EXPERIENTIAL ENVIRONMENTAL EDUCATION:

A TOOL FOR MOUNTAIN CONSERVATION IN THE ECUADORIAN ANDES

by

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ABSTRACT

The 1992 United Nations Convention on Biological Diversity recognizes mountain environments and mountain peoples as threatened. Multidisciplinary and interdisciplinary approaches have been identified as the recommended view in addressing associated environmental conservation issues. However, the knowledge that is generated or acquired by the study of mountain issues must be shared. Only once this sharing of knowledge has occurred can conservation and development schemes be effectively and collectively employed.

This non-thesis project is a proposal for the knowledge sharing of mountain issues in the Andes of Ecuador. The proposed project is destined for urban youth between the ages of 14 and 17 years old, inhabitants of Quito, Ecuador. The method of delivery is through an experiential environmental education project that allows participants the use of all their senses in the discovery of the Andean environment. The proposed project site is Cotopaxi National Park, Ecuador.

Using fundamental elements of adventure education, the aim of this project is to provide the student participants with the tools to learn about their environment in a fun and experiential setting. In doing so, it is anticipated that the students will become environmentally aware citizens, in a local and global context.

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Everybody experiences far more than he understands. Yet it is experience, rather than understanding that influences his behaviour. -McLuhan

Chapter One

1.0 Introduction

Mountains are home to millions of people. For thousands of years, people have made their living in the sometimes hostile environments of the world's great mountain ranges such as the Himalaya and the Andes. The fate of these and other mountain ranges is in question, as resource pressures and conflicts abound, as glaciers recede at unprecedented rates and as the people who inhabit the mountains continue to live in impoverished conditions.

Is there a way for citizens of developing countries to become conscious and mindful of the threats to neighbouring mountain environments? If so, would it be plausible to believe that conservation efforts in such threatened environments would then be strengthened, once citizens were aware?

The purpose of this paper is to propose the use of an outdoor experiential environmental education program to raise awareness of mountain environments and the need for their protection and conservation. The program is designed for urban youth participants, wealthy and poor alike, from the capital city of Quito, Ecuador.

With the Earth Summit in Rio de Janeiro in 1992, also known as the United Nations Conference on Environment and Development, the Convention on Biological Diversity was opened for signing by member states around the world (Mulongoy *et al.*1999:261). A section of the convention specifically addresses mountain environments, entitled "Managing Fragile Ecosystems: Sustainable Mountain Development" in Chapter 13 of Agenda 21 (see Appendix 1). This section was put forward as an effort to recognize and begin to circumvent the problems faced by mountain environments and their inhabitants on a global scale. Chapter 13 distinguishes two target areas where programmes are needed in order to strengthen mountain communities worldwide. These two target areas identified in Agenda 21, Chapter 13 are:

1) Generating and strengthening knowledge about the sustainable development of mountain ecosystems; and

 Promoting integrated watershed development and alternative livelihood opportunities.

It is with the first of these target areas in mind that the experiential environmental education project contained within these pages has been designed. The project is focussed on the sharing of knowledge about the mountainous areas of Ecuador. This knowledge to be shared is centered around four main themes. These themes have been selected by virtue that they conscribe to the priorities of environmental education, which are: i) focus on nature; ii) individual environmental understanding;

and iii) integrative approach to culture-nature relationships (Galego and Acuna 1997:29). The four project themes, which will be referred to throughout the text, are:

1) Andean Ecology

2) Biodiversity in the Andes

3) Traditional Land Use in the Andes

4) Climate Change Affecting the Andes

The first priority of environmental education, according to Galego and Acuna (1997), is to focus on nature. Andean Ecology and Biodiversity in the Andes have been selected as relevant themes for the experiential education project, which clearly fulfill the requirement for a focus on nature. Furthermore, these themes focus on the local nature, which is the Ecuadorian Andes. Glaego and Acuna's (1997) second priority in environmental education is individual environmental understanding. The proposed project achieves environmental understanding at the individual level by virtue of the experiential method. The students will have the opportunity to spend three days in Cotopaxi National Park and surrounding area. where they will be encouraged to experience nature through a variety of planned activities. This experience will directly foster an individual environmental understanding for the participants. The final priority for environmental education, as identified by Galego and Acuna (1997) is; an integrative approach to culturenature relationships. The Traditional Land Use project theme is aimed at presenting the historical and current land use schemes in the Andes in such a way that the

students understand the implications of different technologies, the selection of different crops and the Andean culture which has emerged as a result of inhabiting the mountains over a period of centuries. The project theme Climate Change Affecting the Andes also subscribes to the culture-nature relationship focus, essential in environmental education, due to the emerging awareness that climate change is a response to human-nature interactions. The participants in the experiential environmental education project will see firsthand the recession of the Cotopaxi glacier, and have the opportunity to discuss the implications of glacier recession and climate change with the local farmers of the Cotopaxi region.

This project is an attempt at a development alternative based in education. The aim is to provide urban youth of Quito, Ecuador with the opportunity to experience the wonders of the mountains firsthand. In observing and participating in an outdoor learning experience, the youth will be made aware of the need for conservation and be encouraged to begin thinking of ways in which conservation can be achieved locally. This project aims to bring together a network of people with very different backgrounds, but above all, it aims to involve and encourage local people to rediscover the Andes of Ecuador. Although there are elements and principles of the proposed experiential environmental education project that have been initially developed in the context of North American Outdoor Education Centres, this project is truly unique to Andean people and Andean mountains.

The information presented in this paper was gathered from a variety of sources. The basic concept of an experiential environmental education project came from an examination of contemporary outdoor experiential education models, predominantly North American, that have emerged over the past three decades. After contemplating conservation schemes from developing countries, I realized that it might be possible to incorporate the idea of an experiential environmental education project as a tool for educating citizens of developing countries on various environmental conservation issues, and specifically on mountain environments.

Several visits to Ecuador introduced me to the education system, both as a student and as an instructor. These experiences greatly influenced my decision to target youth as participants in the experiential environmental education project. In utilizing the educational structure already in place, it would not only facilitate the selection of participants, but also help in designing and preparing the activities, specific to a certain age group and educational level.

A further visit to Ecuador allowed me to explore the possibilities for the implementation of such a project and to access literature that was not readily available in Canada. Informal discussions with several mountain guides working in Ecuador, as well as teachers in the Quito area, revealed positive feedback at the possibility of participating in such a project. This was sufficient for me to initiate the first phase, the project proposal, which is essentially the focus of this paper.

This paper is organized into four chapters. The first chapter explores the current situation of mountains in general. It also examines general environmental conservation schemes, and pays particular attention to conservation schemes in developing countries, where pressures on natural resources are often greater.

The second chapter looks into the history of experiential learning and environmental education, outlining the main concepts that have emerged during the past century. This chapter also presents the idea that experiential environmental education could realistically be used as an approach to conservation in a variety of circumstances, including the one proposed within the context of this project.

The third chapter is specific to the proposed experiential environmental education project in Cotopaxi, Ecuador. The characteristics of Cotopaxi National Park and area are described, in order to give the reader a better understanding of the area and its suitability as a site for an experiential environmental education project in Ecuador. The details of the project and its organization are outlined, including the preparatory sessions to be held in the classroom, the schedule of proposed activities, as well as descriptions of the activities themselves. This section also details the four project themes, which constitute the body of information to be disseminated to the student participants.

The final chapter summarizes the paper and concludes by making recommendations on the feasibility and implementation of the project. It also

highlights some issues to be further examined prior to the implementation of such a project. These include legal liability issues, safety standards, financial support, and participant selection.

This project is currently limited to a theoretical situation. It is intended to act as a baseline, or structure, for the eventual implementation of an experiential environmental education project by secondary schools in Quito, Ecuador. It may consequently be used as a proposal for such a project. Therefore, in the context of this project, it is not possible to analyse or to draw conclusions regarding the level of success achieved by participants. Nor is it currently possible to arrive at insightful recommendations for the enhanced success of the project.

1.1 Threatened Environments: Mountains

What has been the driving force in the development of environmental education and awareness is the increasing impact of human life on earth. Exponential increases in world population and soaring consumptive behaviours have contributed to the immense pressure being placed on the natural resources of our planet (Orr 1991:89). This pressure, often compounding, is being observed through such occurrences as loss of habitat and species diversity, air, soil and water pollution, and erratic global climate patterns with a trend towards warming (Myers 1999:244). Human endeavours aimed at circumventing the effects of these observed problems are often bound in technology and not in the alteration of behaviour "the mistake...is that science and technology will rescue us from the consequences of stupidity, arrogance, and ecological malfeasance" (Orr 1991:90).

Mountains are home to very threatened environments. In recent years, the concept of 'threatened environments' has focussed on oceans, biological diversity, transboundary air pollution, trade and industry, and desertification (Centre for International Earth Science Information Network (CIESIN) 2001: URL: http://sedac.ciesin.org/entri/). This has been reflected in international conservation strategies that do not distinguish mountain environments. A comprehensive list of treaties pertaining to environmental issues compiled by the Centre for International Earth Science Information Network can be found in Appendix 6. With the neglect of mountain environments in the eyes of conservation agencies worldwide, the need to

increase awareness of global mountain situations is now greater than ever.

A more specific and detailed description of mountain ecology and landscape will be provided in Chapter three, where the body of information destined for the students is contained. The broad topic of mountain conservation was selected as a driving force behind this project proposal for several reasons. Firstly, as has been identified, mountains are often overlooked as places in need of conservation strategies. Secondly, the Andes complete the physical backdrop to the urban centre of Quito, Ecuador. Within the hustle and bustle of the city, it is easy to forget the human connection with nature, even though the snow-capped Volcan Cotopaxi is visible from downtown. In removing the daily context of life in the city, and being placed in a wilderness area of the high Andes, the participants will have the opportunity to become more aware of themselves as natural beings, and the importance of nature in general. The mountains therefore, provide the regional context within which to explore the dimensions of that environmental understanding. Thirdly, in using a regional context to become environmentally aware, one will begin to see the importance of conservation strategies, and modify behaviour to reflect those values.

1.2 Different Approaches to Conservation

Over the years, conservation has grown to become a significant global concern. Although some unarguably place more emphasis on the resolution of conservation issues than others, it has widely been accepted as a global problem, at least officially since the 1992 Earth Summit in Rio de Janeiro.

Environmental conservation has emerged as an evolutionary process in itself, with new thoughts and trends on approaches to conservation continually being developed. The people who work on conservation issues are worldwide and include non-governmental organizations, governmental organizations, educational institutions and so on. Although the conservation issues at hand may be very localized initially, they may have the potential to extend beyond the local scope and see impacts on a global scale.

One of the best known conservation approaches is the establishment of protected area strategies. These strategies are often made at the national level and serve to designate a system of areas as protected. There are generally multiple levels of protection afforded by these designated areas. Levels of protection can range from highly remote wilderness areas, with no human access, to protected areas where mining and forestry are allowed and deemed compatible with area goals. Areas may be protected on a permanent or temporary basis. The key here is that the establishment of protected areas occurs initially, and sometimes exclusively, at an administrative level. This means that the extent to which the area

classified as 'protected' is truly protected can be questionable (Dasman 1984:344).

Protected areas are by no means the sole effort of conservationists, however. There are laws created that aim to regulate the harvest of certain species, such as salmon, cod, and old-growth rain forests in Canada. At times, there are simply restrictions placed on the methods that may be utilized to harvest certain species, such as the traditional spearing of seals, or the use of horse-drawn logging operations only. There are attempts at environmental education; information campaigns that aim to educate the public on the implications of environmental degradation and loss. Other conservation schemes include alternative economic development. This normally occurs in a sector where natural resources are harvested in an unsustainable manner. Examples of alternative economic development strategies are non-timber forest products and ecotourism ventures. These are simply a few conservation schemes that have been implemented in various countries, at various levels, and have received mixed results. There is no tell-all solution to environmental concerns.

Think tanks, or groups of academics, come together to put their energies into generating solutions on a variety of conservation issues. The Root Causes Project, spearheaded by the World Wide Fund for Nature, Macroeconomics for Sustainable Development Program Office and the Global Environment Facility, was a think tank of leading-edge thinkers on conservation and biodiversity loss. The latest two assumptions that this group of thinkers has agreed upon is very noteworthy (Wood

et al. 2000:9):

1. That conservation strategies must be multi-disciplinary in nature to encompass activities that range from the creation and management of protected areas to the integration of sustainable development principles into international economic policy-making. These strategies must be based on analyses of the complexity of factors that drive Biodiversity loss and must seek to involve many different actors, with their differentiated comparative advantages, in the identification and implementation of solutions.

2. The paradox of Biodiversity loss is that it is considered a global problem but that its actual occurrence is a highly localized phenomenon. The conservation of Biodiversity therefore need to be an undertaking that occurs simultaneously at a variety of scales.

As the generation of assumptions such as these continues, there is hope that conservation strategies will improve and become more effective. The first statement acknowledges that conservation is not a single scientific discipline. By utilizing the various problem-solving approaches inherent and specific to a range of academic disciplines, new and comprehensive strategies may be devised (Berrens 2001:104). The first statement also stresses that for conservation strategies to be successfully implemented, they must become a part of economic policy-making. Conservation and economic policy are not mutually exclusive, they must go forward together. Furthermore, this statement credits all actors with the implementation of solutions. This means that not only academics, but policy-makers, farmers, co-operatives, and

any others identified or who self-identify as having an interest in their environment are accepted as equal and contributing members in the solution-generating process.

The second statement regarding conservation and biodiversity loss concedes that although conservation issues are a global concern, critical environmental situations most often arise on smaller geographic scales. This phenomenon, or 'paradox', as described in the second statement, emphasizes the need for conservation strategies to be multi-level. In order to be successful in achieving their intended goals, conservation strategies must be focussed at small, local or regional scales, but also be a function of a larger, comprehensive strategy that extends far beyond local scales.

1.3 Conservation in Developing Countries: Ecuador

The developing world, as it has been termed, is generally accepted to include countries in the tropics and southern hemisphere. Exceptions include Australia and New Zealand, among others. There are many causes for this 'underdevelopment' or poverty and theories have been postulated over and over again, ranging from European colonialism to Postcolonial dependency (Goldstein 1999:524). However, what remains clear, is that the developing world is largely in debt and burdened by financial crisis.

