught it before.
2	No response	No response
3	2 5 6	No response
4	8 9	These concepts are difficult for the child to understand, especially after the many topics.
5	2 3 5	Students lack background information at this stage, therefore difficult to handle them. Very difficult to explain graphs to students not doing mathematics.
6	2 3	Teaching these are a problem but actually difficult. The problem lies in the understanding of the pupils because of the mathematical aspects mentioned before.
7	8	No response
8	2 5 8	The most students do not do maths as a subject it becomes difficult to explain to them how graphs are drawn and interpreted and to show them how to calculate.
9	1 2 3	Awareness in controlling birth rate.
10	4 5 8	Terms are difficult for pupils to understand - pupils have not experienced these environmental conditions - students forget what was taught in std 8.
11	3 8	The students get difficulty in understanding the mark-recapture because they claim that you will leave out those marked because you see them that you have marked so they fail to understand.
12	2 3 5	2,3 In my own personal experience I have found that most pupils have a poor maths background and do not understand graphs. Also because these concepts are very abstract and difficult to demonstrate (practically) students struggle with cognition in these concepts For 5, because they don't understand the terms density and parameters, they find it difficult to relate it to population growth.
13	5 6 8	It was difficult for my previous student to make difference in density dependent factors and even difficult to understand and the graphs, esp. those that do not do maths.
14	4 5 8	Especially no. 5 is not very clear cut or logical in most text books.
15	5 7 8	No response
16	3 5 9	The calculation part of the three types as I never did maths at matric level.
17	1 4 6 7	No response
18	No response	No response

**Table 5.3** Responses to Question 16. Sections that teachers find easiest to teach.

resp.	(a) sections	(b) reasons
1	No response	No response
2	No response	No response
3	1 7 8	No response
4	1 2 3	These are within comprehension.
5	4 6 7	everyday examples can be related.
6	1 7 8	Easy for student to understand because they are not that different from what they did in std 8 ecology. making use of their familiar communities set up as examples also easify the subjects.
7	1 3 5	The students fare quite well in these sections in their tests.
8	1 4 6	It is very easy to explain the terms growth, immigration, mortality, carrying capacity etc. as there are many examples to be cited by the teacher to make pupils understand. Competition and territoriality can be taught showing them films on wild life.
9	1 3 7	Little calculation and students understand more easily.
10	1 6 9	Examples can be used which are more familiar to the pupils.
11	1 2 4	I find them very easy to teach because you just make practical examples of the violence in this country. the hunger in countries like Ethiopia and other countries where these sections occur. In China and Japan where there is a carrying capacity.
12	4 6 7 8	Students find these sections interesting and because it can be illustrated very easily with examples they understand.
13	1 2 3 4	Some of the terminology is used in other subjects and I just make use of that.
14	1 3 9	These are the most straightforward and also closer to the average students referral framework.
15	1 2 4	No response
16	1 4 6	Very understandable and easy to explain.
17	No response	No response
18	1 2 7	No response

**Table 5.4** Responses to Question 17. Sections that teachers find most interesting to teach.

Resp.	(a) sections	(b) reasons
1	No response	No response
2	No response	No response
3.	1 7 8	No response
4	1 2 6	The first topic is practical, the second is interesting if the students master their graphs and the last one shows the effects of competition.
5	2 4 6	Everyday examples easy to relate. Interesting to handle graphs.
6	1 7 8	Easy for student to understand because they are not that different from what they did in std 8 ecology. making use of their familiar communities set up as examples also easify the subjects.
7	1 3 5	The kids can get hands-on experience on this. e.g. using beans for showing them the mark-recapture method. Both 1 and 5, the pupils can easily relate these to everyday experiences in the outside world.
8	3 6 9	Estimating population size because it gives ample scope for practical. e.g. est. of population size of cockroaches at home, size of student population at school etc. and very interesting to observe the wild antics of the animals in the wild.
9	1 6 7	Most interesting. Easier to explain. Pupils understand easily.
10	1 3 9	3 - Pupils can involve themselves in the topic b.w.o activities???? 1- Historical(apartheid) examples can be used.
11	1 2 4	I find them very easy to teach because you just make practical examples of the violence in this country. the hunger in countries like Ethiopia and other countries where these sections occur. In China and Japan where there is a carrying capacity.
12	4 6 9	Because I can relate it to the student's own life and social situation.
13	1 2 3 4	Some of the terminology is used in other subjects and I just make use of that.
14	2 3 9	It could apply directly to the students.
15	1 2 4	No response
16	1 4 6	Can be understood by the students and very realistic to their lives.
17	No response	No response
18	1 2 7	No response



**Table 5.5** Responses to Question 18. Sections that teachers find the most important for the students to learn about.

Resp.	(a) sections	(b) reasons
1	1 8 9	It is dealing with their day to day experiences.
2	No response	No response
3	1 3 8	No response
4	1 5 7	No response
5	1 4 5	Affect their living standards and conditions.
6	1 5 7	Though all are important but the above ticked are utmost because they deal with what happens in their daily lives thus reflects the relevancy of their studies.
7	1 4 5	In order to survive the future, students should be quite aware of how these will affect their ways of life.
8	2 3 9	It is very much important for the youth to understand that the rate at which the human pop. grows is not a healthy one and that certain precautions must be taken to counter this. They must to keep record and monitor the human pop. growth.
9	1 5 9	Involves the societies in which they live.
10	4 8 9	Across the globe we have a problem of over population. Students should be made aware of this because they are the future generation which might be able to do something about this problem.
11	1 2 4	They are familiar with them because they see violence around them, burning of shacks in Khayelitsha, but people are increasing even then
12	7 8 9	Because the students can use this information in their live and it could change the way they view their social construct e.g. pollution etc.
13	5 6 8 9	They will be able to know that population needs to be maintained because over population will cause many problems such as competition etc....
14	2 4 9	Because SA is facing a serious population explosion problem - and with knowledge they can play a role in being part of the solution.
15	1 4 5	Because they pertain to their everyday life.
16	1 4 7	Very practical and not abstract to them.
17	No response	No response
18	1 2 4 7	No response

**Table 5.6** Responses to Question 19. Sections with which the students have the most difficulty.

resp.	(a) sections	(b) reasons
1	No response	No response
2	No response	No response
3	1 2 8	No response
4	4 8 9	No response
5	2 3 5	Completely new topic to students at this stage, Insufficient time, therefore difficult to follow. Lack of enough teaching aids.
6	2 3	The problems lie with the graphs and mathematical calculations because most of the students deal with history and geography other than mathematics and physical science.
7	2 8	Some of the Students cannot answer the data-related questions.
8	2 3 9	Many students are not well versed with the maths and this makes it difficult for them to interpret and draw graphs and master the calculations needed when dealing with the concept of energy flow and parameters of energy budget.
9	2 3	Lots complex.
10	2 8	Students are unaware that they can use their own experience to describe these sections, due to the dependence on the teachers notes.
11	3 8	No response
12	2 3 5	It is very abstract and mathematical.
13	5 7 8	It was difficult for my previous student to make difference in density dependent factors and even difficult to understand and the graphs, esp. those that do not do maths.
14	2 3 5 8	Very abstract concepts.
15	5 7	No response
16	5 9	The terminology takes long to be realised by them. Needs better explanation to them.
17	No response	No response
18	3	No response

## Chapter 6

### Teachers' views on population as an environmental factor

This chapter examines the responses to the questions that deal with the respondents' views on population growth, and the environmental consequences of population growth. An overview of the human population, the effects and consequences of overpopulation, and the question of population in relation to poverty and consumption has been outlined in section 2.4.

