SELECTED CONSERVATION TOPICS
WITH A CONCENTRATION ON SRI LANKA

Authored by: Kittle, A.M & Watson, A.C. 2002 Colombo Sri Lanka.

Module 1

Conservation and Research

- What is Conservation?
- The Importance of Biodiversity
- Economically Sustainable Conservation
- Research and Conservation
  - Conservation for Research
  - Research for Conservation
- Why is Research important to Conservation?

Module 2

Island Habitats

- What Are Islands
- The Colonization of Islands
- Competition on Islands
- Threats to Island species
- Continental Habitat "Islands"
- The Sri Lankan Example

Module 3

Primate Families

- Natural History of Primates
- Primates in Sri Lanka - Toque Macaque
  - Grey Langur
  - Purple-faced Langur
  - Loris (prosimian)
- The Need for Conservation

Module 4

Big Cat Conservation

- Cats of the World
- Conservation status
- Big Cats in Sri Lanka
- Leopard research – a case study

Module 5

Coastal Conservation

- What is a Coast Habitat?
- Importance of Coastal Conservation
- Its Importance and application to Sri Lanka
- Sea Turtles – a case study

Module #1

Research and Conservation

Content:

What is Conservation?	Page 1
The Importance of Biodiversity	Page 2-3
Basic Attitudes towards living diversity - Table – 1	Page 3
Economically Sustainable Conservation	Page 4
Moneterizing Biodiversity- Box 1	Page 4 -6
Research and Conservation	
Conservation for Research	Page 6 -7
Research for Conservation	Page 7- 8
Why is Research important to Conservation	Page 9 -10
References	

What is Conservation?

The term "conservation" has become popular over the last half century and its constantly evolving definition mirrors its shift towards the center of conventional

thought processes. Early on the word "conservation" was mostly used in connection with the preservation of the status quo through ecosystem protection. It was a word applied to selected habitats, particular floral or faunal populations or "wild" spaces mostly for the purpose of outdoor recreation. More recently, however, the term has become less restricted in its application and has been transformed into something akin to an attitude, which has been extended to all resources. It is closely linked with the phrase "sustainable development" to emphasize a way of thinking that is both ancient in origin and modern in application.

For societies living intricately entwined with the natural world and relying upon it in its primary form for all aspects of daily life, ensuring that what is taken from the system today will not overburden the system tomorrow is second nature. While it is foolhardy to imagine that all early societies were in perfect harmony with their environments, it is true that in all successful long-term societies some form of balance with the natural world was enacted. It had to be, to ensure the survival of the society. There were no written rules regarding this balance, in fact in most cases it seems to have been an almost subconscious or natural phenomenon emerging from the fact that beings did not elevate themselves above the system as they often do today, but functioned as an integral part of the greater ecological whole.

In modern parlance "conservation" might be defined as an operational system of management of the biosphere that encourages it to yield the greatest sustainable benefit to the present generation without decreasing its potential to meet the needs of future generations. This notion was clearly stated many years ago by a native leader from the West Coat of the modern United States, when he stated that "we have not inherited the earth from our parents, we have borrowed it from our children". So the term, once used passively to express the hands-off preservation of things, has evolved into a much more active expression denoting protection, maintenance and enhancement of the environment in general. Furthermore it emphasizes the sustainability of all future development and the avoidance of any action deemed irreversible, especially with regards to living resources. This is a patently anthropocentric and utilitarian view, which in some ways limits the general application of the term but at the same time, perhaps, is impossible to avoid.

Now that the term "conservation" has been clarified, the question remains as to why it is really important. What does it really mean to say an ecological system must maintain its potential to meet the needs of future generations? How can this concept be quantified so that it has resonance from a practical perspective?