Within the developing world, there are very different levels of development. This makes it difficult to render broad assumptions and generalities about the developing world without taking a closer look at the actual situation of individual countries. However, environmental problems tend to be somewhat of an exception to this rule of generalities. Because of their global nature, environmental problems are a critical concern in the developing world. The level of basic human needs that are met in the developing world vary from country to country, as does the level of concern for environmental issues. It must be acknowledged that in order for countries in the developing world to manage for environmental and conservation issues, basic human needs must first be met. This is by far one of the largest obstacles for the success of conservation schemes in the developing world:

The major challenge facing the developing nations of the south is that of significantly increasing productivity and output to overcome poverty and

deprivation. Until this is achieved, at least in part, it is unrealistic to expect the environmental standards that apply in the north to be adopted in the south as well. So long as poverty is widespread, the south will be tempted and often compelled — to accept higher levels of pollution and lower levels of control, just as the highly industrialized countries of today did until relatively recently.

(United Nations Environmental, Scientific and Cultural Organization 2002: URL: http://www.unesco.org/education/esd/english/population/educat.shtml).

Developing countries are often home to some of the richest biological diversity on the globe. It has been estimated that developing countries harbor a combined eighty percent of the world's entire stock of biodiversity (Raven and Carcraft 1999:290). These are the same geographic areas that face huge international debt loads and 'underdevelopment'. Tropical countries are considered 'hotspots' for conservation, however, until the inhabitants of such nations see a rise in their relatively meagre standard of living, it is likely that the pursuit of environmental quality will be left in the shadows of the predominant quest for higher income and buying power. Poverty has been identified as one of the greatest threats to the health of the planet (Association of Canadian Community Colleges 1990:4).

There is a need for conscientization before development issues can be addressed among rural and urban poor in Ecuador. This is a process of people learning and discovering the reasons for the poverty surrounding them, both in an

urban and rural setting (Bebbington 1996:132). Once poverty is addressed, further development and growth of the population can occur, and the relationship between a healthy environment and a healthy person will become evident.

Ecuador has received considerable international attention regarding its environmental position in the world. Ecuador is known as the wealthiest country, in terms of biodiversity per unit area, across South America. This is due to such a high concentration of various ecosystems within a considerably small geographic area (Fundacion Jose Peralta 2001:110). Figure 1 provides a map indicating the geographic location of Ecuador.

The discovery of oil in the lowland tropical moist forests during the 1960s, and the ongoing environmental and social problems that have ensued this discovery, have also contributed to the dissemination of information regarding Ecuador's wilderness and indigenous territories, through media (Kimerling 1991, Kimerling 1997, Kane 1995, Martz 1987, Narvaez 1996). This media attention, along with a growing tourism industry, have shed light on Ecuador's environmental situation in a global context. Pressures on Ecuadorian national governments, often from North American and European organizations, have supported the creation of a National Park system and a network of protected areas with other designations around the country. Figure 2 provides a map of Ecuador's Protected Areas.

However, this model of protected area and National Park designation adopted by the Ecuadorian government is inherently laden with problems. Although

it is still an attempt at conservation, it is a very western model, and not necessarily the most practical in a country such as Ecuador. The main concern should be for the inhabitants of the areas that have been designated as protected. As Ecuador is a geographically small and populated country, there is no room for relocation. The indigenous populations of Ecuador are considerable, approaching nearly 25 percent of the country's total population, and mostly rural (Fundacion Jose Peralta 2001:100). It is largely these people that are affected by area designations.

The majority of Ecuador's conservation efforts revolve around this protected area strategy. However, there have been other conservation schemes proposed, and sometimes tried. The eventual problem that new conservation strategies being employed in Ecuador encounter is government support, or lack thereof: "...the region may be proactively managed only if political decisions include conservation as a goal of development" (Sarmiento 1997:14).

South America: geographical location of Ecuador



Figure 1 -South America: geographical location of Ecuador Source: ESRI 1998 World Data

Protected Areas in Ecuador



Protected Area Index

- 1 Parque Nacional Podocarpus
- 2 Parque Nacional Cajas
- 3 Parque El Condor
- 4 Refugio Isla Santa Clara
- 5 Reserva Manglares Churute
- 6 Parque Nacional Machalilla
- 7 Parque Nacional Sangay
- 8 Parque Nacional Yasuni
- 9 Reserva Faunistica Cuyabeno
- 10 Parque Nacional Llanganates
- 11 Reserva Faunistica Chimborazo
- 12 Reserva Ecologica Los Ilinizas

Figure 2 -

Protected Areas in Ecuador Sources: ESRI 1998 World Data, Tirira 2001:202

- 13 Area Recreacion El Boliche
- 14 Parque Nacional Cotopaxi
- 15 Refugio Pasochoa
- 16 Reserva Ecologica Antisana
- 17 Parque Nacional Sumaco Napo Galeras
- 18 Reserva Cayambe Coca
- 19 Reserva Pululahua
- 20 Reserva Cotacachi Cayapas
- 21 Reserva Mache Chindul
- 22 Reserva El Angel
- 23 Reserva Cayapas Mataje

Chapter Two

2.1 Experiential Learning

The theory behind experiential learning is that education and activity are not mutually exclusive. In fact, an experience or activity can significantly enhance the learning process and render it far more appealing than traditional 'textbook' forms of education. However, the educational component remains the purpose, and the experience or activity is simply the method used to deliver the material, and foster the development of certain qualities in the student. Gerston defines the best learning and teaching environment as " the location that maximizes the potential for learning" and goes on to include that this can be indoor as well as outdoors, as long as the student is given the chance to actually experience learning (Gerston 1983: vii).

Educational psychologists define learning as "a change in the individual caused by experience" (Slavin 1986:104). This means that everyday we learn, not only in a classroom setting with teachers and a textbook, but as we go through and experience life. There are two main categories of learning theories that interact in an experiential learning process. The first is the cognitive branch, whereby the focus is on the mental functions we use to learn and remember material. The second category of learning theories is the behavioural branch, which refers to the actual and observable behaviours employed in the learning process (Kraft 1999:181). Experiential education intertwines both cognitive and behavioural

approaches to learning, which allows for more flexibility in adapting to the way people learn.

It is essential to determine where the experience should be in the learning process, and this is often what determines the success and impact of the experience on the student (Miles and Priest 1999: 179). If a student is about to learn of a certain phenomena or event, should the experience come before or after the material has been presented? These are fundamental and central questions to the study and development of experiential learning, and ones that are most often dependent on the experience and theme at hand.

It is difficult to make generalities and guidelines regarding experiential learning, because there are numerous possible experiences or activities that may work for any particular educational target. A commonly acceptable approach to experiential learning follows three main stages. The first stage requires the presentation or encounter with a problem; it is also known as the *pre-experience phase*. The second stage involves the brainstorming and critical thinking required in order to develop possible solutions or desired outcomes; this is also known as the *experience phase*. The third and final stage includes the application of the solution or series of solutions generated; this stage has also been called the *post-experience phase* (Miles and Priest 1999:179, Priest and Gass 1997:162).

2.2 History of Experiential Learning

There is no strictly identified point in time when experiential education began, but there are clearly marked events and issues that have surfaced over the years, enough to depict a rough history of experiential education. One of the first theorists to develop a basic model of learning in general, was Dewey (1938). His basic model included both experience and theory and went as follows (Wurdinger and Priest 1999:187):

1. Perplexity or confusion.

- 2. A careful survey of all the variables that define the problem.
- 3. Developing a tentative hypothesis or plan which may be tested.
- 4. Testing the hypothesis, and
- 5. Reflecting on the experience for later use.

This model was developed as a response to a perceived lack of firsthand experience in the classrooms of the day. It established the premise that we can learn from experience. This model is applicable to a variety of instances, where experience and learning are central, regardless of the subject or context. To summarize the elements of the model; firstly, as the problem is presented to the student, the student experiences confusion and perhaps appears to not comprehend the problem. Secondly, the student sorts through the confusion to observe the problem and examine it from different angles. Thirdly, the student devises a hypothesis, based on the information gathered during the observational phase. The student then tests the hypothesis devised and finally, ponders the

outcome of the whole experience and stores that information internally, where it may be drawn upon in the future. Dewey (1938) continued to explore models for learning, but remained convinced that the students' chance to test a theory was central to the learning process (Wurdinger and Priest 1999:190). John Dewey (1938) and his theories spearheaded the *Progressive Education Movement* through the 1930s, perhaps the first concrete movement for the recognition and advancement of experiential education.

Jean Piaget (1964) was also a very influential figure on theories and models of learning. A Swiss child psychologist, Piaget's (1964) main work was first published in the 1960s, on cognitive growth and human developmental stages throughout this growth. Piaget's main human developmental theory was focussed on active learning and concrete experiences. His theory maintains four factors (Kraft 1999:184):

- 1. Physical maturation.
- 2. Experiences that involve handling, moving, and thinking about concrete objects.
- 3. Social interaction, particularly with other children, and
- Equilibration which results from bringing the other three factors together to build and rebuild mental structures.

Piaget (1964) combines this theory with five stages of growth that he has identified.

These stages of growth are as follows (Kraft 1999:184):

- i) 0-2 years of age: sensorimotor control
- ii) 2-4 years of age: extracting concepts from experience
- iii) 4-7 years of age: intuitive thought

iv) 7-11 years of age: concrete operational thought

v) 11-15 years of age: formal or abstract operational thought

Piaget's (1964) theories were very important to experiential learning because they upheld the belief that learning is inherently an active process (Kraft 1999:184). Piaget was able to pinpoint stages of learning from birth, and give estimates of average ages during which they would occur. This was revolutionary thinking, and led the way for a multitude of teaching methods to target the various learning stages. Hence, in the identification of active learning processes and the stages in which they occur, Piaget (1964) opened the doors for education techniques to become more effective than they were previously, by taking into account the learning stage in which the child was.

James Coleman (1979) was another important theorist to the field of experiential learning and was most noted for his work on the assimilation learning model versus the experiential learning model. His basic premise was that in the case of traditional learning, or assimilation learning, "the student generally receives the information through a symbolic medium such as a lecture or book, and then assimilates and organizes the information so that the general principle is understood" (Kraft 1999:184). Coleman's (1979) experiential learning model follows the same steps as the assimilation model, although in reverse. He claims that the information is not transmitted to the student, but rather is generated by a series of actions or steps, which then lead to the discovery and understanding of certain underlying principles (Kraft 1999:185).

Lauren Resnick (1981) arrived at four general ways in which school learning differed from outside school learning through her research in the 1980s. The four ways she identified are (Kraft 1999:185):

1. Individual cognition in school versus shared cognition outside;

Pure mentation in schools versus tool manipulation outside;

Symbol manipulation in school versus contextualized reasoning outside school;

 Generalized learning in school versus situation-specific competencies outside.

Her theory was equally as important to the experiential education movement, especially nearing the end of the twentieth century (Kraft 1999:185). Resnick (1981) made clear distinctions between in and out of school learning, which had not been done before. Given that institutionalized education generally falls within the boundaries of what Resnick calls 'in school', in identifying the 'outside' learning, it would seem that she rationalized and put value in it. Therefore, Resnick (1981) made huge steps forward in placing value on learning that occurs outside of school, or what we know to be experiential education.

These are but the generalities of some of the main theorist's works that have contributed to the evolution of the concept of experiential education during the twentieth century. From Dewey (1938) to Resnick (1981), the ideas and theories have built upon each other and continue to support the foundation for the experiential education movement.

2.3 Experiential Environmental Education as an Approach to Conservation

There exists a basic conceptual framework that solidly grounds the theories that have been recently developed in the area of experiential education. This basic conceptual framework also provides a baseline from which the environmental education tangent of experiential education has been founded. It is important to outline here some of the key concepts that constitute not only the values of experiential education, but also of experiential environmental education.

Clark (1991) globally states that the mind set or world view held by most westerners is based in technology, whereby things are broken down and fragmented in order to understand them. This mind set or world view, has also been defined as adherent to the reductionist method or empirical logic. This is evident whether it be in the way we conduct pure science, the way we teach children in schools, or the way in which we make the majority of our social decisions. This mind set is slowly being challenged by an ecological world view, whereby science and technology are still valued, but are held within a larger, global context. In an ecological world view, experience and knowledge have equal importance (Clark 1991:17).

Education is based in knowledge, and the educational systems of today are reliant on factual knowledge and often tend to ignore the importance of knowledge gained from experience. Experiential education seeks to not only incorporate personal experience in knowledge gathering, but to use personal experience as the means of obtaining knowledge. Experiential education gives the participant or

student the opportunity to learn a variety of things through non-conventional modes of study. Experiential environmental education is participative and seeks to incorporate many perspectives in order for the student to be presented with various environmental issues. This encourages the student to form his or her own opinions and to be proactive in finding solutions to today's environmental concerns.

Orr (1991) points out that only through education can we begin to address the behaviours and beliefs, which are responsible for the earthly problems that humans have created. He attributes today's environmental crises to the increasing disconnectedness of humans from the natural world (Orr 1991:90). Orr proposes 'earth-centred learning' with the ultimate goal of challenging society's values on which our science, technology, economy, politics and education are built. Table 1 illustrates Orr's seven propositions.

Number	Earth-centered learning proposition
1	All education is environmental education
2	Environmental issues are complex and cannot be understood through a single discipline or department
3	The study of place is a fundamental organizing concept for education
4	For inhabitants, education occurs in part as a dialogue with a place and has the characteristics of good conversation
5	The way education occurs is as important as its content
6	Experience in the natural world is both an essential part of understanding the environment, and conducive to good thinking
7	Education relevant to the challenge of building a sustainable society will enhance the learner's competence with natural systems

Table 1 - Orr's Earth-centered learning propositionsSource: Orr 1991:91

In challenging society's values through earth-centred learning, behaviours can be changed. Experiential environmental education is fundamental if we are to see behaviours that reflect a holistic society.

Olli *et al.* (2001) attempt to examine and define some of the correlates of environmental behaviours that exist in the world. They have proposed through their work that there might exist an environmental attitude-behaviour correspondence or ABC. This environmental Attitude-Behaviour Correspondence, however, must take into account many factors and not simply the correlates being examined. Some of the other factors include such things as sociodemographics, political attitudes, environmental knowledge and social context, which is the actual participation of a person in an environmental organization.