#### 6.1 Analysis of teacher responses to questions about their environmental views

Since environmental problems cannot be separated from population issues, it is imperative that the relationship between these be more deeply investigated within the realm of environmental education. These issues are explored in the last part of the questionnaire (see Appendix 2, Questions 20 to 25). Collectively, these questions sought to examine teachers' views on the growth of the human population and environmental issues relating to this. Teachers' perceptions about population growth and its links with poverty and consumption as well as teachers' understanding of the concept of sustainable development were examined. Teachers' views of environmental problems as a consequence of population growth were also sought.

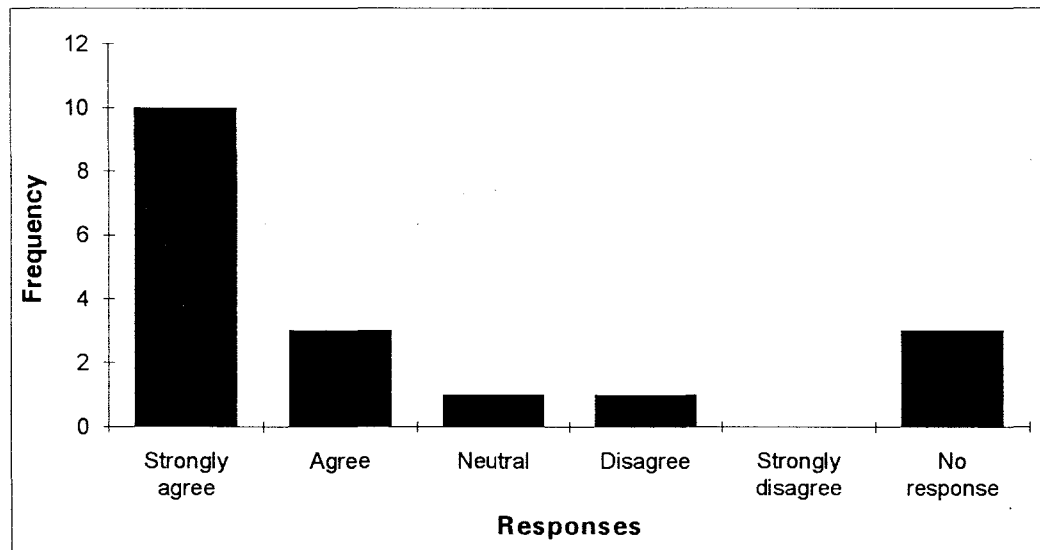


Figure 6.1 Responses to statement in Question 20(a): *The rate at which the human population is expanding is a problem.*

##### 6.1.1 The problem of human population growth rate.

In Question 20(a) the respondents were required to respond on a Likert scale to the statement *The rate at which the human population is expanding is a problem*, and in

Question 20(b) they were asked to supply reasons for their choices. This question required the respondents to examine their own perceptions about the human population expansion. Of the 15 individuals who responded, 10 gave a response of 'strongly agree', and three a response of 'agree' (see Figure 6.1). It can be assumed therefore, that in the group of teachers in this research sample, there is a high degree of awareness of the environmental consequences of overpopulation. It is not unreasonable to assume that the respondents, being mostly teachers from a disadvantaged background, teaching in township schools that enrol students from traditionally disadvantaged communities, are acutely aware of the problems relating to poverty and high population growth.

**Table 6.1** Responses to Question 20: *The rate at which the human population is growing at present is a problem.*

Resp.	Response (a)	Reason (b)
1	agree	The percentage of population growth almost doubles after every $\pm 30$ . Limiting factors such as food, space, natural resources etc. are not renewable.
2	No response	No response
3	disagree	Because this is a natural phenomenon. We just have make through study and preparations for this phenomenon.
4	neutral	I foresee no stage when there will be insufficient food and land for humans.
5	strongly agree	Economic reason.
6	strongly agree	It is really a problem because it leads to competition for the limited resources such as food, housing, etc. and this depletes the comfort and the peace of mind the people would have if the population growth rate was not high.
7	strongly agree	There are many people who are suffering due to the expanding population. Not enough food, land and jobs for better life. The human population number should be in proportion with the land available for better production.
8	agree	The rate at which the human race is expanding is alarming especially in 3rd world countries. This causes poverty and hunger. and also the devastation of our habitat.
9	strongly agree	High unemployment rate.
10	strongly agree	Across the globe the environment are destroyed due to over population.
11	No response	No response
12	strongly agree	We do not have the economic and natural resources to accommodate the population.
13	agree	There is a shortage of houses caused by the expanding population. Shortage of jobs etc...
14	strongly agree	We experience daily here the problems that it causes. Human number increasing pose a serious problem world wide.
15	strongly agree	Because it poses problems on the environmental resources.
16	strongly agree	There is a great need of health workers, especially in the informal settlements.
17	No response	No response
18	strongly agree	No response

This awareness is evident in the types of reasons given for their choices (see Table 6.1). A number of problems including issues of unemployment, poor health, lack of food, housing, environmental destruction as well as diminishing natural resources were cited by the respondents. It is curious that respondent No.6 should have contrasted population growth and competition for resources with comfort and "peace of mind". It is almost as if there is a sense of realisation that if everyone were able to live according to standards in the first world, there would not be enough for all people. This respondent possibly realises that, in order to have material comforts, which are limited, the population growth needs

to be limited. The world's carrying capacity in terms of human numbers is challenged by respondent No.7, who expresses a concern for human suffering because of population expansion. Respondent No.8 recognises that environmental destruction in third world countries is directly related to the high population growth and population density in these countries.

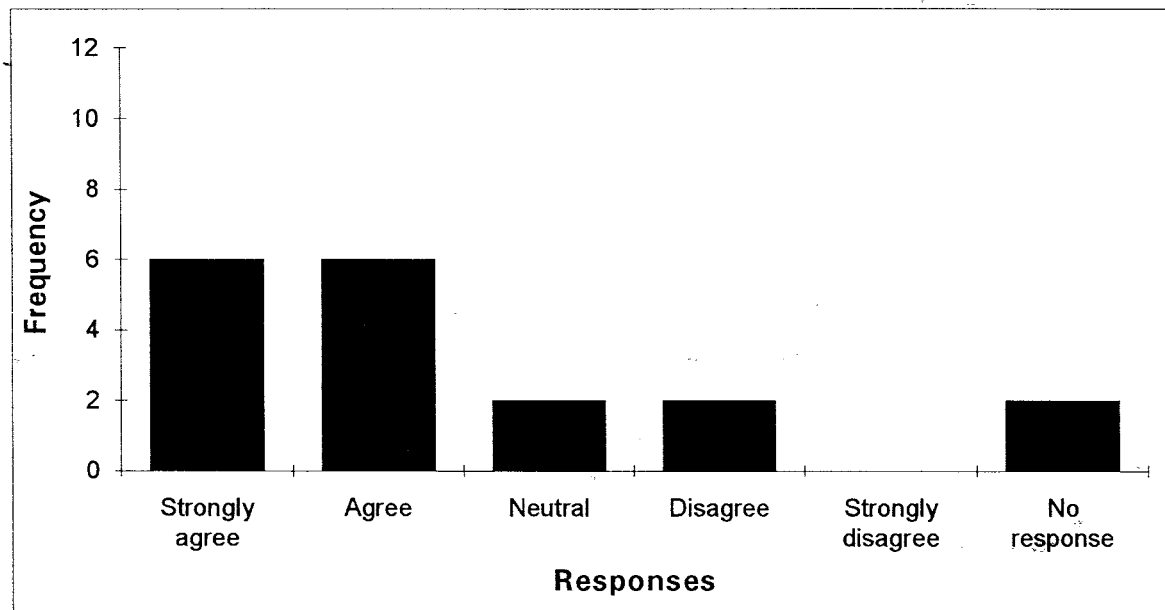
Although most of the respondents either strongly agreed or agreed with the statement, the comments provided by those respondents who were neutral or did not agree, are equally important. It is particularly noteworthy that respondent No.3, who disagreed with the statement, sees the present rate of population growth as a "natural phenomenon" (see Table 6.2). This statement is true for populations in nature, but nature has been manipulated by humans, and so the rules no longer apply to humans. This respondent's awareness of the reasons why the human population is expanding at the rate that it is, and the implications of this for the environment are therefore questionable. This respondent does however show a concern for the lack of sex education at school level which can result in unplanned pregnancies (see Table 6.2).