Focusing upon the conservation of biodiversity (individuals, populations, species, ecosystems), it is possible to break this potentially overwhelming concept down to an array of component parts. To begin with, it is important to have a clear understanding of the foundation theory. The term 'biodiversity' means slightly different things to different people but through the amalgamation of terms and definitions it can reasonably be stated that it is the variety and variability of composition, structure and function between and among living resources and the ecosystems in which they occur. This variety and variability includes the diversity of species and genetic material.

The Importance of Biodiversity

The reasons why this concept of biodiversity is important are numerous. It is convenient to characterize biodiversity loss as having two distinct effects: Ecologic and economic.

1. The ecological effects of biodiversity loss are viewed in terms of the long-term stability of the natural environment. It is an established ecological principle that, in very general terms, a minimum number of species is required to develop the cyclic relations between plants (producers), animals (consumers) and micro-organisms (decomposers) that enable an ecological function to be sustained. While it has yet to be determined precisely what this minimum number is it is certain that most systems are complex and require numerous interactions at all levels for stability.

Another key factor relating to the ecological importance of biodiversity is the preservation of ecosystem resilience. It is possible to define resilience as the "degree to which an ecosystem's structure and long-standing composition can be disturbed and yet retain or return to its original features" (Fielder and Jain, 1992). According to the U.S. National Research Council, the maintenance of these ecological functions is paramount for future human welfare as the human species is inextricably linked to these functions via the process of evolution. Loss of diversity and the subsequent eco-systemic changes could impact this process immensely.

2. The second major realm affected by the loss of biodiversity is the economic realm. The direct economic value placed on biodiversity can be further sub-divided into two categories: Consumptive use value and productive use value. The first of these refers to aspects of biodiversity that are used by local people for their own well-being and are not sold on a national or international market. This consumptive use value category includes some fuel-wood, vegetables, fruit, meat, medicine and building materials. On the other hand, productive use value refers to those aspects of biodiversity that are extracted from the wild and subsequently sold on a national or international market. This category includes some fuel-wood, construction timber, ivory, animal fodder, seaweed, beeswax, petroleum substitutes, pharmaceuticals and many, many more items.

The indirect economic benefits that biodiversity holds for the human inhabitants of this planet are almost too many to contemplate however some are more obvious than others. The primary one of these is revenue generated from tourism (see below).

In a particularly ambitious attempt to quantify economically the worth of eco-systemic functions Robert Costanza et al. (1997) assigned market price dollar values to these functions. The results (Box 1) clearly show just how much the earth's "commons" are being taken for granted.

Box 1:

"Moneterizing Biodiversity"

The present global reality is that all things boil down to economic feasibility. The bottom line is that all decisions relating to every aspect of life - from social welfare to healthcare to transportation to immigration to conservation - are judged in terms of monetary units (usually US $). With the rapid rate of "globalization" bringing this concept and all of its attendant structures into every corner of the planet, it seems that the only way to justify any action is by proving its mettle in economic terms. This battle is being waged throughout the world quite successfully, however it is sometimes very difficult to find a common denominator that allows for economic comparisons to be made. For example, it is possible to estimate roughly the economic worth (if not the symbolic worth) of a wild elephant in Sri Lanka by taking into consideration the revenue generated from wildlife tourism, the costs of maintaining national parks etc., but how does one put a value on a wave breaking off the Sri Lankan coast?

According to Costanza et al. (1997) this wave is part of a larger "ecosystem service" which is essentially a flow of material, energy or information from natural sources

that combine with manufactured and human services to produce human wealth. Or, more generally, an ecosystem function that is critical to any of the earth's life support systems and contributes to human welfare. Historically these services, such as nutrient cycling, gas migration and soil formation have been ignored or inadequately quantified in economic terms. Applying quantitative values to various goods and services across different ecosystems is far from easy but the team made an attempt using a relatively straightforward valuation technique. This technique utilizes the "willingness to pay" as an economic judge by which value can be assigned to a natural process. For example, in a forest environment it might be possible to determine that a given ecological process increases the value of that forest's timber on the world market by $25/hectare. Therefore that function is "worth" $25/hectare. When this is added to the aesthetic or recreational value of the forest the total worth increases. Costanza et al. used this technique across continents and systems in an effort to come up with a grand and comprehensive valuation table for all major ecological functions.