Through Olli *et al.*'s (2001) examination of several correlate studies, they have come to the conclusion that verbal commitment is the most strongly correlated to environmental behaviour. It might seem surprising that a person's verbal commitment to recycling, for example, is more likely to change their environmental behaviour than the possession of a higher education. This is not to say that the possession of a higher education had no effect on environmental behaviour in their findings, just less than that of verbal commitment. In fact, the findings showed that the strongest correlate of environmental behaviour was verbal commitment, followed by attitude, knowledge, educational level and finally, by income (Olli *et al.* 2001:183).

Experiential environmental education, where the participant is given the opportunity to learn about nature while experiencing nature, is therefore not an absurd proposal for strengthening one's environmental behaviour. The development of an environmental consciousness can either begin, or be built upon, through participation in experiential environmental education.

Experiential environmental education is a tool that, if successfully applied, can possibly enhance the process of popular education. In providing the youth participants with a wilderness experience, in which they learn not only outdoor skills, natural history, communication, teamwork and leadership, they also participate in a process that may mark that particular wilderness outing as a significant point in their lives (Andrews 1999:35). Turner (1977) describes this 'significant point in their

lives' as a transformational experience; "a process of transition from which one returns to society empowered by renewed creative energy, an expanded world view, and a greater sense of hope". Turner (1977) also argues that when a person returns from such a transformational experience, they tend to become agents of change for societal transformation at large (Andrews 1999:36). This leads me to believe that the youth participants in the proposed experiential environmental education project will emerge with a heightened sense of environmental awareness, and become agents of change within their societal context. The student' societal context may only be their immediate family or their classmates, but the importance is that these students will have participated in a transformational experience that has rendered them agents of change.
2.4 Education in Ecuador and the Andes

Education in Ecuador is very similar to that of education across Latin America and the developing world. Public education is largely underfunded and often inadequate (Raven and Carcraft 1999:290). Rural education schemes are often more disparate than their urban counterparts. Therefore, in areas where the majority of the population is rural-dwelling, such as the Andes, public education is even lower than the national average. On a more positive note, overall educational levels in Ecuador and other Andean countries have risen significantly in the last three decades (Scarpaci and Irarrazaval 1991:204). Also, the attendance of females has risen in educational institutions in Ecuador, demonstrating the overall increased levels of public education.

Literacy rates are generally the most widely accepted indicators of overall education levels (Scarpaci and Irarrazaval 1991:203). Table 2 presents the literacy trends in Ecuador over the past thirty years, indicating the significant rise in literacy levels between 1970 and 1990.

Year	Literacy Rate (%)
1960	68
1970	69
1980	81
1990	86

Table 2 - Literacy trends in Ecuador (1960-1990)Source: World Bank, World Development Reports 1983-1993

Despite the increase in literacy rates in Ecuador, it is important to note that it is still common for a student to receive several years of primary education and then to leave, migrating to the nearest urban centre in search of paid work. Quito, and other Andean cities, have a very young population base due to this migration of the rural poor (Inbar and Llerena 2000:72, Latin American and Caribbean Commission on Development and Environment 1997: 76).

Although public secondary enrolment has also been increasing, it is still considerably less than primary enrolment. A recent UNESCO report on education has found that, for all of Latin America, only 54 percent of secondary-aged children are enrolled in school, compared with a primary enrollment of 80 percent for all of Latin America and 100 percent primary enrollment in Ecuador (UNESCO 2002: URL:http://www.unesco.org/education/news_en/070202_primary_lac.shtml. This is especially true in rural areas, as urban areas tend to have a much higher enrolment in secondary school. Other problems that have been highlighted with regards to public education in Ecuador and Latin America are related to the expenditures of the public purse. The national governments cannot afford to provide quality education on their own; requiring outside assistance from the international community (UNESCO

2002:URL:http://www.unesco.org/education/esd/english/population/educat.shtml). Unfortunately, rural areas receive far less money for education than do urban areas. The same is true for the quality of education provided in rural versus urban areas, due in part to poorly paid educators and poor teaching supplies (Scarpaci

and Irarrazaval 1991:208).

Another reason that public education in Ecuador is very representative of the rest of Latin America is because the present education system is a relic of educative strategies that were formerly adopted from the colonial parent country of Spain. Education is not progressive in Ecuador, due mostly to the reasons outlined above. New programs and strategies are rare, as is the use of experiential education techniques.

Education has often been identified as a positive factor in combatting the struggle of underdevelopment. Leading international institutions such as UNESCO and the World Bank concur that an educated population is a way to reduce the poverty that thwarts developing nations;

"The relationship between education and population cannot be understood in isolation, but only in the context of the struggle for development and sustainability; and must, in turn, be placed in the broader context of the struggle to overcome poverty, promote justice and equity and ensure respect of the environment and, thus, for the right of future generations to live healthy and fulfilling lives."

(UNESCO 2002:URL:http://www.unesco.org/education/esd/english/population/educat.shtml)

The proposed experiential environmental education project may be an easier way to provide a higher quality of education, with a focus on environmental knowledge. Participation in the proposed project requires no government funding, rather it is projected that costs will be funded through non-governmental

organizations with interests in conservation and environmental awareness in Latin America. This form of environmental education requires no textbook or supplies, other than what is provided within the program structure. Furthermore, with an intensive three-day program, as described in the next chapter, students are exposed to a greater amount of information in a shortened time period. The participation in the proposed project does not interfere with the regular, publicly funded curriculum, already in place in Ecuador, but rather, seeks to complement it.

Chapter Three

3.1 Cotopaxi National Park and Area as a Site for Environmental Education

Cotopaxi National Park was created by the Ecuadorian government in 1975 (Fundacion Jose Peralta 2001:120). It was among the first of a network of national parks to be created in Ecuador (refer to Figure 2 for geographic location of Cotopaxi National Park). Cotopaxi is classified as a *paramo* environment, a high-altitude tundra-like ecosystem ranging from 3400 metres to the summit at 5,897 metres. Cotopaxi is a volcano, considered to be the highest active volcano in the world (Anhalzer 2000:26, Rachowiecki and Wagenahauser 1987:127). Although its flanks are covered in glacier, *Volcan* Cotopaxi always remains a distant threat to the valley city of Quito, capital of Ecuador.

Cotopaxi lies in the *Cordillera Real*, also known as the *Cordillera Oriental*, which is the oldest of the Cordilleras. It is geologically composed mainly of volcanic rock, or gneiss as well as granite (Teran 1999:77). The Sierra is the high Andean plateau which rests between the *Cordillera Oriental* and *Occidental*. The bulk of Ecuador's population of 10,000,000 live in the Sierra, where the land is fertile and agriculture is widely practised. The *Cordillera Real* is the last frontier before giving way to the lowland tropical moist forests which compose the northwestern tip of the Amazon basin. This gives the area surrounding Cotopaxi a distinct climatological regime, and is often very wet.

Cotopaxi National Park has a small area, encompassing roughly 300 square

kilometres. It is one of the most visited national parks in Ecuador (Rachowiecki and Wagenhauser 1987:127). The park infrastructure is minimal. There is a park entrance gate at the west side of the park, and a small visitor centre and museum. Just above 4800 metres, on the side of the volcano, there also exists a climbers refuge, which can sleep up to 50 people in basic bunks. There is no other infrastructure in the park other than picnic areas, basic shelters, and campsites, although camping is permitted anywhere.

The high altitude *paramo* environment that typifies Cotopaxi and the surrounding Andes is very unique and extremely diverse in flora and fauna. However, as a mountainous region, it is also one of the most threatened environments (see Appendix 1). This places a greater importance on Cotopaxi National Park, and the development of an adequate management scheme, so that as a protected area, it remains as close to its natural state as possible.

Table 3 presents a list of mammals and their associated status, that have been observed in or near Cotopaxi National Park, and that are considered to be red-listed based on the International Union for Conservation of Nature (IUCN) categories, as modified in 2000 (Tirira 2001:9). See Appendix 3 for a diagram listing IUCN categories.

Scientific name	Common Name	IUCN Status	
Pudu mephistophiles	Dwarf deer, Pudu	Vulnerable	
Oncifelis colocolo	Andean mountain cat, Pampas cat	Vulnerable	
Puma concolor	Puma, Mountain lion	Vulnerable	
Tremarctos ornatus	Spectacled, Andean bear	Endangered	
Tapirus pinchaque	Mountain, Andean tapir	Endangered	
Coendou quichua Quichua hairy dwarf, Andean porcupine		Vulnerable	
Mazama rufina Dwarf red deer, Brocket deer		Near threatened	
Agouti taczanowskii	Mountain paca	Near threatened	
Nasuella olivacea Andean coati I		Data deficient	

Table 3 - Red-listed mammals located in Cotopaxi region, Ecuador Source: Tirira 2000

A comprehensive work on the status of Ecuador's plant life is currently not available.

Cotopaxi National Park is an ideal location for an experiential environmental education project because it covers significantly threatened Andean ecosystems. The intense altitudinal gradient ranging from 3400 metres above sea level to just under 6000 metres, allows for the exploration and comparison of Andean mountain ecology. Due to its designation as a National Park of Ecuador, a project run in Cotopaxi would also encourage and familiarize students with concepts related to protected area status and resource management policies within protected areas of Ecuador.

Cotopaxi is fittingly located 55 kilometres south of Quito, which renders travel time less than two hours by bus or car, making the park a reasonable destination both financially and logistically. As a part of the project includes time spent discovering traditional land use practices in the Andes, Cotopaxi National Park is ideally located, with easy access to many local agricultural projects. Various small communities near the park boundaries will thus be able to participate by hosting students and giving interactive tours of their agricultural endeavours.

3.2 Outline of the Experiential Environmental Education Project in Cotopaxi

The proposed experiential environmental education project consists of preparatory sessions to be done in the classroom, followed by a three-day, two night outing to the Cotopaxi National Park and surrounding area. This section will describe in detail the essence of the program as well as proposed activities, organization and examination of the four main project themes. Table 4 gives an overview of the proposed project schedule.

Week Session		Description	
1	Andean Ecology: an introduction	In-class preparatory session	
2	Biodiversity in the Andes	In-class preparatory session	
3	Traditional Land Use in the Andes	In-class preparatory session	
4	Climate Change in the Andes	In-class preparatory session	
4	Field Excursion Preparation	In-class preparatory session	
5	Field Excursion	Outdoor Experiential Environmental Education project	
6	Final Debrief	al Debrief In-class debriefing session	

Table 4 - Proposed project schedule

3.3 AEE Matrix

The Association for Experiential Education (AEE) began in the 1970s with a group of American educators looking to enhance education strategies by incorporating experiential forms of education. The AEE is now a member-based organization promoting experiential education in various fields, including environmental education. The membership is international in scope, with an academic journal published on a regular basis called the *Journal of Experiential Education*. The AEE mission statement is: "to develop and promote experiential education. The ASSOCIATION. The ASSOCIATION is committed to support professional development, theoretical advancement, and evaluation of experiential education worldwide." (Association for Experiential Education 2002: URL:http://aee.org/aboutaee.html)

The Association for Experiential Education has developed a simple matrix that is useful for assisting in the definition of appropriate requirements and goals for different groups of people participating in experiential education projects. There are four essential variables that compose the matrix: the kind of environment, the kind of activity, the level of technical expertise required and the profile of program participants (Association for Experiential Education 1998:vii). The matrix is a tool to assist in project organization. It enforces focus and enables the project to have defined variables, all of which can be easily examined and modified prior to project implementation. The following is a description of the matrix as it relates to the proposed urban youth project in Ecuador. Table 5 is a tabular representation of the matrix.

Type of Group	* Secondary students 14 -17 years of age * Residents of Quito, Ecuador	
Physical Environment	 Institution, urban Cotopaxi National Park Cultivated highland areas near Cotopaxi National Park 	
Activity Type	 1 - Initiatives 2 - Moderate physical investment 3 - 3 days, 2 nights 4 - Participatory environmental education 	
Technical Expertise	Leader to Student ratio 4:15 1 - Team-building facilitator 2 - Local knowledge 3 - Teacher chaperone 4 - AEGM guide	
Participant Profile * Youth urbanites * Little wilderness experience		

Table 5 - Association for Experiential Education MatrixSource: Association for Experiential Education 1998:vii

i. **Kind of Environment** - The first part of the project is institutional and will be based in the school itself, whereby students are introduced to the elements they will be studying in the field. This will include slide shows presenting concepts of land use, ecology, climatology, etc. This section of the program will also promote group work and leadership development skills by having students organize into various task groups for menu planning and meal preparation during the field trip. The field portion of the project will be based in Cotopaxi National Park and surrounding agricultural land in Ecuador. Legal requirements in Cotopaxi National Park include payment of entrance fees and adherence to park regulations. Physical variables include weather, difficulty of terrain, distance from vehicle access and altitude. Legal requirements while on excursion in nearby cultivated areas are as per property owner.

ii. **Kind of Activity** - This program is designed to bring about environmental awareness through a variety of land-based activities that use hiking, initiatives, and problem-solving exercises to centre around the environmental education theme. Throughout and prior to the activities, the students will be exposed to the various training objectives related to hiking. These include such things as identification of proper clothing for hiking, appropriate equipment for safe hiking, low-impact hiking and camping techniques related to Andean environments, food and water requirements for high altitude hiking, and route identification using 1:50 000 Instituto Geographica Militar (IGM) topographical sheets (AEE 1998:143). Initiatives and problem-solving tasks are an integral part of the program and are effective in

physiologically readying the group, in mentally establishing a safe and comfortable group environment, in beginning to trust others, and eventually to support the environmental focus of the program (AEE 1998:149).

iii. Level of Technical Expertise - Each group will consist of no more than 15 student participants at a time. The support for each group will consist of at least one facilitator, one teacher chaperone from the student' school, as well as one other person certified through the Ecuadorian mountain guide association, Associación Ecuatoriana de Guías de Montaña (AEGM). This is adequate to ensure a high level of safety and to support an adult to student ratio of 1:5.