Respondent No.4, who indicated 'neutral', also seems to be unaware of the poverty and starvation experienced in Africa and elsewhere in the world. It is possible that she has not considered the social and economic factors relating to lack of access of land for cultivation, both on a subsistence level, or otherwise. Her answer to Question 21, which asked whether the present population growth could be sustained in South Africa, was, "there is enough food. The only problem is the inflation rate" (table 6.3). This response reveals a possible lack of insight regarding this matter.

From the responses, it is evident that many respondents are unaware of the social and economic reasons for the high population growth in third world countries. They do however recognise that the present population growth is affecting access to land, housing, social services, resource depletion, and environmental degradation. Kaplan (1994) in his discussion of problems in certain West African states, reports that the world faces a period of unprecedented upheaval, which will have been brought on by a scarcity of resources, worsening overpopulation, uncontrollable disease, brutal warfare, and the collapse of present political systems. Although these problems relate to countries in other parts of Africa, a similar situation is starting to manifest itself in South Africa, and the respondents seem to be aware of this.

### 6.1.2 The growth of the South African population.

Question 21(a) required a response on the Likert scale to the statement: *The population of South Africa will double to 80 million in the next 35 years. The reason for this is that people are having too many children.* The respondents were expected to critically examine the statement, and provide reasons for their choices in Question 21(b). This would then be expected to provide some insight to the respondents' perceptions about the growing population of South Africa.



**Figure 6.2** Responses to statement in Question 21(a): *The population in South Africa will double in the next 35 years. The reason for this is that people are having too many children.*

Although the majority (12) of the respondents (see Figure 6.2) either 'strongly agreed' or 'agreed' with the statement, the reasons given by all the respondents, with the exception of respondent No.10, reflect a lack of insight about the root causes of population growth in the traditionally disadvantaged proportion of the South African population. This respondent (No.10) recognises that there are differences between what he calls the "western" culture and what one can presume to be the African culture (see Table 6.2). Unfortunately these underlying cultural differences are not explained. Respondent No.1, in recognising the role of "socio-economic and educational standards" (see Table 6.2) in reducing population growth, suggests that "black people" are the problem, but fails to elucidate the link between the traditional life of these people and the population growth within these communities.

Six of the respondents, either directly or indirectly, made reference to the role of education and/or family planning. The indirect statement, "people are ignorant or ill-informed" (No.12) indicates a need in this respect. Other problems mentioned include lack

of accommodation, unemployment, squatter settlements and lack of resources for a growing population. Interestingly, no direct mention has been made of population growth in the rural areas. This is understandable since all the respondents are living in the urban metropolis of the Cape peninsula.

**Table 6.2** Responses to the statement in Question 21: *The population in South Africa will double in the next 35 years. The reason for this is that people are having too many children.*

Resp.	Response (a)	Reason (b)
1	neutral	One also needs to take into consideration that socio-economic and educational standards play a crucial role in decreasing population growth. In the South African context with all these political changes, I believe that standard of living is going to improve in most of black people who happened to be the problem and they will become more aware of their future generations.
2	No response	No response
3	disagree	It is not that people are having too many children, but its lack of sex education in our schools results in early pregnancy and unplanned children.
4	disagree	At the same time many are dying and there is a reduction.
5	agree	People exposed to education have started to plan their families. Only populations that have not been exposed to education are still planning big families.
6	strongly agree	The birth rate is bigger than the death rate.
7	agree	I'm not sure about the actual statistics but it is quite expanding. This is also shown by the lack of houses and growing number of squatter-camps. There are not enough resources to sustain these growing numbers.
8	agree	This is true because according to statistics the birth rate in SA exceeds the death rate.
9	strongly agree	ignorant
10	strongly agree	SA has the greatest cultural difference. These cultures still strongly believe in their own culture which is not based on western culture.
11	agree	The reason why they seem to increase is because they have no houses to live in as a result they seem overpopulated.
12	strongly agree	People are ignorant and ill-informed about crucial issues such as family planning and child spacing etc...
13	neutral	I'm not sure about the figures, but I feel that since there are so many educational projects aiming at reducing these problems.
14	strongly agree	The facts speak for themselves.
15	strongly agree	Most people at the present moment have no accommodation, shelter, food, are unemployed.
16	agree	As I have already explained, the informal settlement is without jobs and have many children.
17	No response	No response
18	agree	No response

The lack of housing is a concern of respondents No's 7 and 11 who see it as being indicative of a growing population. Respondent No.11 interestingly expresses a perception that too few houses creates an impression of overpopulation. None of the respondents, in their responses (see Table 6.2), have shown any recognition that the mass migration of people to the cities from rural areas is a major factor in the growth of populations in the informal settlements that are mushrooming in and around the large urban areas. Between 1980 and 1990 it was estimated that the proportion of the black population in urban areas has risen from 42 per cent to 50 per cent (Simkins, 1993), with

a large proportion of these people living in squatter shacks, in unhealthy conditions, and undesirable circumstances.

Two of the respondents (No's. 6 and 8) recognise that the principle of population growth is a function of the birth rate exceeding the death rate, but they do not venture any explanations for why these are different. Respondent No.4 does not agree with the statement, and argues that the population is not increasing, but undergoing a reduction due to people dying. It is possible that this respondent believes the population to be in a stable state with the number of births and deaths being equal, and that there is no danger of overpopulation.