The results, while necessarily composed of rough estimates, are intriguing:

1. The earth's myriad ecosystems provide approximately US$ 33 trillion in services annually. This is almost twice that of global Gross National Product.
2. Most services are outside current market valuation systems and therefore presently have no economic value. Examples of this are gas regulation "worth" US$ 1.8 trillion/year, waste treatment "worth" US$2.3 trillion/year and the most valuable of all, nutrient cycling "worth" a staggering US $ 17 trillion/year.
3. Marine ecosystems are the most productive accounting for 63% of the total with coastal marine systems making up 80% of that total or ~50% of the whole. Terrestrial ecosystems account for the remaining 37% with forests and wetlands being the most "valuable" of those systems.

This is not to say that the way forward is to assign financial values to everything for it has already been proven that making decisions based on market analysis does not always lead to the furtherance of conservation. However it does effectively underscore the importance of eco-systemic functions that are too often overlooked or simply taken for granted. One area into which this type of biodiversity valuation might be incorporated is the cost-benefit analyses of development plans. Currently it is the development proposal that is given the benefit of the doubt whilst those concerned for its effect on the environment are required to prove their case. This can be seen in many Environmental Impact Assessments (EIA's). By acknowledging the importance of ecosystem services it is theoretically possible to switch that burden of proof, making the developer responsible for justifying the proposed development.

These economic and ecologic reasons for promoting the conservation of the earth's biodiversity are not enough according to everyone and there are those who champion the notion that the aesthetic and spiritual value of biodiversity are of prime importance. The aesthetic value of biodiversity to the human species is a central concept in the work of varied parties from internationally esteemed biological science writers like Edward O. Wilson to the U.S. National Research Council (1992). Professor Stephen Kellert goes even further than this in positing that there are nine (9) basic values of, or attitudes towards, nature and living diversity (Table 1).

Although most scientists would stop there, limiting the value of biodiversity to human perceptions and benefits is not universally accepted. Vandana Shiva (1993) states that putting value on biodiversity only as a raw material comes from an anti-nature standpoint. Following from this belief the case can be made for conserving natural biodiversity based on the intrinsic worth of ecosystems, most practically because of the historically transitory nature of utilitarian values.

Recognizing both the direct and indirect material benefits that the preservation of biodiversity holds for the human species is essential for underscoring the immediate commitment that is needed for this preservation. However, anthropocentric views and values are not enough on their own. Ecosystems and their various functions, structures and compositions need to be valued intrinsically if any long term solutions to the problem of the earth's dwindling biodiversity are to be found.

Table 1 - Basic Attitudes Towards Living Diversity

Basic Attitudes Toward Living Diversity	
Term	Definition
Naturalistic	Primary interest and affection for wildlife and the outdoors
Ecologistic	Primary concern for the environment as a system and for interrelationships between wildlife species and natural habitats.
Humanistic	Primary interest and strong affection for individual animals, particularly pets. Regarding wildlife, focus on large attractive animals with strong anthropomorphic associations.
Moralistic	Primary concern for the right and wrong treatment of animals, with strong opposition to presumed exploitation and cruelty toward animals.
Scientistic	Primary interest in the physical attributes and biological functioning of animals.
Aesthetic	Primary interest in the artistic and symbolic characteristics of animals.
Utilitarian	Primary concern for the practical and material value of animals or the animal's habitat.
Dominionistic	Primary interest in the mastery and control of animals, typically in sporting situations.
Negativistic	Primary orientation an avoidance of animals either due to indifference, dislike or fear.

Source: Reprinted directly from Keller, Dr. Stephen R., and Dr. JulieDunlap,1989,"Informal Learning at the Zoo: A Study of Attitude and Knowledge Impacts".