The facilitator is a key person in not only delivering the content of the program, but in ensuring the smooth execution of the program. This person is responsible for motivating and challenging students, and assisting them to rise to the challenges presented in a positive manner. The facilitator must be a qualified person, preferably with a strong background in outdoor environmental education. The facilitator must be an exceptional communicator in the Spanish language and have experience working with youth in a wilderness setting.

iv. **Profile of Student Participants** - The age of the student participants will be between 14 and 17 years old. Each group will be mixed male and female students. Physical abilities will be varied and are a consideration for participation in this program. Mental abilities required are moderate to high for this program and by selecting school students, it is ensured that the mental abilities of a grade nine student will be met. The socioeconomic background of participants will be variable

and may range from very low to very high depending on the participant school. It is possible that wealthy private schools will participate in this program as well as underfunded public schools with economically disadvantaged students. However, the program is non-discriminative in nature, and just as suitable for economically advantaged and disadvantaged students alike. The cultural background of participants is to some degree variable, but will mainly be that of urban Ecuadorians.

3.4 Experiential Environmental Education Project Components

3.4.1 In-Class Preparatory Sessions - The initial phase of the project will take place in the classroom. The average classroom size in Quito secondary schools is roughly between 24 and 30 students. All students will participate simultaneously in the in-class sessions, and afterwards be divided in two groups of 12 to 15 students each for the purpose of the field excursion.

The in-class sessions are to be held with the purpose of introducing basic concepts of Andean environments to the students. There will be a person from outside the school identified as a key resource for each of the four main project

themes: 1) Andean Ecology

- 2) Biodiversity in the Andes
- 3) Traditional Land Use in the Andes
- 4) Climate Change Affecting the Andes.

This resource person will then be responsible for leading a two hour in-class session presenting his or her topic. Resource persons will be encouraged to present their material in an interactive manner using slide shows and group discussions that foster the development of students' independent thought. Resource persons may also be present during the field portion of the project.

A fifth in-class preparatory session will be added for the purpose of introducing students to the necessary equipment and clothing for the field excursion. This time slot will also be used to divide the students into food groups for meal preparation during the field excursion. Each field group of 12 to 15

students will be further divided into three groups of 4 or 5 students each. Each of the sub-groups will be responsible for the preparation of two meals for the entire group throughout the course of the field excursion. During this preparatory session, food groups will be given a list of Andean recipes. From this list of Andean recipes, each sub-group will select two and make a shopping list with the quantities of each ingredient needed.

The equipment needed for the field excursion will be provided to the students at the time of the excursion. A comprehensive equipment list can be found in Appendix 5. Personal clothing required will be partially provided, if needed. Individual sizing will be taken for outerwear and boots during the fifth preparatory session. All equipment is easily obtainable at outdoor gear rental shops in Quito. Through project funding, the goal is for students to have no financial burdens related to their participation in the project.

3.4.2 Initiatives - Initiatives are activities designed with the goal of enhancing certain skills within a group setting. Initiatives are a very useful tool for facilitators, especially in the outdoors. Initiatives can include games used as *icebreakers*, whereby group members are made to feel more comfortable with one another and to share themselves by beginning to work as a team. Initiatives can also be used to enhance group dynamics and to improve communication between team members. Initiatives can be used to build trust and strength among group members. Initiatives can also be used to simply make the group laugh and refocus on the tasks ahead. These are all important factors that may determine the success

of the group project, which in this case, is the field excursion to Cotopaxi National Park and area.

3.4.3 The Facilitator - The facilitator is a key person in the successful delivery of the initiative tasks. The role of the facilitator is not only to motivate the participants to face the challenge presented, but to help the participants analyse the outcomes after each activity has ended. The facilitator must be someone with experience in group facilitation, with a focus on youth. The facilitator's greatest role is to allow for the transfer of learning. The transfer of learning "represents the integration of learning from the adventure program into the participant's real life...such as on the job, within the family, or at school" (Priest and Gass 1997:175).

3.4.4 Food - Meals during the three day field program will focus on the cooperative preparation of traditional Andean dishes. Groups of four to five students will be responsible for each of the three daily meals. This encourages the students to take direct responsibility for the feeding of the entire group by promoting their skills in teamwork and leadership. Meals will be pre-planned by the students themselves, by selecting from a series of recipes that have been adjusted to group size. This will allow the student groups a reasonable amount of independent choice. All recipes will be aimed at integrating locally grown cereals, grains and produce, some of which may be obscure to the students.

3.4.5 Camp Craft - Camp craft is a collective term used to describe the set of skills needed to set up camp in a wilderness setting. This includes such things as fire building, tent set up, shelter building, gas stove usage, camp food preparation, identification of water source and overall management and organization of a camp. The camp craft skills imparted to the students in the context of the proposed experiential environmental education project will strictly adhere to the philosophies of Leave No Trace Ethics. Table 6 lists the basic principles of the Leave No Trace movement.

	Leave No Trace Principles	
1	Plan ahead and prepare	
2	Travel and camp on durable surfaces	
3	Dispose of waste properly	
4	Leave what you find	
5	Minimize campfire impacts	
6	Respect wildlife	
7	Be considerate of other visitors	

Table 6 - Leave No Trace Principles

Source: Leave No Trace Organization 2001: www.Int.org

Appendix 4 presents a more detailed description of the Leave No Trace principles.

The field trip section of the program being three days in length requires a two

night camping experience. The first night will be spent near the Laguna

Limpiopungo, a small lake in Cotopaxi National Park. This is a flat area near the

base of Volcan Cotopaxi, at an altitude of 3800 metres. There is adequate space

to support tents for a group of 15-18 people. An afternoon session on the first day will be dedicated to campcraft skills demonstrations, with the students taking over the organization and co-ordinating of their camp set up. Facilitators and chaperone(s) will be used as support resources only, allowing the students a handson learning experience. The second night of the program will also be spent at Laguna Limpopungo and the students will again be in charge of the camp organization and task execution.

3.4.6 Debriefing - Just as the facilitator plays an important role in the development of the group members, so does the act of debriefing the experience. Debriefing is done throughout the project, after each activity, and sometimes at the end of the day. Debriefing is also the final phase of the project as a whole, where participants reflect on the WHOLE EXPERIENCE. In this context, "debriefing refers to the facilitator's attempts to help participants gain meaning from a particular experience after completing it" (Knapp 1999:154). It is therefore important that the experiential environmental education project in Cotopaxi be facilitated by someone confident in facilitating such experiences and in debriefing them. The final debrief session will occur at the end of the last day of the field excursion and will be followed up in-class within ten days of the excursion. The final debriefing session allows for students to make commitments to solutions, either individual or groupbased. This allows the students to make changes based on their learning experience during the project. A viable outcome would be the formation of an Andean Awareness Club at the participants' school, which could ensure the

students' continued learning.

3.5 Three Day Field Excursion to Cotopaxi and Area

3.5.1 Field Excursion Schedule

This section will describe the components of the field excursion. Table 7 provides

the proposed field excursion schedule for the three day outing.

Session Block	Day 1	Day 2	Day 3
Morning	Depart Quito 8 a.m.	Awake and breakfast 7 a.m.	Awake and breakfast 7 a.m.
	 Arrive Laguna Limpiopungo 10:30 a.m. Initiatives Session Lunch 1 hour 	 Ecology/ Biodiversity Activity Lunch 1 hour 	 Cleanup Site Depart for farm Traditional Land Use Activity Lunch 1 hour
Afternoon Cam	Campcraft skills	Hike to snowline	Traditional Land Use Activity <i>cont'd</i> .
	Climate Activity	Climate Activity	Depart for Quito
Evening	vening Dinner and cleanup Dinner and cleanup 2 hours 2 hours	Dinner and cleanup 2 hours	Arrive Quito 5-6 p.m.
	Group games/discussion 1.5 hours	Group games/discussion 1.5 hours	

Table 7 - Proposed field excursion schedule

3.5.2 Sample of Proposed Field Activities Exploring Project Themes Activity Ecology/Biodiversity: This activity is modelled with the classic Scavenger *Hunt* in mind. The purpose is to demystify the idea of very little diversity in flora and fauna in the high Andes. Students will be asked to individually estimate a number of different plant species and different animal species present near the Laguna Limpiopungo area of Cotopaxi National Park. Initially, the students will be asked to estimate their numbers by observing from the point at which they are standing. They will then record these numbers (estimate plant species, estimate animal species). The students will then be paired off and given an identification key that includes twenty of the most common plant and animal species, as well as five of the more rare plant and animal species of the area. The students will also be given a small scale map of the immediate area in order to approximately locate the sites at which they encounter certain species. After the allotted time has expired, the students will group up and share their initial estimates as well as how many species of plants and animals they were actually able to identify in the field. The estimated time required for this activity from start to finish is 2.5 hours.

Activity Climate: Using an altimeter and a handful of stones, construct a temperature profile of *Volcan* Cotopaxi. Base this profile on the theory proposed by Teodoro Wolf, whereby there is a decrease in temperature of 1 (one) degree Celsius for each 200 metres of altitude above sea level. Along the profile, indicate several altitudes known such as the summit of Cotopaxi (5,897m), the park entrance gate (3,300m) and the city of Quito (2, 850m) as well as your present altitude

(3,800m). Use the baseline sea level temperature of 26 degrees Celsius. How do you suppose this temperature profile changes at night? The estimated time required for this activity from start to finish is 1.5 hours.

Using an IGM (Instituto Geographica Militar) topographic sheet Activity Climate: of Volcan Cotopaxi at a scale of 1:50 000, calculate an approximate volume of the glacier. The IGM sheets for Cotopaxi record information from the years 1968 and1985-1990, the last times it was surveyed. As you stand in front of the glacier, lightly sketch the edge of the glacier as it appears to you now. Calculate the difference in volume from the earliest and more recent IGM topographic sheet in order to estimate the amount of loss that has occurred over the past three decades. The estimated time required for this activity from start to finish is 1.5 hours. Activity Traditional Land Use: Students will be divided into small groups of three to five persons each. Each group will rotate through three stations. The first station will consist of a walking tour of a highland farmer's field, or series of fields. Students will learn the various grains and vegetables that are grown and the regular growing season of each. The second station will be hands-on and students will be required to assist in the season-dependent activities of either: 1) the harvest of a grain or vegetable such as potatoes, carrots or quinoa, 2) the planting of a grain or vegetable, or 3) basic maintenance tasks such as the application of water, fertilizer, or removal of weeds. The third station will present the students with a history of the farm. This will be an interactive exchange between members of the farm household and the students. Topics to be covered will include the

establishment of the farm, climate changes observed, relative success of the farm, and adoption of new or traditional farming techniques over the years. The estimated time required for this series of activities from start to finish is 4 hours.

3.6 Environmental Education Project Themes: Knowledge to be Shared

3.6.1 Theme One - Andean Ecology

The Andes, characterized by tropical latitudes and high average temperatures have resulted in a very different mountain ecology than their temperate counterparts (Lambertini 2000:22). A basic understanding of this mountain ecology, the study of relationships between living plants and animals and their physical surroundings, is essential in developing an environmental viewpoint for Ecuadorian youth.

Studies indicate that the steep hillsides, which form the Andes, were once covered in forest, even before Inca rule of the region in the sixteenth century. Today, much of this landscape has been modified and little, if any, original forest cover remains (Latin American and Carribean Commission on Development and Environment 1997:24). A study examining historical landscape photos in the Cordillera Blanca of Peru has also concluded that there is a considerable amount of nonnative Andean forest cover, mainly *Eucalyptus* and *Pinus* (Byers 2000:52). This accurately depicts the state of forest cover in the Ecuadorian Andes as well.

The South American continent has had an interesting evolution which has led to the typically high abundance of flora and fauna that are present and widespread today. The single continent that dominated the planet millions of years ago eventually broke off into the pieces we now identify as the seven continents. However, before this breaking off of the continents occurred, wildlife and seeds were able to travel distances uninterrupted by the sea (Latin American and Carribean Commission on Development and Environment 1997:29). Once this flora and fauna was isolated from the other continents, it developed particular habitats and evolved to become the wealth of diversity that has become so sacred today.

Lamoids, new world genus of the family camelidae, are found throughout the highlands of the South American continent. They have been categorized as a sustainable herd animal suitable for grazing in the majority of the highland areas (Latin American and Carribean Commission on Development and Environment 1997:29). The alpaca (Lama pacos) and the Ilama (Lama glama) have both been domesticated, although the vicuña (Lama vicugna) and the guanaco (Lama guanicoe) remain the wild relatives, found in isolated pockets throughout Ecuador, Peru, Bolivia, Chile and Argentina. The herding of Ilamas and alpacas is important because it could drastically improve the highland landscape which has been decimated over the years, in part by sheep and goat herds. The main differences between the lamoid herds and the sheep and goat herds is in the grazing techniques they use and their hoof construction. Lamoids are easily able to graze on natural native plants occurring in the Andes, whereas sheep and goats have a harder time digesting certain native species, common throughout the Andes. Furthermore, the hooves of sheep and goats are more destructive to the soil and

root systems of Andean flora than the soft pads of lamoids' feet (Latin American and Carribean Commission on Development and Environment 1997:30). This results in a greater adaptability of the lamoids to the Andean environment, and is more sustainable from an ecological standpoint.

Cotopaxi National Park in Ecuador has recently begun a re-introduction program of Ilamas and alpacas within the park boundaries. The re-introduction project is part of a larger ecological restoration project in the park. The park managers have decided that the presence of lamoids is beneficial to the natural landscape of Cotopaxi. As Cotopaxi National Park is one of the most frequently visited National Parks in all of Ecuador, the management also deemed the presence of the lamoids to be an important educational tool for the tourists that visit the area.

These current issues in Andean ecology have been selected for emphasis in this section because they are current topics relating to sustainable development strategies. The higher altitude margin of 3000 to 6000 metres above sea level will be broken down into major ecosystems and described to students using illustrative material. Major characteristics of these ecosystems will be described in order to provide an overall picture of high altitude Andean landscape. Such a basic overview of Andean ecology will lay the foundation for the introduction of biodiversity concepts to the students.

3.6.2 Theme Two - Biodiversity in the Andes

The Andes possess a resources that is not widely understood, but has become the focus of much research in recent years. This resource is what is commonly known as biodiversity. Biodiversity "... is the product for evolution of life on the planet and is the basis for the process of future evolution" (Lambertini 2000:40). Biodiversity is a difficult concept to grasp, although essential to the understanding and appreciation of the Andes.