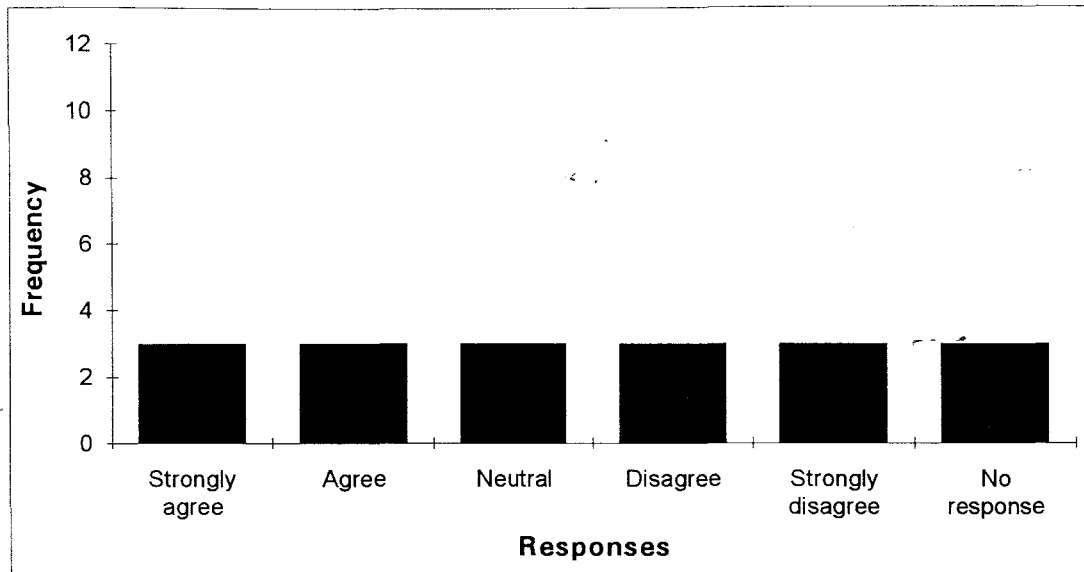
The respondents seem to have directed their responses to the portion of the statement that *the South African population will double in 35 years*. Only respondent (No.3) directly challenged the statement that *people are having too many children*. He however only touches on the problem of unplanned pregnancies, and not the other reasons discussed in section 2.5, that contribute to population growth.

### **6.1.3 South Africa's ability to sustain a high population growth.**

The respondents were asked in Question 22(a) to respond on the Likert scale to the statement: *South Africa can easily sustain such a population growth*, and to furnish their reasons in Question 22(b). The frequencies of responses produced an unusual pattern in that the frequency of responses for each of the divisions on the Likert scale were the same (see Figure 6.3). On closer examination of the reasons given by the respondents that indicated 'strongly agree' or 'agree', it is evident that they in fact do not agree with the statement (see Table 6.3), but seem to be expressing conditions that could assist this statement becoming a reality.

The limitations to sustainability in South Africa are set by the limited arable land and water resources. Although it is generally accepted that South Africa can sustain a maximum human population of 80 million with the present water resources, this was not mentioned by any of the respondents. Instead, lack of food and resources, and housing problems were cited. Education, and training in self sufficiency were mentioned as possible solutions to the growing population.





**Figure 6.3** Responses to statement in Question 22(a): *South Africa can easily sustain such a population growth*

Respondent No. 7 shows a degree of insight by citing the rising incidence of violence as a consequence of overpopulation, as a reason why South Africa is unable to sustain a high population growth.

**Table 6.3** Responses to the statement in Question 22: *South Africa can sustain such a population growth.*

Resp	response (a)	reason (b)
1	disagree	I disagree because limiting factors are mostly not renewable and things like drought and other forms of natural disasters are more prominent.
2	No response	No response
3	agree	By radically changing the socio-economic rootstock of our society.
4	agree	There is enough food and land. The only problem is the inflation rate.
5	strongly agree	More education esp. disadvantaged.
6	disagree	It cannot because it seems to me that South Africa has got a problem now. So 80 million would double or triple the problem as far as housing, food, jobs, etc. are concerned.
7	strongly disagree	There are not enough resources to sustain the growing numbers. This has led to an increase in violence. No jobs has led to people resorting to robberies and theft. There are not enough schools for the big number of pupils and students.
8	No response	No response
9	strongly agree	Resource are far less to cater with the needs of the people.
10	strongly disagree	Basic resources like mealies are already imported from other countries.
11	agree	By building more spaces to live in.
12	disagree	We could only accommodate.
13	neutral	If these education projects can help, the population growth can reduce and the problem of overpopulation can be solved.
14	strongly disagree	Very large parts of the country are desert/semi-desert where no food can be produced for human consumption. If the population keeps growing, very soon the land will not be able to produce enough food for everybody.
15	strongly agree	If people can control birth rate. If people can be trained to be self-sufficient.
16	neutral	There are many things that can be done. I mean South Africa has a great potential. She can improve the living standards of her people.
17	No response	No response
18	neutral	No response

She views unemployment as a consequence of population growth and cites this as a reason for the incidence of crime in this country. The shortage of schools is also one of her concerns.

Respondent No.4 was the only one who agreed with the statement, and gave a reason that could be interpreted as being correct, especially if one takes into account the unequal distribution of resources. The statement that there is enough food and land is reasonable, since historically under the apartheid system, there has been an inequitable distribution of land in this country. The reference to the inflation rate, however, shows that this respondent is not very well informed in matters relating to economics.

The respondents who disagreed, or strongly disagreed gave explanations which were in line with the real reasons as to why it is doubtful whether South Africa will be able to sustain a high population growth. These reasons included: lack of resources, food, housing, as well as factors relating to the arid land and water shortages in South Africa. The reasons given by respondent No.16 reflect a positive outlook for the future of South Africa, which is further justified by the need for improving living standards (see Table 6.3).

## **6.2 The question of sustainable development**

Question 23 required the respondents to give their understanding of the term **sustainable development**. Before considering the responses to this question, it may be useful to explore the meaning of sustainable development. The 'Brundtland Commission' defines it as; "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987: 43). Although at face value this statement seems noble in terms of conserving the environment, in actual fact argues Adams (1991), it is based on cornucopian philosophy and is more concerned with economic growth in terms of production, technology, national politics, new systems of international trade and finance, than for the environment itself. The term "sustainable development" seems to be a desirable phrase which is often used in a political context whenever it is necessary to justify, or object to certain commercial ventures which may have possible detrimental impacts on the environment.

This question was added specifically to determine whether teachers', are aware firstly, of the phrase and secondly, whether they show any conceptual understanding of it. The assumption here was that even if they were aware of it, they did not fully understand the implications of it, either in terms of development, or environmental conservation. As far as population dynamics is concerned, this question is important in terms of demography and the affect of population growth and environmental sustainability. Essentially, it addresses the section 7.6 of the population dynamics syllabus topic which deals with

human populations (see Figure 5.1). The responses from this question will be helpful in the development of a new teaching and learning module on population dynamics. This development will be done within a framework of sustainability using the sustainability principles postulated by Chiras (1993) and will incorporate the theme of sustainability.

Only respondent No. 7 seemed to show some level of understanding in this regard (see Table 6.4). This respondent's reference to the country not becoming "impoverished" can be broadly interpreted as taking future generations into consideration i.e. "meeting the needs of the present", and is thus in line with the acceptable understanding of the phrase.

**Table 6.4** Responses to Question 23: *What do you understand by the term sustainable development?*

Resp.	Response
1	It is development that can still be controlled and lasting.
2	No response
3	It is development based mainly on human resources and can be maintained for human development for a long period of time.
4	Population will not die out.
5	Not clear.
6	?
7	Sustainable development in a country which will allow for a minimal amount of suffering due to lack of food, shelter and resources. The country should progress fairly well and not become impoverished.
8	No response
9	To be able to maintain development with the available resources.
10	A development which is affordable so it can be continuous.
11	No response
12	When the economy can accommodate the population and poverty, unemployment etc. are minimal.
13	Not sure about the meaning -- Where development is constant.
14	Development can only take place positively if the environment can support that development.
15	Development that can carry on for a substantial period of time.
16	That can be done by improving the present, meaning that South Africa can be better.
17	No response
18	No response

Other respondents (No's.1, 3, 9, 10, 13, 14 and 15) expressed their understanding of sustainable development as development which is long lasting or continuous or constant, either in economic terms, or in terms of available resources. Future generations do not seem to be directly considered in the understanding expressed by these respondents, although there are some indirect implications. From the types of responses it can be inferred that in reality, none of the respondents have a clear understanding of the phrase "sustainable development" as it is understood in the field of environmental education, or in terms of resource economics (Adams, 1991).