Economically Sustainable Conservation

The conventional wisdom of today indicates that any conservation strategy that has the potential to succeed must include substantial efforts to bridge the gap between people and the wildlife with which they share their land (Anderson and Grove, 1989). This means that any program that is initiated must have the participation and cooperation of the rural peoples whose lives it will invariably affect. In modern society this generally means that for wildlife to be actively preserved it must provide an economic benefit to local communities.

The advantages of a healthy and vigorous wildlife population in Sri Lanka are already in evidence. One example is Yala National Park, a prime tourist destination in the country. Attracting over 200 000 visitors per year, both local and foreign, it brings in nearly Rs.30 million annually and provides year-round employment for local people as guides, rangers and within the hospitality industry (Management Plan, YPAC Report, 1997). While still in its infancy this sector has tremendous potential if, and only if, properly managed. At present however, this income is simply incorporated into the government treasury without due consideration as to where it was generated. As a result the impressive economic worth of the country's wildlife is largely ignored. The wildlife sector in turn, tends not to be adequately financed for conservation purposes, as it is not thought to be financially valuable enough to merit consideration.

There is a saying in East Africa that has evolved from the successful conservation of the region's wildlife through tourism, "Wildlife pays, so wildlife stays". To make wildlife "pay" in Sri Lanka it is the nature tourism industry that needs to be bolstered and it is the so-called "charismatic mega fauns" such as the elephant and leopard that tourists pay to see. Already there is a small but dedicated group of local tourists who visit Yala National Park almost exclusively because of its visible leopard population. Meanwhile foreign tour groups on specialized leopard safaris began operation in 2002 and, as can be seen in India and Nepal with tiger tours, this niche market can have tremendous economic benefits. There is, however, a fine line between tourism aiding conservation and tourism feeding off and negatively affecting conservation. It is, and has to be, a carefully controlled scenario that will ensure the positive side for conservation.

Examples abound of how scientific research has aided in the development and implementation of conservation strategies that create positive economic feedback both to local communities and entire nations. In Kenya, for example, US$450 million is generated each year by the nation's national parks. That means that each lion is worth US$27 000 per year! In Costa Rica, a nation similar to Sri Lanka in offering a mix of habitats and a wealth of wildlife, nature tourism now ranks as the country's leading source of income. To ensure that this tourist boom continues the right way, the government has set aside 30% of the land area for conservation. Perhaps the most direct example of a happy marriage between research and tourism is Ecuador's Galapagos Islands. Ostensibly a strictly protected environment utilized by international researchers and a limited number of high paying tourists, these islands contribute over US$180 million annually to the Ecuadorian economy (The Nature Company, 1996). Of course none of these examples is perfect but they do provide evidence that economically sustainable conservation is a viable option.

Research and Conservation

Like the term "conservation", the relationship between research and conservation has gone through an evolutionary process within the last half century. Originally research was done purely to satisfy humankind's tremendous thirst for knowledge. The answers gleaned were enough on their own to justify the work being carried out and had no greater application even if they did occasionally have greater meaning. The Greeks innovated the practice on a more or less formal scale with Aristotle's methods of scientific inquiry. This empirical system was further developed into a rigid school of thought that mimics a tree in that it contains a strong and central trunk from which numerous branches have sprung (and sometimes fallen) over the course of time. The scientific method is now firmly ensconced as the standard procedure for many avenues of academic pursuit and has become something akin to a religion for millions. As scientific research became more accepted and widespread it also became much more application oriented. Medical researchers began conducting studies focused on cause and effect; aeronautical engineers began studying bird flight not for its own interest but in order to construct better machines for human usage. Wildlife research has gone through similar changes. Charles Darwin and Alfred Wallace are commonly credited with instituting the concept of field biology in the course of their attempts to understand evolutionary processes. Once the intriguing notion of evolution gained acceptance most wildlife research was conducted in this vein, the attempt being to come to terms with the incredible theory. It wasn't really until the 1960s that conservation began being tied in with research and even then it was as a by-product of the initial research and not a reason for the research itself. There are three internationally renowned research projects that display the link between conservation and research and in fact clearly demonstrate the subtle change in the relationship of the two concepts from "conservation for research" to "research for conservation".