Over the past few centuries of agricultural production in the Andes, the situation of diminishing forest cover has worsened and the state of the land is poor in many cases (Latin American and Carribean Commission on Development and Environment 1997:28). The steepness of the landscape and the loss of trees to solidly hold the soil in place have resulted in a degradation of soil quality and have widely destabilized hillsides. Combine this with countrywide road building projects, the establishment of electricity grids and pipeline construction for both oil and water, and the results are even worse. It has all led to an increase of occurrence and intensity of destructive landslides (Latin American and Carribean Commission on Development and Environment 1997:26).

One of the most significant threats to Andean hillsides is also the practice of unsustainable agriculture and grazing (Latin American and Caribbean Commission on Development and Environment 1997:21). Despite these anthropogenic influences resulting in the modification of the Andean landscape, the influences of the equatorial latitude, tropical climate and high altitude continue to harbor some of

the most unique species on the planet, both flora and fauna. However, habitats are diminishing at unprecedented rates, a phenomenon not uncommon in many of the most biodiverse places on earth. Recent surveys indicate that the region known as the Tropical Andes, which includes Ecuador, has been categorized as a hyper biodiversity hotspot, defined as an area " where exceptional concentrations of endemic species are undergoing exceptional loss of habitat" (Myers et al. 2000:853). The survey conducted by Myers et al. (2000) has assembled a list of the most threatened biodiverse areas in the world, and tried to prioritize them, the top priority areas being the ones most in need of urgent conservation strategies. This categorization reflects the high level of species endemism and the extent to which it is threatened by rapid loss of habitat (Myers et al. 2000:854). Not surprisingly, Ecuador's Andes are the number one priority area in the world for immediate action on the conservation front. Tropical developing countries, such as Ecuador, are faced with the further task of creating effective conservation schemes with very limited financial resources (Latin American and Carribean Commission on Development and Environment 1997:4).

The purpose of including a biodiversity theme in the experiential environmental education project is to share knowledge. In sharing the knowledge that has been accumulated regarding biodiversity in the Andes, the students can include themselves in decisions being made about their environment:

"One cannot save efficiently or intelligently what one does not know. All knowledge about biodiversity that can be shared globally - whether through

science, poetry, art, or something else - will be essential if we are to preserve biodiversity for its productivity, its restoration, its collective economic use, and its beauty." (Raven and Carcraft 1999:296)

3.6.3 Theme Three - Traditional Land Use in the Andes

Traditional land use is important to mountain conservation and the biodiversity of the Andes slopes and highland plateaus. Indigenous resource management practices as well as agricultural practices and techniques should be looked to as an alternative over contemporary agricultural modernization. Recently, there has been a resurgence in attempts to recover terracing, indigenous irrigation systems and Andean crops, including potato varieties and quinoa (Bebbington 1996:131). The reasons behind these recent attempts to revitalize Andean agriculture are essential pieces of information that can be passed on from highland agricultors to urban youth.

The Andes have been home to a centre of crop diversity for hundreds of years. However, with the European colonialism of the ancient Inca empire nearly five hundred years ago, came what is known as botanical colonialism. Botanical colonialism refers to the forced adoption of certain plants for cultivation. The European colonizers imposed their preferred crops such as wheat, barley, carrots and broad beans (Latin American and Caribbean Commission on Development and Environment 1997:20, National Research Council 1990:1).

Traditional Andean crops have, however, persisted despite the botanical colonialism that occurred as a result of the Conquest. These traditional crops,

which represent a wealth of diversity, have persisted in large part due to the somewhat hostile environments granted by the Andean geography. The persistence of these crops is also due to their protectors over the centuries. The highland natives of Colombia, Ecuador, Peru and Bolivia, often categorized as rural peasants, should be rightfully credited for the continued survival in harvest and production of these native plants (National Research Council 1990:3).

Although this diversity of domesticated plants, rich in nutrition and highly adaptable to many environments, are still common among the traditionalists of the Andean highlands, they are not sought out as a world food source (Latin American and Caribbean Commission on Development and Environment 1997:4). They are, instead, little known and inspire little interest. This ignorance on behalf of the western and modern world, has been reasoned down to the idea that "Indian foods are still equated with lower status" (National Research Council 1990:11). Agriculture in the Andes could possibly become a more significant form of sustainable development for the largely indigenous populations residing in the highlands. Through the continued use of the small-scale, traditional cultivation methods, which are generally considered sustainable, soil use could be intensified in order to maximize production (Latin American and Caribbean Commission on Development and Environment 1997:156). Also, by introducing and promoting certain products on the international market, small-scale Andean farms could be made more profitable, while ensuring the long-term health of the environment. This could have significant positive impacts for local Andean communities by keeping the

population at home, instead of moving to urban centres in search of work and a better life, a phenomenon which has been increasing in recent years (Latin American and Caribbean Commission on Development and Environment 1997:77). It could also mean an enhanced quality of life in the highlands for the indigenous populations which are, as a general rule, among the poorest, not only in Ecuador, but throughout the Andes.

The traditional highland cultivation techniques that have been referred to as sustainable include practices whereby the tree cover is maintained and soil erosion is minimal, if at all. A handful of these techniques used on the steep slopes and varying soils of the Andes are contouring, terracing, orienting crops, crop rotations, and agro-forestry (Latin American and Carribean Commission on Development and Environment 1997:156). Contouring refers to the use of the natural features of the land in such a way that the edges of the contours are protected by either a stone retention wall or simply vegetation, hedges for example. This, in turn, provides a level of stability so that erosion of the soil on the steep slopes is physically stopped along the edges of the contours. Terracing is similar, in the sense that it makes use of the natural features of the steep sides. However, in terracing, an actual flat and level surface is built up at each level and usually held in place by stone walls. This trademark feature of Inca society is still used across the Andes today. Crop orientation and crop rotation refer to the actual planting scheme being used on the ground. Orienting the crops in certain directions places a certain level of control over the growth of the plants. This translates into strategic planting so that erosion

will be controlled and also so that the plants receive as much light as possible while growing in presence of shade-giving trees. Crop rotation is extremely important in that it gives the soil a rest in between crops , and also ensures that the same crop, a monocrop, is not continually planted in the same plot, which eventually reduces output.

Impossible to enumerate or describe each of the commonly cultivated Andean plants and trees, it is important to highlight several that have been identified as having a high potential as either food sources for the inhabitants of Andean and other countries, or as nitrogen-fixing and useful for endeavours such as reforestation and agroforestry. Plants and trees to be examined will include those found in the Cotopaxi region of Ecuador.

Kiwicha: Considered to be an ancient Andean grain, is uncommon except in the Andean highlands where it thrives in various conditions. It is drought and pest resistant, and grows surprisingly well at altitudes up to 3600m (National Research Council 1989:147). Kiwicha, known as amaranth in conventional terminology (*Amaranthus caudatus*), is very high in protein, which adds a substantial nutritional element to the common starch-based Andean diet. It has huge potential, for the general population of Ecuador, as well as for the world market.

Potatoes: It is estimated that potatoes have been harvested throughout the Andes for at least 8,000 years (National Research Council 1989:93). It took until well after the Spanish Conquest for potatoes to slowly make their way into European agriculture and to become a popular world staple. However, the several species

that were adopted internationally could make way for varieties that are not known outside of small pockets in the Andes. The ability to withstand frost, common potato pests such as nematodes, as well as to grow in less than ideal conditions are among some of the qualities possessed by the hundreds of less-known Andean varieties which could potentially be adopted elsewhere (National Research Council 1989:93)

3.6.4 Theme Four - Climate Change Affecting the Andes

It is now widely accepted that the earth's climate is experiencing a trend towards warming, although it is still statistically difficult to identify rapid changes (Price and Haslett 1995:73). Mountain climate is heterogeneous and difficult to describe at present, let alone to forecast future trends in a warming scenario (Price and Haslett 1995:86). The emphasis at this level is placed on awareness, local initiatives at cutting fossil fuel emissions, and the relationships between potable water and healthy mountain watersheds.

The Andes are generally characterized by different microclimates dependent on their exact location. It is important to bear in mind that there are two predominant cordilleras or mountain chains in Ecuador, the eastern or *Cordillera Real* and the western or *Cordillera Occidental*. The *Cordillera Real* is the spine separating the lowland tropical moist forest, which forms the northeast corner of the Amazon basin, from the highland plateau of Central Ecuador. The *Cordillera Occidental* separates the coastal moist forests and dryland scrub forests that dominate the Pacific coast, from the central highland plateau.

Therefore, the eastern slopes of the Cordillera Real are especially moist due to the up welling of moist warm air from the lowland tropical moist forest (Furley 1996:76). Cloud forests are typical at altitudes up to 3000 metres. At greater altitudes, the forest becomes paramo, also known as montane shrub and grasslands (Furley 1996:76). This paramo is also very moist, compared to the high altitude *punas* of Peru and Bolivia, which are characteristically dry. Over 4000 metres above sea level exists the *tierra helada*, which normally sees temperatures drop to below freezing on a diurnal basis and is home to typical alpine vegetation (Furley 1996:77). Teodoro Wolf, a climate geographer has proposed a temperature scale which claims that for each 200 metres of altitude gained above sea level, the temperature will decrease by one (1) degree Celsius. This theory assumes that the average temperature at sea level, to be used as a baseline, is twenty-six degrees Celsius. However, this is merely a suggestive scale, an approximation at best, which does not factor in many other significant variables such as slope, orientation and soil type, among others (Teran 1999:137).

There are several glaciers throughout the Ecuadorian Andes, areas of perpetual snow, these are mainly found on the actual mountain summits and ridges. What is known as the snowline, the lowest altitude at which the glaciers are present, is somewhere between 4500 and 4900 metres above sea level. However, the average snowline is steadily decreasing with the advent of glacier recession due to global climate warming. Upon examination of Cotopaxi glacier, this recession is evident. The decline of the glacier's edge in the past ten years has been roughly

600 vertical feet. It has also been estimated that on sections of the glacier, where rock bands are now evident, the glacier is approximately 150 feet thinner than it was twenty years ago. These figures have been averaged over the period between the 1970s and 1990s (Anhalzer 2000:41).

Some scientists claim that by the early twenty-first century, glaciers found at tropical latitudes throughout the world will have completely disappeared, exposing the underlying rubble (Anhalzer 2000:41). This is already very evident, not only with the recession of Cotopaxi glacier, but also in the documented recession of glaciers throughout the *Cordillera Blanca* in Peru and the *Cordillera Real* in Bolivia.

The threat of climate change in mountain regions is not only the potential loss of glaciated areas, but the effect of the different climate regime on the existing flora and fauna of the region in question (Price and Haslett 1995:79). What remains to be seen is whether or not the flora and fauna of these mountain regions can adapt and migrate at the same rate as the climate changes are occurring. However, on perhaps a positive note, it has been hypothesized that migration for mountain-dwelling plants and animals may be easier than for inhabitants of flat areas simply because migration can occur vertically, where the needed micro-climate may exist within a small range of hundreds of metres above sea-level (Price and Haslett 1995:82).

Water Resources of the Andes

The mountains of the world have aptly been named the *Water towers for the twenty-first Century* in a collective document published by the Mountain Agenda, which presents important concepts for mountain conservation and documents case studies of mountain waters around the world. It is common knowledge that the world's freshwater supply is facing a crisis situation. However, every living thing fully depends on water for its sustenance. Mountains provide the source waters for all of the earth's major river systems, as well as provide a major water source for an estimated fifty percent of the global human population (Mountain Agenda 1998:4).

The waters derived in the Andes have a most important role, not only in the provision of freshwater to the inhabitants of the highlands and lowlands on a regular basis, but in the ability to provide water to areas during crucial times of the year affected by seasonal aridity (Mountain Agenda 1998:4). It is the glacial meltwater throughout the Andes that ensures adequate supply for crop irrigation and human and animal consumption. Recently, with increasing urbanization , the demand for freshwater in the cities has also increased. Water is often sought in the mountains surrounding cities. Such is the case with the Quito water project, deriving freshwater from the mountains near *Papallacta*, 60 kilometres east of Quito.

Volcan Cotopaxi itself divides the waters that flow down its flanks. The headwaters of both the *rio Guayallabamba* and the *rio Cutuchi* find their source on Cotopaxi. The *rio Guayallabamba* flows towards the west, and exits at the Pacific Ocean, whereas the *rio Cutuchi* flows east, through to the Amazon and exits at the

Atlantic side of the South American continent (Teran 1999:131).

Now, more than ever, as the source is being naturally depleted by climate change, and at the same time, is facing increased demands, it is essential to realize the importance of protecting the mountain watersheds of the Andes; "Improved knowledge and management of this valuable resource is now recognised as essential in support of food production, in design of rural and urban facilities, in water resources development programs and in the maintenance of environmental standards." (Singh and Singh 2001:ii).
Chapter Four

4.1 Conclusions and Recommendations

Environmental problems must be examined not from a unique, singlediscipline perspective, but from an open or pluralistic perspective. What I mean by an open perspective, is one in which facets of many disciplines may be utilized to solve environmental conservation issues, and not necessarily in any pre-determined or methodical way. The environment, as we understand it to be the physical, social and cultural surroundings, is not a single discipline in itself. It is a combination, and truly it is everything. It is therefore only logical that solving environmental problems requires a new thinking, independent of traditional academic boundaries. And only once this new thinking has been attained will we see results, in the solution of environmental problems.

What the information gathered within this document is intended for is to be shared with the youth of Ecuador. The intention is for this information to be shared in such a way that it will stimulate and encourage the furthered learning about the mountains in which they reside. Once the youth have been awakened to the present situation of their immediate environment through the sharing of this knowledge, it is hoped that they will be moved to become involved, and to stay informed on issues not only related to their Andean environment, but also to the global environment.

Before this project can move to the implementation phase, several things need to be accomplished. Firstly, a risk management plan should be prepared. A comprehensive risk management plan should ideally precede any type of field trip, whether the trip is to take place in North America or not. It is an established industry standard in the field of adventure education and adventure programming. The goal of a risk management plan is to evaluate the possible inherent risks in conducting a wilderness trip or expedition, prior to the trip. By identifying risks prior to a trip, it is possible to plan a prepared response or response guidelines, in the event that an accident does occur during the trip. Table 8 presents guidelines in risk management plan preparation for international adventure programs.