It is also noteworthy that eight of the respondents indicated their lack of understanding either by not responding, or overtly stating that they were not sure what is meant by sustainable development. It is also reasonable to assume that the respondents, although charged with teaching population dynamics, and being qualified in a greater or lesser

degree to teach it, are not fully aware of the complex factors that determine the human population growth and its effect on the environment.

### **6.3 Population growth and poverty and consumption**

In South Africa, the disparity between the affluent and poor sectors of society, and the perceived contribution of each to environmental degradation is a sensitive issue.

Question 24 sought to ascertain the respondents' knowledge and understanding of the links between population and poverty, and population and consumption. This question was intended to be entirely open-ended in order to get as broad a spectrum of responses as possible. The questions could, however, have been more specific in terms of the links with environmental degradation and resource usage, but it was expected that comments that reflected these factors would emerge.

#### **6.3.1 Population and poverty**

It has been argued that there are causal links between population and poverty, but in the South African situation, having been influenced by apartheid, these links are not well defined. There is also a negative correlation between population growth and levels of income (Wynberg, 1993). The relationship between population growth and poverty in developing countries, has been discussed in section 2.5. Question 24(a) was posed in order to elicit the respondents' ideas on these matters.

All but one of the respondents who answered this question linked population growth to poverty in some way or another. Respondents No. 3, 5, 7, 9, 11, 15 and 16, in general, alleged that population growth results in a lack of availability of resources and food, which in turn leads to poverty (see Table 6.5). To some extent there is truth in this, but the "lack of availability of resources" is the crucial issue. It should be interpreted as the inequitable distribution of resources. The responses from No's. 1, 12, 13 and 14 reflect a belief that population growth leads to poverty. This statement is true for most developing countries, but the opposite has been the case in countries like the USA with its high immigration rate, and Malaysia where an increased birth rate is actively encouraged. In both of these countries, *human* resources are seen as the key to wealth and not the cause of poverty. The sustainability of these systems in terms of *environmental* resources however, is questionable. Respondent No.6 believes that poverty leads to high birth rate, which cannot be controlled. This response creates the impression that he is not aware of the numerous birth control methods present in the modern world. He also blames poverty for increased death rate and disease, thereby acknowledging the lack of primary health care in poverty stricken communities. An interesting argument is forwarded by respondent No. 4, who does not link population growth and poverty, but blames poverty on unequal

job opportunities and discrimination. This seems to support the lack of definition of the links as stated earlier.

**Table 6.5** Responses to Question 24: *Do you think there are any links between population and poverty and consumption?*

Resp	(a) population and poverty	(b) population and consumption
1	High percentage of population growth is directly proportional to poverty. Low population growth is indirectly proportional to poverty.	High percentage of population growth is directly proportional to higher consumption and vice-versa.
2	No response	No response
3	Yes, as population grows, the resources become limited and the need arise for other methods.	Yes
4	No links. Poverty is mainly caused by a lack of jobs, education, and in the past, discrimination.	No links. Resources are plenty, but poverty is the problem, not population growth.
5	Increase in population → lack of jobs, few resources for all, therefore poverty.	Not clear.
6	Poverty leads to high birth rate for there are no means for controlling birth rate It can also lead to high death rate due to lack of food, diseases, etc...	?
7	If the rate of population growth is high this will definitely lead to poverty because the available resources will become replenished(not clear what is meant).	Low population growth means low consumption and low consumption allows time and space for more production High rate of population growth quickly leads to the total consumption of available resources.
8	Normally population growth should be reduced by poverty and hunger, but due to the humanitarian aid this is not the case. Population growth increased drastically among the poor.	If the growth rate of a population is high the rate of consumption will also be high.
9	The higher the population rate the high the increase in poverty because of the limited availability of our resources.	With a very high population the higher the consumption rate. To an extent that the available resources do not meet the needs of the people.
10	Population growth increased rapidly among the poor because it is difficult for the individuals to understand problems such as overpopulation (religion also plays a role).	The larger the population , the larger the degree of consumption.
11	The people give more birth and there is less food.	When there are many children/people there need to be too much food because the more there are the more consumption is.
12	Yes a population explosion (with the increased consumption that usually follows it) often leads to poverty if not accommodated by economic growth.	Increased population causes over consumption of the country's resources are depleted.
13	Yes, if population is very high there is a high possibility of poverty.	More people consume a lot, but less people consume a little.
14	If human population growth takes place mindlessly it could always result in poverty.	More individuals are obviously more consumers, but that is not necessarily a positive result.
15	As the population grows there is more need for food resources.	No response
16	Too great a population can lead to poverty because of the lack of resources.	The above should come close to a balance in a way.
17	No response	No response
18	No response	No response

### 6.3.2 Population and consumption

Consumption patterns cannot be linked directly with population numbers. It is well documented that about 20 per cent of the world's population (in developed countries), is

at present using about 80 per cent of the world's resources. A similar pattern of consumption exists in the affluent sector of the South African population. Preston & Rees, (1994) argue that in South Africa, the proportion of per capita resource usage between the rich and the poor can be as high as a ratio of 100 : 1.

In Question 24(b) the respondents were encouraged to make comments on issues of population and consumption. None of the respondents were able to see the link between consumption patterns and population as described earlier. Instead they interpreted this statement in a literal sense by equating population growth directly with increased consumption (see Table 6.5). This may be true for the rural populations who are dependent on resources like firewood, but in urbanised communities this is not the case. The over-utilisation of these resources in South Africa is leading to rapid depletion of these, and is a function of population growth. However, the problem has been exacerbated by the unequal distribution of land during the apartheid era. In the past, the rural people were prevented from leaving their homelands, and in addition, the government removed millions of people back to their places of origin. This in turn led to a population density which expediated environmental degradation in terms of soil erosion, deforestation and desertification.

Although these questions were open for free interpretation by the respondents, they have shown a remarkable consistency of responses. This indicates that most of the respondents had similar interpretations of the questions. It is possible that if the questions had been worded in such a way as to guide the respondents' thoughts along the lines of environmental degradation and resource utilisation, the responses would have been more in line with expected answers.

#### **6.4 Environmental problems and population growth**

Environmental problems are well documented, but are perceived differently in different sectors of society. In the more affluent developed sector, the problems include pollution, waste generation and considerable resource depletion. Other types of environmental degradation occur in the large farming communities. These include soil erosion, monoculture, with its problems of fertiliser and pesticide usage, as well as overutilisation of water resources due to uneconomic irrigation practices. In the poor underdeveloped sector of society, the links between population and environmental problems are very apparent. They include problems of de-vegetation which lead to soil erosion, desertification, the loss of wildlife and biodiversity.

It is quite conceivable that people in general, are not consciously aware of the links between population increase and environmental degradation. The responses to Question 25 not only reveal the respondents' understanding of what they consider to be

environmental problems, but also how these are linked to population growth. The respondents were asked in Question 25 to list environmental problems that they perceived to be a direct consequence of population growth (see Appendix 2). For environmental education, the environment is seen holistically as an interaction between the political, social, economic and biophysical world. Taking this view into account, the responses that emerged from this question can be crudely divided into environmental problems of a social nature relating to humans in particular, and problems that are directly related to environmental degradation. The former are important since they reflect the socio-economic and cultural dilemmas faced by people in the less developed or disadvantaged communities.