<u>Conservation for Research</u>

Louis Leakey was a British-Kenyan paleo-anthropologist, well known for his exhaustive and important investigations into the history of human evolution, particularly his excavations in Tanzania's Olduvai Gorge. His fascination with human ancestry extended to the evolutionary links between human beings and their closest living relatives, the great apes. In an effort to learn more about the links between humans and apes he was instrumental in the implementation of three research centres run by three remarkable women – Jane Goodall, Dian Fossey and Birute Galdikas.

Jane Goodall, a British ethologist, was Leakey's first protégé. In 1960 she started the Gombe Stream Chimpanzee Reserve on the shores of Tanzania's Lake Tanganyika. The focus of her work was chimpanzee behaviour and social structure and the impetus could be found in anthropological theory and evolutionary biology. Regarded as a pioneer of modern fieldwork, Goodall exposed to the world many of the mysteries of chimpanzee life while at the same time developing a great fondness for her study subjects. Along with fascinating insights into chimpanzee social structure her study was the first to formally document tool usage in a non-human population. This very visible link between humans and apes helped to forge a much more compassionate attitude towards chimpanzees. During the course of her 10 years of fieldwork at Gombe, Goodall became increasingly concerned about the plight of the chimpanzees from extensive poaching and habitat destruction and in 1977 began the Jane Goodall Institute for Wildlife Research, Education and Conservation. Here, therefore, was a

direct link between research and conservation and while originally the conservation thrust was in aid of her research subjects the pattern inexorably shifted towards research centered upon answering questions relating to future conservation of the chimps. Today there are chimpanzee sanctuaries, set up by Goodall, in four African countries for the care and rehabilitation of orphaned chimps.

The work of American zoologist, Dian Fossey's followed a somewhat similar path beginning with the implementation of the Karisoke Research Centre in 1967. Her study subjects were the gorillas living in the Virunga mountains of Rwanda and Zaire (now the Democratic Republic of the Congo) and from them she learned a tremendous amount about gorilla social hierarchy, diet and behaviour. It was from this 18-year study that Fossey was able to dispel the long-standing myth which attributed a fierce and aggressive nature to mountain gorillas. The more she learned about these gentle, peaceful beings the more concerned she grew about their future welfare. While the chimpanzees of Gombe were often killed for their flesh as well as the pet trade, the mountain gorillas of Virunga were hunted to satisfy a more obscene desire. Incredibly enough, the hands of gorillas were gaining a fashionable reputation as ashtrays in the world's wealthy circles! As a result, dismembered carcasses littered the lush, tropical hills around Karisoke causing the passionate Fossey to change the focus of her efforts from pure research to aggressive conservation. Possibly her efforts were too aggressive as Dian Fossey was murdered in 1985 in her camp, probably by poachers with whom she had waged a personal battle. While the origin of her research was to investigate links between humans and apes, the blossoming realization concerning the plight of the gorillas caused a shift in the research paradigm towards conservation-oriented studies.

The last of Louis Leakey's proteges is the Canadian anthropologist Birute Galdikas who has studied orangutans in the Central Indonesian island of Borneo since 1971. The pattern that Galdikas's research has followed is almost exactly parallel to both Goodall's and Fossey's. It began with the intention of studying the great apes with an eye to the past and evolution, inevitably changing focus towards the future and conservation. Like her two contemporaries, Galdikas has been successful in highlighting the plight of her research subjects and has been instrumental in pushing the Indonesian government into changing the Tanjung Putting Reserve into a National Park. She is also the director of the Orphaned Orangutan Education and Care Centre and an ardent anti-logging protestor on behalf of her voiceless charges.