	Before the crisis
1	Be aware of the assumptions being made about the country visited
2	Carefully evaluate the risks associated with in-country travel
3	Create an emergency evacuation plan
4	Determine how costs associated with emergency medical care will be paid
5	Know the availability of medical prescriptions in foreign countries
6	Know the locations and emergency response capacities of embassies and other similar institutions
7	Know each country's communication systems, for instance, phone, fax, e-mail

Table 8 - Guidelines for the establishment of risk management plans in international adventure programs Source: Garvey 1998:63 It would be expected that any risk management plan conducted prior to the implementation of an experiential environmental education project in Cotopaxi, Ecuador, would follow these guidelines.

The other issue that needs to be addressed, prior to the implementation of the project is funding. Ideally, students should not have to contribute financially in order to participate in this project. After a rapid survey estimating expenses such as transportation, food, camping gear rentals and National Park entry fees in Ecuador, it is realistic to have the project operational at a cost of roughly 800 US Dollars per group. This figure does not take into account the wages of the AEGM guide, teacher chaperone, traditional knowledge person or facilitator. However, it is possible that the persons approached for such tasks would be willing to participate in kind, or with a small honorarium. Fundraising will be an essential determinant in the eventual success of this project, and is not to be ignored.

This leads to the final recommendation prior to project implementation; a business plan. Successful endeavours, regardless if employing a not-for-profit strategy, require a well-planned structure. I believe that a properly prepared business plan would assist in securing funding for the project by targeting the financial interests of various organizations and individuals. Furthermore, a business plan would aid the project in terms of its management, marketing, and operations. This in turn, will ensure the longevity of the project, so that the ultimate goal, of seeing as many students through such an experience as possible, is achieved.

I would like to conclude this paper by re-stating the importance for an experiential environmental education project, such as the one proposed in Cotopaxi National Park. Ecuador, and Latin America as a whole, suffer from the troubles that plague the developing world. There are key areas in the neotropics that have been identified as hotspots for conservation. One of these hotspots is the Tropical Andes, which run through Ecuador. As a country plagued with the throes of underdevelopment, Ecuador does not hold environmental conservation as a priority on the development agenda. Education is also not one of the main priorities for Ecuadorian officials and policy makers. However, education and environmental conservation go hand in hand.

Education is necessary in order for people to understand the importance of a healthy environment. Through concepts of experiential education, we have seen that the way in which education occurs, is as important as the material being presented. Therefore, I have proposed that the use of experiential education methods to present environmental knowledge is superior to traditional in-class textbook methods of education.

The Cotopaxi National Park and area is an excellent site for an experiential environmental education project to occur, because it provides a regional context for environmental knowledge and a wilderness area to enhance the adventure education qualities of the program. Secondary school-aged youth have been selected as the target age group to participate in such a project because these are formative years, and also because it is easier to work within an educational system

that already exists.

The financial burden of participating in such a project will be bore by fundraising, specifically aiming at grants from non-governmental organizations involved in conservation and environmental awareness in Latin America. This project also encourages the development of a network, whereby key experts and individuals locally involved in the identified project themes of Andean ecology, biodiversity, traditional land use and climate change, among others, are invited to contribute their knowledge and expertise.

What I have tried to do with the design of this project is pool information from a variety of sources and academic disciplines in order to approach one issue: mountain conservation in the Andes. However, it is not only the pooling of this information that is important, but what is to be done with this information once it has been gathered. It is my intention that this project will take one step towards bridging the gap between the scientific knowledge documented and undocumented, and bring this knowledge to the people that need it, perhaps the most, the new generation of environmentally-aware youth of Ecuador.

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Agenda 21, Chapter 13

Managing Fragile Ecosystems: Sustainable Mountain Development

Source: United Nations Division for Sustainable Development (UNSD). 2001. Agenda 21, Chapter 13 [online]. URL:http://www.un.org/esa/sustdev/agenda21.htm

Introduction

13.1 Mountains are an important source of water, energy and biological diversity. Furthermore, they are a source of such key resources as minerals, forest products and agricultural products and of recreation. As a major ecosystem representing the complex and interrelated ecology of our planet, mountain environments are essential to the survival of the global ecosystem. Mountain ecosystems are, however, rapidly changing. They are susceptible to accelerated soil erosion, landslides and rapid loss of habitat and genetic diversity. On the human side, there is widespread poverty among mountain inhabitants and loss of indigenous knowledge. As a result, most global mountain areas are experiencing environmental degradation. Hence, the proper management of mountain resources and socioeconomic development of the people deserves immediate action.

13.2 About 10 per cent of the world's population depends on mountain resources. A much larger percentage draws on other mountain resources, including and especially water. Mountains are a storehouse of biological diversity and endangered species.

13.3 Two programme areas are included in this chapter to further elaborate the problem of fragile ecosystems with regard to all mountains of the world. These are:

(a) Generating and strengthening knowledge about the ecology and sustainable development of mountain ecosystems;

(b) Promoting integrated watershed development and alternative livelihood opportunities.

Programme Areas

A. Generating and strengthening knowledge about the ecology and sustainable development of mountain ecosystems

Basis for action

13.4 Mountains are highly vulnerable to human and natural ecological imbalance. Mountains are the areas most sensitive to all climatic changes in the atmosphere. Specific information on ecology, natural resource potential and socio-economic activities is essential. Mountain and hillside areas hold a rich variety of ecological systems. Because of their vertical dimensions, mountains create gradients of temperature, precipitation and insolation. A given mountain slope may include several climatic systems - such as tropical, subtropical, temperate and alpine - each of which represents a microcosm of a larger habitat diversity. There is, however, a lack of knowledge of mountain ecosystems. The creation of a global mountain database is therefore vital for launching programmes that contribute to the sustainable development of mountain ecosystems.

Objectives

13.5 The objectives of this programme area are:

(a) To undertake a survey of the different forms of soils, forest, water use, crop, plant and animal resources of mountain ecosystems, taking into account the work of existing international and regional organizations;

(b) To maintain and generate database and information systems to facilitate the integrated management and environmental assessment of mountain ecosystems, taking into account the work of existing international and regional organizations;

(c) To improve and build the existing land/water ecological knowledge base regarding technologies and agricultural and conservation practices in the mountain regions of the world, with the participation of local communities;

(d) To create and strengthen the communications network and information clearing-house for existing organizations concerned with mountain issues;

(e) To improve coordination of regional efforts to protect fragile mountain ecosystems through the consideration of appropriate mechanisms, including regional legal and other instruments;

(f) To generate information to establish databases and information systems to facilitate an evaluation of environmental risks and natural disasters in mountain ecosystems.

Activities

(a) Management-related activities

13.6 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Strengthen existing institutions or establish new ones at local, national and regional levels to generate a multidisciplinary land/water ecological knowledge

base on mountain ecosystems;

(b) Promote national policies that would provide incentives to local people for the use and transfer of environment-friendly technologies and farming and conservation practices;

(c) Build up the knowledge base and understanding by creating mechanisms for cooperation and information exchange among national and regional institutions working on fragile ecosystems;

(d) Encourage policies that would provide incentives to farmers and local people to undertake conservation and regenerative measures;

(e) Diversify mountain economies, inter alia, by creating and/or strengthening tourism, in accordance with integrated management of mountain areas;

(f) Integrate all forest, rangeland and wildlife activities in such a way that specific mountain ecosystems are maintained;

(g) Establish appropriate natural reserves in representative species-rich sites and areas.

(b) Data and information

13.7 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Maintain and establish meteorological, hydrological and physical monitoring analysis and capabilities that would encompass the climatic diversity as well as water distribution of various mountain regions of the world;

(b) Build an inventory of different forms of soils, forests, water use, and crop, plant and animal genetic resources, giving priority to those under threat of extinction. Genetic resources should be protected in situ by maintaining and establishing protected areas and improving traditional farming and animal husbandry activities and establishing programmes for evaluating the potential value of the resources;

(c) Identify hazardous areas that are most vulnerable to erosion, floods, landslides, earthquakes, snow avalanches and other natural hazards;

(d) Identify mountain areas threatened by air pollution from neighbouring industrial and urban areas.

(c) International and regional cooperation

13.8 National Governments and intergovernmental organizations should:

(a) Coordinate regional and international cooperation and facilitate an exchange of information and experience among the specialized agencies, the World Bank, IFAD and other international and regional organizations, national Governments, research institutions and non-governmental organizations working on mountain development;

(b) Encourage regional, national and international networking of people's initiatives and the activities of international, regional and local non-governmental organizations working on mountain development, such as the United Nations University (UNU), the Woodland Mountain Institutes (WMI), the International Center for Integrated Mountain Development (ICIMOD), the International Mountain Society (IMS), the African Mountain Association and the Andean Mountain Association, besides supporting those organizations in exchange of information and experience;

(c) Protect Fragile Mountain Ecosystem through the consideration of appropriate mechanisms including regional legal and other instruments.

Means of implementation

(a) Financing and cost evaluation

13.9 The Conference secretariat has estimated the average total annual cost (1993-2000) of implementing the activities of this programme to be about \$50 million from the international community on grant or concessional terms. These are indicative and order-of-magnitude estimates only and have not been reviewed by Governments. Actual costs and financial terms, including any that are nonconcessional, will depend upon, inter alia, the specific strategies and programmes Governments decide upon for implementation.

(b) Scientific and technological means

13.10 Governments at the appropriate level, with the support of the relevant international and regional organizations, should strengthen scientific research and technological development programmes, including diffusion through national and regional institutions, particularly in meteorology, hydrology, forestry, soil sciences and plant sciences.

(c) Human resource development

13.11 Governments at the appropriate level, and with the support of the relevant international and regional organizations, should:

(a) Launch training and extension programmes in environmentally appropriate technologies and practices that would be suitable to mountain ecosystems;

(b) Support higher education through fellowships and research grants for environmental studies in mountains and hill areas, particularly for candidates from indigenous mountain populations;

(c) Undertake environmental education for farmers, in particular for women, to help the rural population better understand the ecological issues regarding the sustainable development of mountain ecosystems.

(d) Capacity-building

13.12 Governments at the appropriate level, with the support of the relevant international and regional organizations, should build up national and regional institutional bases that could carry out research, training and dissemination of information on the sustainable development of the economies of fragile ecosystems.

B. Promoting integrated watershed development and alternative livelihood opportunities

Basis for action

13.13 Nearly half of the world's population is affected in various ways by mountain ecology and the degradation of watershed areas. About 10 per cent of the Earth's population lives in mountain areas with higher slopes, while about 40 per cent occupies the adjacent medium- and lower-watershed areas. There are serious problems of ecological deterioration in these watershed areas. For example, in the hillside areas of the Andean countries of South America a large portion of the farming population is now faced with a rapid deterioration of land resources. Similarly, the mountain and upland areas of the Himalayas, South-East Asia and East and Central Africa, which make vital contributions to agricultural production, are threatened by cultivation of marginal lands due to expanding population. In many areas this is accompanied by excessive livestock grazing, deforestation and loss of biomass cover.

13.14 Soil erosion can have a devastating impact on the vast numbers of rural people who depend on rainfed agriculture in the mountain and hillside areas. Poverty, unemployment, poor health and bad sanitation are widespread. Promoting integrated watershed development programmes through effective participation of local people is a key to preventing further ecological imbalance. An integrated approach is needed for conserving, upgrading and using the natural resource base of land, water, plant, animal and human resources. In addition, promoting alternative livelihood opportunities, particularly through development of employment

schemes that increase the productive base, will have a significant role in improving the standard of living among the large rural population living in mountain ecosystems.

Objectives

13.15 The objectives of this programme area are:

(a) By the year 2000, to develop appropriate land-use planning and management for both arable and non-arable land in mountain-fed watershed areas to prevent soil erosion, increase biomass production and maintain the ecological balance;

(b) To promote income-generating activities, such as sustainable tourism, fisheries and environmentally sound mining, and to improve infrastructure and social services, in particular to protect the livelihoods of local communities and indigenous people;

(c) To develop technical and institutional arrangements for affected countries to mitigate the effects of natural disasters through hazard-prevention measures, risk zoning, early-warning systems, evacuation plans and emergency supplies.

Activities

(a) Management-related activities

13.16 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Undertake measures to prevent soil erosion and promote erosion-control activities in all sectors;

(b) Establish task forces or watershed development committees, complementing existing institutions, to coordinate integrated services to support local initiatives in animal husbandry, forestry, horticulture and rural development at all administrative levels;

(c) Enhance popular participation in the management of local resources through appropriate legislation;

(d) Support non-governmental organizations and other private groups assisting local organizations and communities in the preparation of projects that would enhance participatory development of local people;

(e) Provide mechanisms to preserve threatened areas that could protect wildlife, conserve biological diversity or serve as national parks;

(f) Develop national policies that would provide incentives to farmers and local people to undertake conservation measures and to use environment-friendly technologies;

(g) Undertake income-generating activities in cottage and agro-processing industries, such as the cultivation and processing of medicinal and aromatic plants;

(h) Undertake the above activities, taking into account the need for full participation of women, including indigenous people and local communities, in development.

(b) Data and information

13.17 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Maintain and establish systematic observation and evaluation capacities at the national, state or provincial level to generate information for daily operations and to assess the environmental and socio-economic impacts of projects;

(b) Generate data on alternative livelihoods and diversified production systems at the village level on annual and tree crops, livestock, poultry, beekeeping, fisheries, village industries, markets, transport and income-earning opportunities, taking fully into account the role of women and integrating them into the planning and implementation process.

(c) International and regional cooperation

13.18 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Strengthen the role of appropriate international research and training institutes such as the Consultative Group on International Agricultural Research Centers (CGIAR) and the International Board for Soil Research and Management (IBSRAM), as well as regional research centres, such as the Woodland Mountain Institutes and the International Center for Integrated Mountain Development, in undertaking applied research relevant to watershed development;

(b) Promote regional cooperation and exchange of data and information among countries sharing the same mountain ranges and river basins, particularly those affected by mountain disasters and floods;

(c) Maintain and establish partnerships with non-governmental organizations and other private groups working in watershed development.