**Table 6.6** Responses to Question 25: *Please list the environmental problems that you think are a direct consequence of population growth?*

Resp.	lists
1	1. Informal settlements 2. High population density. 3. Well serviced environments in which people live. 4. Environmental awareness.
2	No response
3	Poverty pollution erosion.
4	Contraception are not readily available, Sex education and abortion should be legalised.
5	poverty, availability of jobs, good medication facilities.
6	competition, poverty, high birth rate.
7	decrease in vegetation, increased littering, diseases, depletion of ozone layer.
8	No response
9	deforestation, pollution of water, soil, air.
10	pollution, overpopulation.
11	birth-rate, moving of people, immigration and emigration.
12	pollution(squatter camps) extinction of especially plant life, e.g. the cape flats has lost many indigenous species due to housing.
13	shelter etc...
14	air pollution, water pollution, soil erosion and pollution.
15	pollution of water and air, lack of food, destruction.
16	the informal settlement and joblessness.
17	No response
18	No response

The socio-economic hardships that are experienced in disadvantaged communities cannot be separated from certain types of environmental problems caused by these situations. Poverty, high population growth, lack of food and shelter, unemployment, lack of medical care, competition, immigration and emigration, and overpopulation are some of the problems that were listed by the respondents (see Table 6.6). Even though the respondents were not specifically asked to, none of them qualified any of their choices, which makes it difficult to interpret some of the underlying reasoning behind their choices, and how they perceive them to relate to problems within the biophysical realm of the environment, and environmental degradation.

Problems relating to the biophysical environment listed by the respondents are well documented problems, and include ozone depletion, pollution of water and soil, soil erosion, decrease in vegetation (loss of biodiversity?), deforestation, species depletion because of informal housing and general environmental destruction. It is reasonable to assume that the respondents who answered the question listed environmental problems as they perceived them to be. It is also interesting that it was the graduate respondents (No's. 3, 7, 10, 12, and 14) who listed problems relating to environmental degradation, and most of the respondents with diplomas who listed the environmental problems of a social nature. While this may not be significant, it does give an indication that teachers who are better qualified, seem to display academically acquired knowledge relating to the teaching of their subject. It is possible that the teachers who have diplomas only, seem to rely on socially acquired knowledge of an everyday nature and seem to be more socially aware.

### **6.5 Conclusions**

In this chapter the respondents' environmental views relating to population were presented and analysed. There is a concern for population growth in the world as well as in South Africa amongst the respondents. There is also an acute awareness of problems relating to poverty and high population growth, although there is no evidence to suggest that the respondents are aware of the economic and social reasons for high population growth in third world countries. There is a realisation that the population growth rate in South Africa cannot be sustained because of food shortages, lack of housing and other socially related reasons. There are definite indications that the respondents are not fully aware of the patterns of population and poverty as well as population and consumption. Sustainable development as a concept is poorly understood in the terms of the intended meaning. Teachers who are better qualified seem to be concerned with issues relating to environmental degradation while others are more concerned with the socio-economic aspects of the environment.



## **Conclusions, evaluation and implications for the future**

The broad aim of this pilot study was to gain information from a sample of teachers about their feelings towards population dynamics and to gauge their knowledge and understanding of environmental issues relating to human population dynamics. In this light, it was important to establish basic information about the research sample, and to get an insight into their knowledge, understanding and teaching of the topic. This relevant background information about the research sample makes it possible, in the analysis, to relate it directly to the responses and make inferences accordingly. Having insight into the teachers' views on environmental aspects of the human population, and essential environmental concepts, makes the development of teaching and learning materials that carry the banner of environmental education that much more relevant. The information from this research, together with information from a future nation-wide survey, will serve as guidelines for the development of a teaching and learning module on population dynamics. Since all environmental problems are linked to human populations in some way or another, population dynamics as a school topic is an essential vehicle for environmental education.

### **7.1 Conclusions**

#### **7.1.1 Views about teaching population dynamics**

Population dynamics is an important topic for students to learn about. The teachers see the importance of population dynamics in the light of the human populations and the types of problems associated with the expanding human population. With the knowledge of the teachers' qualifications, the evaluation of the responses can be seen in a more discerning light. The teaching that takes place in large classes in these underprivileged schools is predominantly teacher-centred and the teachers are most comfortable with the transmission mode of content devolution. The emphasis is placed on the final external examination system, and this has an influence on how the subject is taught. There is not much emphasis placed on the teaching of population dynamics mainly because it is the last section in the syllabus and teachers are pressed for time close to the examinations. It is also doubtful whether teachers apportion the appropriate time to teaching population dynamics. There seems to be very little planning amongst teachers in their departments beyond timetable negotiations and a superficial exchange of ideas.

None of the text books used in the schools were highly rated by all of the respondents. They tend to favour study guides and books that have a self instructional approach. The

teachers who are better qualified are more critical of the text books which are available to them through the department. In general, the quality of the reasons given by the teachers seems to correspond with their level of qualifications. The better qualified teachers are more concerned with issues relating to the biophysical aspects of the environment, whereas the less qualified teachers seem to be more concerned with issues relating to the socio-economic aspects of the environment.

### **7.1.2 Population dynamics syllabus sections**

Correlations of the choices made by the teachers indicate that they had taken the questionnaire seriously. The correlations also confirm the reliability of the responses, especially for this section of the questionnaire. Population dynamics has a number of different areas of interest, some of which are more difficult to teach than others, and difficult for students to understand. The sections in population dynamics which are the most difficult to teach and/or the most difficult for the students to understand are those that carry graphical illustrations and require mathematical knowledge and those that present difficulties for second language users. If one views the responses in terms of the sub-sections that were represented in the 1994 DET examinations, it is not difficult to see why these sub-sections of the syllabus are deemed more important than others. Sections that are easy to teach present the least difficulty for students. The sections that are the easiest to teach, are also the most interesting, and the most important for students to learn about.

Three criticisms emerge from the results of this section of the questionnaire. The first is that nine sub-sections for the respondents to choose from, may have been too many. The second is that, in choosing three sections, it makes it that much more difficult for the respondents to give meaningful explanations regarding each of their choices, and thirdly, a set of follow-up interviews would have clarified some of the responses. It would have been better if the respondents were asked to choose only one, or at the most, two sections in the list that was offered. This would have separated them out more sharply, and made it easier to supply more relevant qualitative responses. The sub-section of the syllabus that deals with human populations and problems relating to them, is the most important in terms of environmental education, and will be stressed in the future development of teaching and learning materials. The reasons supplied in many of the questions show that these sections, and the learning of them have a bearing on the lives of the students since they tend to relate to their surroundings. The teachers show an awareness of the problems facing the human population, and they believe that learning population dynamics will assist the students in addressing them. The section dealing with human populations is a popular choice as an important section for the student to learn about. The future of the

planet lies in the hands of the younger generation, and knowledge of the environmental problems that face the world, will enable them to play their part in the solutions to these.

### **7.1.3 Environmental views and population**

The teachers agreed that the human population expansion is a problem, and they are aware of the environmental consequences of overpopulation. Their background helps them to better understand environmental issues relating to the human population. There is also an awareness of the links between population growth and environmental degradation, and of the social and economic reasons for the high population growth in developing countries. They recognise that the present population growth is affecting access to land, housing, social services, resource depletion, and environmental degradation. They also believe that population growth causes a depletion of resources, which in turn leads to poverty. They are not aware of the consequences of consumption and the direct link it has, not with overpopulation, but with the affluent section of the population with its consumerist lifestyle. They have an alternative belief that more people lead to greater consumption, but do not take into account the people who live a subsistence lifestyle. There is a realisation amongst the teachers that South Africa is not able to sustain its present population growth, but they recognise the importance of education in solving population problems. The teachers have a limited, simplistic interpretation of sustainable development, but none of them show an understanding of it in terms of the Brundtland definition. One general conclusion is that the teachers who are better qualified, tend to have a better knowledge and understanding of environmental issues and their link with population.