These three dedicated professionals were largely responsible for making popular the concept of conservation as an end unto itself. As a result of this academic and professional awakening there has been a radical shift in both goals and methodologies regarding wildlife research with much more emphasis being placed on studies that focus upon an increased understanding of species or population dynamics in an effort to ensure future protection. The academic field of conservation biology might be a new one but it has spread far and wide in terms of both popularity and acceptance and there are now numerous conservation-oriented field studies around the world working towards guaranteeing a future for the earth's biodiversity. To add to that, like the great ape studies previously mentioned, almost all research that does not specifically focus upon conservation now has offshoots aimed in that direction.

Table 2: The evolution of research focus

Phase	**Research Focus**	**Research Impetus**	**Perception of Subject**

Early	Anthropology Evolutionary biology	Interest in link b/w humans and apes and general evolution	As ancient relatives of humans and/or as time indicators of the earths evolution
Middle	Behavioural Life History	Concern for research population.	As valued research subjects and individuals.
Late	Behavioural Life History Conservation	Concern for the future of species as a whole	As beings with an intrinsic right to exist

Research for Conservation

Many research projects around the world are now focused on conservation with that being the very reason for the study's existence. This is a radical change from the days when research was solely carried out to increase the wealth of human knowledge. Often it was researchers in the field, focusing upon one aspect of scientific inquiry or another that would "discover" the threat to a particular place or population. From this realization of the endangered status of the ecosystem or species would spring new research aimed expressly at investigating the situation with an eventual goal of resolving the problem. This is exactly what occurred both in India with the tiger and in China with the panda bear.

Indian scientists began to uncover the extent of the decline in tiger populations across the country in the late 1960s and brought their disheartening discovery to the attention of the Indian government. In 1973, due to the acceptance of this threat by Prime Minister Indira Gandhi and an impressive resolve to do something about it, Project Tiger was born. The aim of this far-reaching initiative was to learn as much about the tiger as possible and use the information to improve its future protection. Thanks to a concerted, country-wide effort and massive international support India has gone from having 9 sanctuaries and national parks holding ~1800 tigers in 1973 to having 18 preserves containing ~4000 tigers.

While the numbers are difficult to accurately verify and there are some known sources of error with regards to India's tiger censuses, the overall effect of improving the status of the tiger in India is clear.

The Chinese government has never been accused of committing too many of its resources to the protection of its native flora and fauna so it is somewhat surprising that it is in this populous country that another moderately successful conservation strategy is unfolding. Not surprisingly, it was the international community, through the tireless work of organizations like the World Wildlife Fund (WWF) and global exposure on the pages of National Geographic magazine, that put the initial pressure on the Chinese government to improve its protection of the giant panda bear. The WWF successfully appealed to the wider public by utilizing this charismatic mega-faun for their international logo so that appealing images of the fuzzy, rotund, clown-like creature spread around the world, increasing popular support for its preservation. In the early 1990s the Chinese government called in George Schaller, one of the leading advocates for the conservation of endangered species to visit the country and come up with a conservation strategy aimed at saving the dwindling panda bear populations. Intensive research has led to the establishment of the Wolong Panda reserve in western China's Szechuan province, which is a 2000km2 park complete

with a captive breeding and reintroduction centre. Continued studies focus on the protection of the mountainous bamboo forests which are the home of the panda bear as well as on many aspects of giant panda ecology.
There are hundreds of conservation biology study projects around the world aimed at protecting and preserving all manner of field, flower, bird and bear. From sea turtles, to golden lion tamarins, freshwater lakes to wildflowers, research is growing hand in hand with conservation to improve the future wellbeing of the earth and its inhabitants, not the least of which are humans.

Why is Research important to Conservation?