Means of implementation

(a) Financial and cost evaluation

13.19 The Conference secretariat has estimated the average total annual cost (1993-2000) of implementing the activities of this programme to be about \$13 billion, including about \$1.9 billion from the international community on grant or concessional terms. These are indicative and order-of-magnitude estimates only and have not been reviewed by Governments. Actual costs and financial terms, including any that are non-concessional, will depend upon, inter alia, the specific strategies and programmes Governments decide upon for implementation.

13.20 Financing for the promotion of alternative livelihoods in mountain ecosystems should be viewed as part of a country's anti-poverty or alternative livelihoods programme, which is also discussed in chapter 3 (Combating poverty) and chapter 14 (Promoting sustainable agriculture and rural development) of Agenda 21.

(b) Scientific and technical means

13.21 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Consider undertaking pilot projects that combine environmental protection and development functions with particular emphasis on some of the traditional environmental management practices or systems that have a good impact on the environment;

(b) Generate technologies for specific watershed and farm conditions through a participatory approach involving local men and women, researchers and extension agents who will carry out experiments and trials on farm conditions;

(c) Promote technologies of vegetative conservation measures for erosion prevention, in situ moisture management, improved cropping technology, fodder production and agroforestry that are low-cost, simple and easily adopted by local people.

(c) Human resource development

13.22 Governments at the appropriate level, with the support of the relevant international and regional organizations, should:

(a) Promote a multidisciplinary and cross-sectoral approach in training and the dissemination of knowledge to local people on a wide range of issues, such as household production systems, conservation and utilization of arable and non-arable land, treatment of drainage lines and recharging of groundwater, livestock management, fisheries, agroforestry and horticulture;

(b) Develop human resources by providing access to education, health, energy and infrastructure;

(c) Promote local awareness and preparedness for disaster prevention and mitigation, combined with the latest available technology for early warning and forecasting.

(d) Capacity-building

13.23 Governments at the appropriate level, with the support of the relevant international and regional organizations, should develop and strengthen national centres for watershed management to encourage a comprehensive approach to the environmental, socio-economic, technological, legislative, financial and administrative aspects and provide support to policy makers, administrators, field staff and farmers for watershed development.

13.24 The private sector and local communities, in cooperation with national Governments, should promote local infrastructure development, including communication networks, mini- or micro-hydro development to support cottage industries, and access to markets.

Cusco Declaration on Sustainable Development of Mountain Ecosystems

Source: International Workshop on Sustainable Mountain Development. 2001. Cusco Declaration. International Workshop on Mountain Ecosystems: A Vision of the Future. Centro Bartolomé de las Casas, Cusco, Peru, 25-27 April 2001.

The representatives and experts from Argentina, Austria, Belgium, Bolivia, Canada, Colombia, Chile, Ecuador, Spain, the United States of America, Finland, France, Mexico, Nepal, the Netherlands, Peru, Switzerland, Venezuela, meeting in Cusco, the ancient capital of Peru, on the occasion of the "International Workshop on Mountain Ecosystems: A Vision of the Future" held on 25-27 April 2001, have drawn up this Declaration:

1. Realizing the importance and value of mountain regions, which prompted the United Nations General Assembly to declare 2002 the International Year of Mountains (IYM-2002),

2. Recognizing the importance of mountain regions, as enshrined in Chapter 13 (Sustainable Mountain Development) of Agenda 21,

3. Noting the pertinent provisions of the United Nations Framework Convention on Climate Change, especially that which relates to the adverse effects of climate changes in mountain ecosystems,

4. Noting the provisions of the Convention on Biological Diversity for the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings,

5. Noting further the pertinent provisions of the United Nations Convention to Combat Desertification, the RAMSAR Convention on Wetlands, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other international instruments,

6. Recognizing that mountains are an important source of water, energy and biological diversity. Furthermore, they are a source of such key resources as minerals, forest products and agricultural products and of recreation. Moreover, a major ecosystem representing our planet's complex and interrelated ecology,

7. Acknowledging that the negative impacts of recent years to mountain ecosystems translate, among others, into the rapid loss of habitat and genetic diversity, environmental degradation, deterioration of the quality of water for human

consumption, retreat of glaciers and on the human side, social exclusion and poverty among mountain inhabitants and loss of indigenous knowledge,

8. Conscious that the conservation of ecosystems, prevention and mitigation of disasters and sustainable development of mountain regions are a common emerging concern of our countries and the international community,

9. Conscious that most global mountain areas are experiencing environmental, social and economic degradation,

10. Affirming our commitment to the sustainable development of mountain ecosystems,

11. Acknowledging further that the International Year of Mountains - 2002 provides the perfect opportunity to consolidate and capitalize efforts leading to the sustainable development and conservation of natural and cultural patrimony of mountain regions,

Declare as follows:

On Environmental Aspects:

1. The need to promote the use of mountain areas from an ecosystemic and participative approach, including local governments and communities while integrating social, landscaping, environmental and economical aspects in the creation and implementation process.

2. The need to acknowledge cultural knowledge and traditional technologies of mountain societies as a scientific and technological patrimony for the sustainable development of mountain ecosystem.

3. The need to rely on baseline information and carry out environmental impact studies on tourist activities and other present and potential economic mountain activities, while encouraging their pursuit and sustainable handling.

4. The need to promote integrated watershed development and participation of the communities, civil society and governments, at local and national level, for the management of mountain ecosystems.

5. The need to encourage investments to effect integral and participative investigations for the sustainable management of natural resources and the dissemination of results obtained thereby to society.

6. The need to encourage recognition of biodiversity as a global competitive advantage of mountains, as well as its conservation and sustainable use for the well being of the populations.

On Cultural and Social Aspects:

1. The need to promote respect, appraisal and incorporation of cultural through dialogue and participation of the populations in political decision-making processes, as well as intercultural support and environmental education programmes.

2. The need to encourage citizen participation of every social actor in order to promote ample and equitable access to information, as well as the "social responsibility of companies" as an strategic approach for sustainable development.

3. The need to acknowledge that water and biodiversity are communal properties and therefore, the State and individuals are responsible for their use, regulation, control and conservation, in agreement with the legislation in force, while respecting the organizations, cultural traditions and customary rights of the populations.

4. The need to promote the strengthening of local capacities and the State to develop a pluricultural and participative policy on environmental management.

5. The need for production systems to recognize the contributions of traditional knowledge and practices, as well as encourage the equitable sharing of benefits arising from the utilization of such knowledge and practices among the communities and its members.

6. The absolute need to generate areas for the empowerment of mountain populations, mainly of those farmers and natives whose voices are still not heard or taken into account in political decision-making processes.

On Economic Aspects:

1. The need to consider the following high-priority aspects for sustainable economic development:

- Economic compensation policies for mountain populations must be encouraged for the services rendered to develop low lands, specially, water use, power generation, minerals and disasters prevention.
- Consumption of mountain products, at local and national levels, must be encouraged, as well as competitive conditions to access international markets created.
- Access to financing must be made available by designing creative competitive advantage mechanisms to advance the productive activity of moutain areas.
- 2. The need to recognize the importance of mountain regions as regulators of water

resources required in order to advance activities in high and low areas. Consideration must be given to the cost related to making this resource available.

3. The need to encourage the allocation of public assets to mountain areas in order to improve competitiveness and the quality of life of the populations.

4. The need to encourage the use of clean alternative energies and technologies in the productive activity, as well as improve the quality of life of mountain populations.

5. The need to encourage infrastructure to develop communications that permit access to timely information in order to advance economic activities.

6. The need to encourage community-based, clean and sustainable tourism in order to articulate it with the other typical productive activities of mountain areas.

7. The need to create conditions for clean mining and hydrocarbures activities, articulating them to the local sustainable development.

And Recommend:

1. The need to propel and support the realization of activities leading to the celebration of the IYM-2002; the inauguration of the IYM-2002 during the United Nations General Assembly; the IV Symposium on Sustainable Development of Mountain Ecosystems (Merida-Venezuela); the III Latin American Congress on Hydrographic Basins in Mountain Areas (Cartagena-Colombia); the II World Meeting of Mountain Populations (Quito-Ecuador) and; the II International Workshop on Mountain Ecosystems (Huaraz, Callejon de Huaylas - Peru).

2. The need to broaden participation during the IYM-2002 preparatory activities with representatives from the base communities, local governments and the population in order to deepen awareness and responsibility on the matter.

3. The need to assess the advances made in the implementation of Chapter 13 of Agenda 21, at regional and national level, in order to identify new opportunities to act.

Cusco, 27 April, 2001

International Union for the Conservation of Nature -Red List Categories

Source: International Union for Conservation of Nature (IUCN). 2000. The 2000 IUCN Red List of Species [online]. URL: www.redlist.org

Nature of the categories

All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories



Source: Leave No Trace Organization (LNT). 2001. Principles of Leave No Trace [online]. Boulder, Colorado. URL: http://www.int.org/

The Leave No Trace Principles of outdoor ethics form the framework of Leave No Trace's message:

- 1. Plan Ahead and Prepare
- 2. Travel and Camp on Durable Surfaces
- 3. Dispose of Waste Properly
- 4. Leave What You Find
- 5. Minimize Campfire Impacts
- 6. Respect Wildlife
- 7. Be Considerate of Other Visitors

1. Plan Ahead and Prepare

- Know the regulations and special concerns for the area you'll visit.
- Prepare for extreme weather, hazards, and emergencies.
- Schedule your trip to avoid times of high use.
- Visit in small groups. Split larger parties into groups of 4-6.
- Repackage food to minimize waste.
- Use a map and compass to eliminate the use of marking paint, rock cairns or flagging

2. Travel and Camp on Durable Surfaces

- Durable surfaces include established trails and campsites, rock, gravel, dry grasses or snow.
- Protect riparian areas by camping at least 200 feet from lakes and streams.
- Good campsites are found, not made. Altering a site is not necessary.
- In popular areas:
- Concentrate use on existing trails and campsites.
- Walk single file in the middle of the trail, even when wet or muddy.
- Keep campsites small. Focus activity in areas where vegetation is absent.
- In pristine areas
- Disperse use to prevent the creation of campsites and trails.
- Avoid places where impacts are just beginning.

3. Dispose of Waste Properly

- Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled foods. Pack out all trash, leftover food, and litter.
- Deposit solid human waste in catholes dug 6 to 8 inches deep at least 200 feet from water, camp, and trails. Cover and disguise the cathole when finished.
- Pack out toilet paper and hygiene products.
- To wash yourself or your dishes, carry water 200 feet away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater

4. Leave What You Find

- Preserve the past: examine, but do not touch, cultural or historic structures and artifacts.
- Leave rocks, plants and other natural objects as you find them.
- Avoid introducing or transporting non-native species.
- Do not build structures, furniture, or dig trenches.

5. Minimize Campfire Impacts

- Campfires can cause lasting impacts to the backcountry. Use a lightweight stove for cooking and enjoy a candle lantern for light.
- Where fires are permitted, use established fire rings, fire pans, or mound fires.
- Keep fires small. Only use sticks from the ground that can be broken by hand.
- Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes.

6. Respect Wildlife

- Observe wildlife from a distance. Do not follow or approach them.
- Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers.
- Protect wildlife and your food by storing rations and trash securely.
- Control pets at all times, or leave them at home.
- Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.

7. Be Considerate of Other Visitors

- Respect other visitors and protect the quality of their experience.
- Be courteous. Yield to other users on the trail.
- Step to the downhill side of the trail when encountering pack stock.
- Take breaks and camp away from trails and other visitors.
- Let nature's sounds prevail. Avoid loud voices and noises.

Field Excursion Equipment List

Personal Gear

- walking boots or shoes
- waterproof jacket and pants
- long underwear (top and bottom, preferably wool)
- warm socks, 4 pairs
- warm sweaters, 2
- pants, 2 pairs (no jeans)
- warm hat
- mittens or gloves, 2 pairs
- toothbrush
- sleeping bag (minus 7 degrees Celsius)
- ensolite sleeping pad
- bowl, cup, spoon
- knife (optional)
- pencil, notebook

Group Gear

- Compasses (10)
- IGM topographical sheets for Cotopaxi (10)
- altimeters (4)
- alpine flora and fauna identification books (5)
- hand lens (5)
- tents
- high altitude stoves and fuel (3)
- First Aid supplies
- group food
- cooking utensils
- group tarp

Comprehensive List of Environmental Treaties

Source:Center for International Earth Science Information Network (CIESIN). 1996-2001. Environmental Treaties and Resource Indicators (ENTRI) [online]. Palisades, NY: CIESIN. URL: http://sedac.ciesin.org/entri/

Global Climate Change

- Agenda 21 3-14 June 1992
- Rio Declaration 3-14 June 1992
- Agreement Establishing the Inter-American Institute for Global Change Research 13 May 1992
- United Nations Framework Convention on Climate Change 9 May 1992

Stratospheric Ozone Depletion

- Adjustments and Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer 23-25 November 1992
- Adjustments and Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer 29 June 1990
- Montreal Protocol on Substances that Deplete the Ozone Layer 16 September 1987
- Vienna Convention for the Protection of the Ozone Layer 22 March 1985

Desertification and Land Cover Change

- United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa 12 September 1994
- United Nations Conference on Desertification (UNCOD) Plan of Action to Combat Desertification and General Assembly Resolutions 29-9 August 1977 (200k file!!)
- Agreement for the Establishment of a Commission for Controlling the Desert Locust in North-West Africa (as amended) 1 November 1970
- Agreement for the Establishment of a Commission for Controlling the Desert Locust in the Near East (as amended) 2 July 1965
- Agreement for the Establishment of a Commission for Controlling the Desert Locust in the Eastern Region of its Distribution Area in South-West Asia (as amended) 3 December 1963
- Convention of the African Migratory Locust Organization 25 May 1962

Deforestation

- International Tropical Timber Agreement 26 January 1994
- International Tropical Timber Agreement 18 November 1983