### **7.2 Critical evaluation**

One of the biggest problems with the use of a questionnaire, is the potential poor quality of the qualitative responses that are provided by the respondents. Time constraints on teachers can result in their not taking enough time or careful thought over the types of answers that they provide. This seems to have been the case in a number of the responses. This problem could have been alleviated had the questionnaire been followed up by a set of structured interviews which would have probed the knowledge of the respondents in the areas that had been poorly covered in the questionnaire. This would also have served as a method of triangulation, and would have added an essential element to the results. In the questionnaire, the teachers were asked if they would be willing to be interviewed. All but four respondents indicated in the affirmative. The intention was to interview the respondents at a later date in order to clarify any data on the questionnaires and to triangulate the results. Because of the prevailing situation and due to time constraints, it was not possible to do the interviews (see section 3.9).

The results did not show up any major flaws in the questionnaire design or in the phrasing of the questions. This does not mean that the questionnaire was perfect. In fact, it was possibly too long, and may have been a time consuming exercise by the respondents to complete it. The fact that there were a number of non-responses in the sections that required time to complete, serves to confirm this.

The validity of the results can be measured in terms of interpretive validity, which is grounded in the language of the people (Maxwell, 1992). The qualitative nature of the data, and the fact that the data are the own words of the respondents makes it difficult to doubt the validity of the results. According to Maxwell (1992: 290), "accounts of participants' meanings are never a matter of direct access, but are always constructed by the researcher on the basis of the participants' accounts...". Since the validity can be seen in terms of the interpretation of, and inferences drawn from the results, it follows that the only threat to validity is the distortion of results, or inaccurate recall of them. In this research, all the responses were written down, so there was no danger of this. The only problems with validity that could arise therefore, is if the inferences that are made from the data are very obviously incorrect. Through the use of interviews, it would have been possible to cross-check inferences to ensure validity in this respect. Reliability of the results is dependent on consistency of response. In the case of qualitative data, any result is acceptable as long as it is sensible, and therefore reliability is not in question. Since it was not evident that any of the respondents had difficulty in understanding the wording of the questionnaire, it can be accepted that the questionnaire was in fact reliable in these terms.

## **7.3 Future implications of the research**

### **7.3.1 Workshops and interviews**

Respondents were asked in the questionnaire whether they would like to attend a workshop on population dynamics (Appendix 2, Question 26), and with which sections of the syllabus they would need assistance. Only two respondents declined the offer. All the others indicated their willingness, and all but two of these listed the sections with which they would need help. Some respondents wanted all the sections covered, and the rest of the respondents only indicated the sections which they themselves had indicated as being the most difficult to teach. In the past, SEP used to offer workshops to local teachers on a regular basis, and there were also regular requests by teachers for help in their classrooms. Due to a change in the education system countrywide, SEP has had to re-negotiate access to schools, and until the relationship between SEP and the separate Provincial Education Departments has been formalised, the running of workshops where teachers are removed

from their classrooms is not possible in the Western Cape. For any future workshop on population dynamics, the results from the research will be important in terms of guidance for the types of issues that will need to be covered in such a workshop.

### **7.3.2 Materials development**

This research has direct implications for the development and writing of a module on population dynamics for both teachers and learners. The aims of the research as they were stated have been achieved in that the necessary information needed for feeding into the development of a teaching and learning module on population dynamics has been obtained. The responses to the section dealing with the population dynamics syllabus give a clear indication of the drawbacks of the present syllabus in terms of environmental education. A teaching and learning module that takes these into account and succeeds in rectifying them, and at the same time includes a section which deals with population problems and addresses solutions in a socially critical way, will be beneficial both to the teachers and learners. In such a module, teachers should be encouraged to use a student-centred approach with interactive materials that stimulate debate and critical reflection so that critical thinking, and problem solving skills become prominent in the classroom situations. In this way the problem of large classes can be addressed through group-work with teacher facilitation.

### **7.3.3 Further research**

Since this pilot study has only covered teachers' perceptions of population dynamics through the restricted use of a questionnaire, it is essential that further research be carried out as a follow-up to this. This will include a national survey with teachers in all the SEP regions, as well as interviews, and workshops with participants. Issues that deal specifically with the human population control and the future sustainability of the planet will be pertinent to such research. In the words of sir Julian Huxley:

The recognition of an optimum population size (of course relative to technological and social conditions) is an indispensable first step towards that planned control of population which is necessary if man's blind reproductive urges are not to wreck his ideals and his plans for material and spiritual betterment (Huxley, quoted in Grant, 1992: 7).

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**Personal communications:**

Irwin, P.R. (1995). Education Department, Rhodes University. Grahamstown.

## **Appendix 1**

### **Focus Group Discussion on Population Dynamics**

Date 1 December 1994

Time 2.00 pm

Venue SEP CDU Peninsula Technikon

The purpose of this discussion is to investigate a number of avenues that may present problems to teachers in the teaching of population dynamics.

Some of the questions that we will be dealing with are:

What is the teachers content knowledge of the topic?

What is their understanding of the topic in terms of teaching it?

What are their needs in terms of academic support?

What are their needs in terms of skills development?

What types teaching materials/training do they need?

What is their knowledge in terms of the socio-political and environmental effect of overpopulation? To what extent will teachers feel comfortable to raise these types of issues with students?

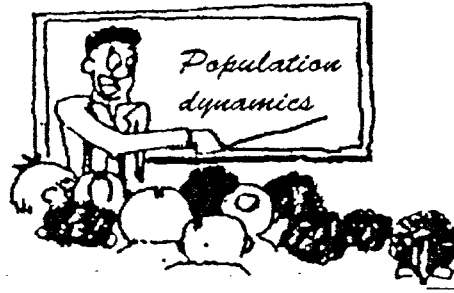
The information from this discussion will be helpful to us in compiling a questionnaire which will be administered to teachers in the Western Cape. The information obtained in this way will be of academic importance and will help to guide us in the development and refinement of the module on Population Dynamics.

Thank you for your participation.

Athol Hockey.

## **Appendix 2**

### **Questionnaire on population dynamics.**



## QUESTIONNAIRE : POPULATION DYNAMICS

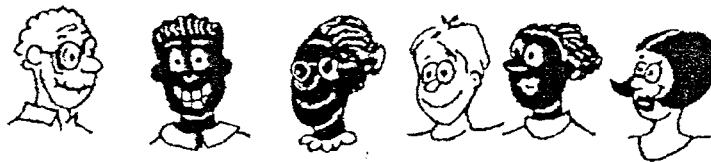
**NB. Please read the information on this page before answering the questionnaire**

### *A bit about Science Education Project (SEP):*

SEP is an organisation which is committed to improving the standard of science education in South Africa through empowering teachers and encouraging an interactive role for students in the classroom. Because of this we need input from teachers to assist in the curriculum process. In answering this questionnaire, you will be assisting this process.

### *What this questionnaire is all about*

This questionnaire is both about your knowledge and needs in terms of teaching population dynamics. The information that you provide is important to us in that it will help us in the development and production of a teaching and learning module on population dynamics.