It is universally agreed that conservation of resources, species, ecosystems etc. is vital to the sustainable future of life on the planet. However what is not yet clear is how one goes about "conserving". Is it enough to simply leave things as they are by limiting access to them or use of them? Unfortunately the answer to this is a resounding "no" because we are now aware, at least to some degree, of the complex structures, processes and inter-relationships that exist within and between all living organisms. The thrust of conservation research is to aid in the determination of planning and policy with regards to a particular biological system as well as to increase the efficiency and effect of those policies.
For example, with regards to a forest patch that is under threat from development, a conservation biologist might investigate the role that that patch plays in the greater eco-systemic functions of the area, the species diversity and wealth that inhabits the forest, the species of primary importance to the health of the patch and the relationship between those species and others. If one is to work to protect a place then it is important to know what is being protected. What is the underlying structure of the ecosystem that makes it the way it is? What are the internal and external threats to the environment and how do they exhibit themselves? What negative effects would result from the destruction or fragmentation of the area in question? This last point is particularly poignant with regards to development.

Examples abound from around the world where development has been implemented only to result in extreme, unforeseen (or sometimes purposefully hidden) consequences that have had terrible detrimental effects either on the environment or on the people living in the area (or, more commonly, on both).
Often, conservation researchers are vital to the organization and management of national parks, reserves and other protected areas. It is research that determines which areas are most important to protect and why, the size of the proposed park or reserve as a function of the species being targeted for protection, the amount and type of encroachment that is feasible in particular parts of the protected area etc. Subsequent to the development of the park or reserve, further research is required to constantly monitor the success of the instituted conservation strategy measured in terms of the health of the system, the stability of the protected populations, the maintenance of the buffer zone etc. Past examples have demonstrated that simply making an area into a national park is not enough. In eastern Africa for example, fencing areas off from the rest of the countryside created many national parks. This had the effect of caging the animals and severely restricting their annual migration patterns that required a much more extensive land area than the parks afforded. The result was the degradation of the parks' resources from overgrazing and increased levels of starvation among certain grazing populations when, in addition to the low fodder levels, water became scarce. Other examples of the ineffectiveness of

simplistic solutions include protected areas that suffer from persistently declining health because the sources of the threats lie outside the boundaries of the protected zone. Wetlands are particularly susceptible to this sort of incident where it is the polluted waters entering the wetland system from an outside source that are damaging the ecosystem. Without persistent monitoring and detailed research such situations can easily be overlooked until it is too late.

Finally, when it comes to the conservation of individual species, research is an invaluable tool. It is impossible to successfully design a conservation strategy that will be effective without thoroughly investigating the species to be protected. This is especially so today, when there is simply not enough available space to ensure that large tracts of land are secure. General population dynamics, demographic structure of the population, predator/prey relationships, diet, ranging behaviour, sociability, adaptation to interference, pressures from internal and external sources, genetic variability and taxonomic status are aspects that need to be known. Therefore it is imperative to understand the life history of a particular species in order for conservation to be possible.

References:

Anderson and Grove, 1989

Costanza, Robert et al., 1997, "The value of the world's ecosystem services and natural capital", Nature 387: 253 – 260.

Encarta Encyclopedia 2000, Microsoft

Fielder and Jain, 1992.

Goudie, Andrew et al., 1985, The Encyclopedia Dictionary of Physical Geography, 2nd Ed., Blackwell Publishers Ltd.

Holing, Dwight, ed., 1996, World Travel: A Guide to International Ecojourneys. The Nature Company Guides Series, US Weldon Owen Inc. San Francisco.

Kellert, Dr. Stephen R. and Dr. Julie Dunlap, 1989, "Informal Learning at the Zoo: A Study of Attitude and Knowledge Impacts"

Kittle, A. M., 1998, The Role of Zoos in the Conservation of Biodiversity: A study of potential and practical impacts, unpublished honours thesis (undergraduate), McMaster University, Hamilton, Ontario.

Prater etc. (Yala management plan)

Shiva, Vandana (1993)

U.S. National Research Council 1992

Wilson, E. O.