Conservation of Biological Diversity

- Resolução Conama Nº 009, de 24 de outubro de 1996 [Resolution Conama No. 9 Protecting Forests between Primordial Atlantic Forests 24 October 1996]
- Decree Creating the National Program of Biodiversity (1995) in Brazil
 December 29 1994 [in Portuguese]
- Law on the Protection of the Wild Fauna and Hunting [Parliament of Albania] 23 November 1994
- Rio Declaration 3-14 June 1992
- Agenda 21 3-14 June 1992
- Convention on Biological Diversity 5 June 1992
- Act Providing for the Establishment and Management of National Integrated Protected Areas System, Defining Its Scope and Coverage, and for Other Purposes 1 June 1992
- Agreement Establishing the Inter-American Institute for Global Change Research 13 May 1992
- Protocol on Environmental Protection to the Antarctic Treaty 4 October 1991
- European Convention for the Protection of Pet Animals 13 November 1987
- Resolutions of the 3rd Meeting of the Conference of the Contracting Parties to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat 5 June 1987
- ASEAN Agreement on the Conservation of Nature and Natural Resources 9 July 1985
- Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region, Nairobi, 21 June 1985
- International Tropical Timber Agreement 18 November 1983
- Protocol to Amend the Convention on Wetlands of International Importance Especially as Waterfowl Habitat 3 December 1982
- Benelux Convention on Nature Conservation and Landscape Protection 8 June 1982
- World Charter for Nature 1982
- Protocol Concerning Mediterranean Specially Protected Areas 3 April 1982
- Convention on the Conservation of Antarctic Marine Living Resources 20 May 1980
- Convention for the Conservation and Management of the Vicuna 20
 December 1979
- Convention on the Conservation of European Wildlife and Natural Habitats
 19 September 1979

- Convention on the Conservation of Migratory Species of Wild Animals 23 June 1979
- European Convention for the Protection of Animals for Slaughter 10 May 1979
- Directive on the Conservation of Wild Birds 2 April 1979
- Treaty for Amazonian Cooperation 3 July 1978
- Convention on Conservation of Nature in the South Pacific 12 June 1976
- European Convention for the Protection of Animals Kept for Farming Purposes 10 March 1976
- Agreement on Conservation of Polar Bears 15 November 1973
- Convention on International Trade in Endangered Species of Wild Fauna and Flora 3 March 1973
- Convention for the Protection of the World Cultural and Natural Heritage 23 November 1972
- Convention for the Conservation of Antarctic Seals 1 June 1972
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat 2 February 1971
- Benelux Convention on the Hunting and Protection of Birds (as amended) 10 June 1970
- European Convention for the Protection of Animals During International Transport 13 December 1968
- African Convention on the Conservation of Nature and Natural Resources 15
 September 1968
- Agreed Measures for the Conservation of Antarctic Fauna and Flora 2 June
 1964
- Agreement Concerning Cooperation in the Quarantine of Plants and Their Protection Against Pests and Diseases 14 December 1959
- Antarctic Treaty 1 Dec 1959
- Plant Protection Agreement for the South-East Asia and Pacific Region (as amended) 27 February 1956
- International Plant Protection Convention 6 December 1951
- Convention for the Establishment of the European and Mediterranean Plant
 Protection Organization (as amended 18 April 1951 PARIS) 18 April 1951
- International Convention for the Protection of Birds 18 October 1950
- Convention on Nature Protection and Wildlife Preservation in the Western
 Hemisphere 12 October 1940

Transboundary Air Pollution

- Convention on the Transboundary Effects of Industrial Accidents 17 March 1992
- Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution Concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes 18 November 1991

- Convention on Environmental Impact Assessment in a Transboundary
 Context 25 February 1991
- Agreement Between the Government of Canada and the Government of the United States of America on Air Quality 1991
- Basel Convention on the Control of Transboundary Movements of Hazardous
 Wastes and Their Disposal 22 March 1989
- Agreement Between the Government of the United States of America and the Government of Canada Concerning the Transboundary Movement of Hazardous Wastes 1986
- Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 Percent 8 July 1985
- Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Long-Term Financing of Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmissions of Air Pollutants in Europe (EMEP) 28 September 1984
- Protocol Concerning Cooperation in Combating Pollution in Cases of Emergency 21 March 1981
- Convention on Long-Range Transboundary Air Pollution 13 November 1979
- Protocol Concerning Cooperation in Combating Pollution in Cases of Emergency 24 April 1978
- Optional Protocol to the Vienna Convention on Civil Liability for Nuclear Damage Concerning the Compulsory Settlement of Disputes 21 May 1963

Oceans and Their Living Resources

- Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean 5 September 2000
- Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area 24 November 1996
- Resolução Conama Nº 010, de 24 de outubro de 1996 [Resolution Conama No. 10 Establishing Protected Areas for the Laying Down of Marine Turtles' Eggs 24 October 1996]
- Code of Conduct for Responsible Fisheries 31 October 1995
- Draft Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks 4 August 1995
- Agreement Relating to the Implementation of Part XI of the 1982 United
 Nations Convention on the Law of the Sea 28 July 1994
- Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas 29 November 1993

- Agreement establishing the South Pacific Regional Environment Programme
 (SPREP) 16 June 1993
- Convention for the Conservation of Southern Bluefin Tuna 10 May 1993
- Annex III to the Protocol of 17 February 1978 relating to the International Convention for the Prevention of Pollution from Ships of 2 November 1973 (MARPOL 73/78), as amended on 30 October 1992
- Convention for the Protection of the Marine Environment of the North East Atlantic 22 September 1992
- Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific Region 9 July 1992
- Agreement Establishing the Inter-American Institute for Global Change Research 13 May 1992
- Protocol on Protection of the Black Sea Marine Environment Against Pollution from Land Based Sources 21 April 1992
- Convention for a North Pacific Marine Science Organisation (PICES) 12
 December 1990
- International Convention on Oil Pollution Preparedness, Response and Cooperation 29 November 1990
- Cooperation Agreement for the Protection of the Coasts and Waters of the North-East Atlantic against Pollution 17 October 1990
- Agreement on the Organization for Indian Ocean Marine Affairs Cooperation 17 September 1990
- Agreement on Cooperation in Research, Conservation and Management of Marine Mammals in the North Atlantic 19 April 1990
- Protocol to the Kuwait Regional Convention for the Protection of the Marine Environment Against Pollution from Land-Based Sources 21 February 1990
- Amendment to the Annex to the Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 3 November 1989
- Protocol Concerning Marine Pollution Resulting from Exploration and Exploitation of the Continental Shelf 29 March 1989
- Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation 10 March 1988
- Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf 10 March 1988
- Agreement on the Network of Aquaculture Centres in Asia and the Pacific 8 January 1988
- Act Prohibiting the Catching of Cetaceans in Brazil 18 December 1987 [in Portuguese]
- Protocol for the Prevention of Pollution of the South Pacific Region by Dumping 25 November 1986
- Protocol Concerning Cooperation in Combating Pollution Emergencies in the South Pacific Region 25 November 1986

- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region 24 November 1986
- International Agreement on the Use of INMARSAT Ship Earth Stations within the Territorial Sea and Ports 16 October 1985
- South Pacific Nuclear Free Zone Treaty 6 August 1985
- Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region 21 June 1985
- 1984 Protocol Amending the Interim Convention on Conservation of North Pacific Fur Seals
- Protocol to Amend the International Convention on Civil Liability for Oil Pollution Damage 25 May 1984
- Protocol to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 25 May 1984
- Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and Other Harmful Substances 13 September 1983
- Supplementary Protocol to the Agreement on Regional Cooperation in Combating Pollution of the South-East Pacific by Hydrocarbons or Other Harmful Substances 22 July 1983
- Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region 24 March 1983
- Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region 24 March 1983
- United Nations Convention on the Law of the Sea 10 December 1982
- Agreement Concerning Interim Arrangements Relating to Polymetallic Nodules of the Deep Sea 2 September 1982
- Convention for the Conservation of Salmon in the North Atlantic Ocean 2
 March 1982
- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment 14 February 1982
- Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency 14 February 1982
- Protocol Concerning Mediterranean Specially Protected Areas 3 April 1982
- Agreement on Regional Cooperation in Combating Pollution of the South-East Pacific by Oil and Other Harmful Substances in Cases of Emergency 12 November 1981
- Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific 12 November 1981
- Convention for Cooperation in the Protection and Development of the Marine and
- Coastal Environment of the West and Central African Region 23 March 1981
- Convention on Future Multilateral Cooperation in North-East Atlantic Fisheries 18 November 1980

- Amendment to the Annex to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 24 September 1980
- Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources 17 May 1980
- 1980 Protocol Amending the Interim Convention on Conservation of North Pacific Fur Seals
- Protocol Amending the International Convention Relating to the Limitation of the Liability of Owners of Sea-Going Ships 21 December 1979
- South Pacific Forum Fisheries Agency Convention 10 July 1979
- Amendments to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter Concerning Settlement of Disputes 12 October 1978
- Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution 24 April 1978
- Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships 17 February 1978
- Protocol to the International Convention on Civil Liability for Oil Pollution Damage 19 November 1976
- Protocol to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 19 November 1976
- Convention on Conservation of Nature in the South Pacific 12 June 1976
- Agreement Concerning the Protection of the Waters of the Mediterranean Shores 10 May 1976
- Convention on Conservation of North Pacific Fur Seals 9 February 1957 (as amended 7 May 1976)
- Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft 16 February 1976
- Convention for the Protection of the Mediterranean Sea Against Pollution 16 February 1976
- Protocol Concerning Cooperation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency 2 February 1976
- Convention on the Prevention of Marine Pollution from Land-based Sources 4 June 1974
- Nordic Environmental Protection Convention 19 February 1974
- Protocol Relating to Intervention on the High Seas in Cases of Pollution by Substances Other than Oil 2 November 1973
- International Convention for the Prevention of Pollution from Ships 2 November 1973
- Convention on Fishing and Conservation of the Living Resources in the Baltic Sea and Belts 13 September 1973

- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 29 December 1972
- Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft (as amended) 15 February 1972
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 18 December 1971
- Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil Concerning the Protection of the Great Barrier Reef 12 October 1971
- Agreement Concerning Cooperation in Taking Measures Against Pollution of the Sea by Oil 16 September 1971
- International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 29 November 1969
- International Convention on Civil Liability for Oil Pollution Damage 29
 November 1969
- Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil 9 June 1969
- International Convention for the Conservation of Atlantic Tunas 14 May 1966
- Convention for the International Council for the Exploration of the Sea (as amended) 12 September 1964
- Agreed Measures for the Conservation of Antarctic Fauna and Flora 2 June
 1964
- Fisheries Convention 9 March 1964
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water 10 October 1963
- Agreement Concerning Cooperation in Marine Fishing 28 July 1962
- International Convention for the Safety of Life at Sea 17 June 1960
- Antarctic Treaty 1 Dec 1959
- Convention Concerning Fishing in the Black Sea (as amended) 7 July 1959
- North-East Atlantic Fisheries Convention 24 January 1959
- Convention on Fishing and Conservation of the Living Resources of the High Seas 29 April 1958
- Optional Protocol of Signature Concerning the Compulsory Settlement of Disputes Arising out of the United Nations Conference on the Law of the Sea 29 April 1958
- Convention on the Territorial Sea & the Contiguous Zone 29 April 1958
- Convention on the Continental Shelf 29 April 1958
- Convention on the High Seas 29 April 1958
- Wages, Hours of Work and Manning (Sea) Convention (Revised), 1958 (No. 109)
- International Convention Relating to the Limitation of the Liability of Owners of Sea-Going Ships 10 October 1957

- Interim Convention on Conservation of North Pacific Fur Seals 9 February 1957
- International Convention for the Prevention of Pollution of the Sea by Oil (as amended on 11 April 1962 and 21 October 1969) 12 May 1954
- Accommodation of Crews Convention (Revised) 29 January 1953
- International Convention for the High Seas Fisheries of the North Pacific Ocean (as amended) 9 May 1952
- Agreement Concerning Measures for Protection of the Stocks of Deep-Sea Prawns (Pandalus borealis), European Lobsters (Homarus vulaaris), Norway Lobsters (Nephropsnorveaicus) and Crabs (Cancer Paqurus) (as amended) 7 March 52
- Agreement for the Establishment of a General Fisheries Council for the Mediterranean (as amended) 24 September 1949
- Convention for the Establishment of an Inter-American Tropical Tuna Commission 31 May 1949
- International Convention for the Regulation of Whaling 2 December 1946
- MARPOL Optional Annex Annex IV: Regulations for the Prevention of Pollution by Sewage from Ships

Trade/Industry and the Environment

- Lei de Crimes Ambientais 12 de fevereiro de 1998 [Act Establishing Sanctions against Environmental Illegal Activities 12 February 1998]
- North American Agreement on Environmental Cooperation between the Government of the United States of America, the Government of Canada, and the Government of the United Mexican States 1 January 1994
- Rio Declaration 3-14 June 1992
- Agenda 21 3-14 June 1992
- Administrative Order Establishing Protection and Conservation of Philippine Wild Birds, Mammals, and Reptiles 13 September 1991
- Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa 30 January 1991
- Administrative Order Establishing Guidelines Governing the Confiscation, Seizure, and Disposition of Wild Flora and Fauna Illegally Collected, Gathered, Acquired, Transported, and Imported Including Paraphernalia 1991
- Basel Convention on the Control of Transboundary Movements of Hazardous
 Wastes and Their Disposal 22 March 1989
- Convention on the Regulation of Antarctic Mineral Resource Activities 2 June 1988
- Lei Nº 7.643, de 18 de Dezembro de 1987 [Act No. 7.643 Prohibiting the Catching of Cetaceans in Brazil 18 December 1987]
- ASEAN Resolution on Sustainable Development 30 October 1987
- Protocol Amending the 1978 Agreement Between the United States of America and Canada on Great Lakes Water Quality 1987
- International Tropical Timber Agreement 18 November 1983
- Agreement Between The United States and Canada on Great Lakes Water Quality 1978
- European Convention for the Protection of Animals Kept for Farming Purposes 10 March 1976
- Convention on International Trade in Endangered Species of Wild Fauna and Flora 3 March 1973
- Convention for the Protection of the World Cultural and Natural Heritage 23 November 1972
- European Agreement on the Restriction of the Use of Certain Detergents in Washing and Cleaning Products 16 September 1968
- African Convention on the Conservation of Nature and Natural Resources 15 September 1968
- Food and Catering (Ships' Crews) Convention, 1946 (No. 68) 24 March 1957
- General Agreement on Tariffs and Trade (GATT) 1947

Population Dynamics

- Rio Declaration 3-14 June 1992
- Agenda 21 3-14 June 1992