### *What you need to know*

- Please give your **own** feelings and perceptions.
- Remember! There are no right or wrong answers.
- Please try to give as much information as possible.
- Nothing you say will be considered trivial.
- This is an anonymous questionnaire, but you may give your name at the end if you wish.
- All the information that you give will be treated in strict confidence.



Please note: this questionnaire consists of 7 pages.



*Please tell us a bit about yourself*

- 1. What **academic** qualifications do you have?.....  
(e.g. BSc, P.T.D, HDE secondary Diploma etc..)
- 2. What **teaching** qualifications do you have? .....  
(e.g. S.T.D, H.D.E, B.Ed, etc.)
- 3. How long have you been a biology teacher? .....years
- 4. Did you study **population dynamics** in your degree or diploma? YES  NO
- 5. Have you done any in-service courses on **population dynamics**? YES  NO

*Now tell us a bit about your teaching*

- 6. How long have you been teaching **population dynamics**? ..... years
- 7(a). Please read the next statement and tick(√) your response in the appropriate block

**Population dynamics is an important topic for students to learn about.**

Strongly agree	agree	neutral	disagree	strongly disagree
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(b) Please explain your view

8. What is the average size of the classes that you teach? .....students

9(a). Do you normally teach the topic **population dynamics** to your classes? YES  NO

(b) If your answer is **no**, please give your reasons

10. At what time of the year do you normally teach **population dynamics**?

11. Explain briefly how you go about teaching **population dynamics**.

12(a). What text book /s do you use?.....

(b) How would you describe the book/s. Please tick (√) your choice in the block.

excellent	good	adequate	poor	very poor
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(c) Please give reasons **why** you describe the book/s as you do.

13(a). What additional teaching materials, if any, do you use in teaching population dynamics?

(b) Where did you obtain your additional materials?

14(a). Do you and other staff in your department ever plan your teaching strategies and methods together? Please tick(✓) your choice in the block.

always	often	sometimes	rarely	never
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(b) If you **do**, please describe them.

***Now please tell us how you feel about teaching population dynamics.***

*For Questions 15 - 20, indicate your choices with a tick in the appropriate boxes.*

***NB.*** Please give your **reasons** in the spaces provided. If you need more space, use the back page.

15(a). In the list of syllabus sections below, please tick (✓) the **three** sections which you as a teacher find **the most difficulty to teach**.

- 1. The parameters that effect population size e.g. growth, reproduction, immigration, mortality, emigration
- 2. The different types of growth forms e.g. geometric and logistic and the associated graphs
- 3. The various techniques for estimating population size e.g. census. mark-recapture
- 4. Carrying capacity : the meaning and importance of it
- 5. Density-dependent and -independent parameters that regulate population growth
- 6. Importance of the different types of competition e.g. inter- & intra-specific, territoriality
- 7. Predator/prey interactions
- 8. The concept of energy flow and the parameters of the energy budget
- 9. Section dealing with human populations.

(b) Please explain **why** you have made your choices.

16(a). In the list of syllabus sections below, please tick (✓) the **three sections** which you, as a teacher, find **the easiest to teach**.

- 1. The parameters that effect population size e.g. growth, reproduction, immigration, mortality, emigration
- 2. The different types of growth forms e.g. geometric and logistic and the associated graphs
- 3. The various techniques for estimating population size e.g. census. mark-recapture
- 4. Carrying capacity : the meaning and importance of it
- 5. Density-dependent and -independent parameters that regulate population growth
- 6. Importance of the different types of competition e.g. inter- & intra-specific, territoriality
- 7. Predator/prey interactions
- 8. The concept of energy flow and the parameters of the energy budget
- 9. Section dealing with human populations.

(b) Please explain **why** you have made your choices.

17(a). In the list of syllabus sections below, please tick (✓) the **three sections** which you, as a teacher, find **the most interesting to teach**.

- 1. The parameters that effect population size e.g. growth, reproduction, immigration, mortality, emigration
- 2. The different types of growth forms e.g. geometric and logistic and the associated graphs
- 3. The various techniques for estimating population size e.g. census. mark-recapture
- 4. Carrying capacity : the meaning and importance of it
- 5. Density-dependent and -independent parameters that regulate population growth
- 6. Importance of the different types of competition e.g. inter- & intra-specific, territoriality
- 7. Predator/prey interactions
- 8. The concept of energy flow and the parameters of the energy budget
- 9. Section dealing with human populations.

(b) Please explain **why** you have made your choice.

18(a). In the list of syllabus sections below, please tick (✓) the **three sections** which you, as a teacher, think are **the most important for students to learn about**.

- 1. The parameters that effect population size e.g. growth, reproduction, immigration, mortality, emigration
- 2. The different types of growth forms e.g. geometric and logistic and the associated graphs
- 3. The various techniques for estimating population size e.g. census. mark-recapture
- 4. Carrying capacity : the meaning and importance of it
- 5. Density-dependent and -independent parameters that regulate population growth
- 6. Importance of the different types of competition e.g. inter- & intra-specific, territoriality
- 7. Predator/prey interactions
- 8. The concept of energy flow and the parameters of the energy budget
- 9. Section dealing with human populations.

(b) Please explain **why** you have made your choices.

19(a). In the list of syllabus sections below, please tick (✓) the sections which you think **your students have the most difficulty with**.

- 1. The parameters that effect population size e.g. growth, reproduction, immigration, mortality, emigration
- 2. The different types of growth forms e.g. geometric and logistic and the associated graphs
- 3. The various techniques for estimating population size e.g. census. mark-recapture
- 4. Carrying capacity : the meaning and importance of it
- 5. Density-dependent and -independent parameters that regulate population growth
- 6. Importance of the different types of competition e.g. inter- & intra-specific, territoriality
- 7. Predator/prey interactions
- 8. The concept of energy flow and the parameters of the energy budget
- 9. Section dealing with human populations.

(b) Please explain **why** your students have difficulty with these.

***Finally some of your environmental views***

In the next three questions please give your response by putting a tick (✓) in the block that you think best describes how you feel about the statement being made.

20(a). **The rate at which the human population is expanding is a problem.**

Strongly agree	agree	neutral	disagree	strongly disagree
----------------	-------	---------	----------	-------------------

(b) Please explain your choice.

21(a). **The population of South Africa will double to 80 million in the next 35 years. The reason for this is that people are having too many children.**

Strongly agree	agree	neutral	disagree	strongly disagree
----------------	-------	---------	----------	-------------------

(b) Please explain your view.

22(a). **South Africa can easily sustain such a human population growth.**

Strongly agree	agree	neutral	disagree	strongly disagree
----------------	-------	---------	----------	-------------------

(b) Please explain your view.

23. What do you understand by the term “sustainable development”?

24. Do you think there are any links between population growth and **poverty and consumption**? Write your thoughts in the spaces below.

(a) population growth and poverty

(b) population growth and consumption

25. Please list any environmental problems that you think are a direct consequence of the human population growth.

26(a). If a course or workshop on **population dynamics** were offered by SEP, would you be interested in attending? 

YES		NO	
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(b). Which sections would you particularly like some help with? Write only the numbers from the syllabus sections listed in questions 15 - 19 (sections 1 - 9).

27(a). Would you be prepared to participate in a personal interview about **population dynamics** for about half-an-hour at a later date? 

YES		NO	
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(b) If so, please give your name, school and phone number in the space below.

**Thank you very much for giving up your time to fill in this questionnaire.**