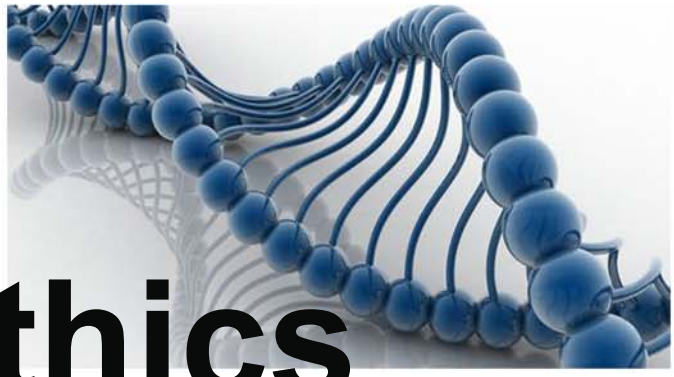

Bioethics

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Bioethics

Foreword by John Buckeridge and Lorna Holtman

The impetus for this issue of *Biology International* followed a very successful symposium presented at the International Union of Biological Sciences (IUBS) *Commission for Biological Education*'s (CBE) BioEd 2012 <http://iubscbe.org/bioed-2012/> held in conjunction with the General Assembly of the IUBS, in Suzhou, China in July 2012. All eight participants at the symposium were invited to write up their papers (see abstracts at <http://iubscbe.org/bioethics/>); these five contributions provide a good sense of the rich presentations and a rather diverse assessment of conservation, environmental ethics and bioethics, and comprise papers from Australia, Egypt, South Africa and Uganda.

In John Buckeridge's opening paper "*A Part, Not Apart from Nature: The IUBS Ethics Commission – An Overview of a Journey*," there is a reflection on the development and history of the *bioethics* concept and long overdue credit is given to the pioneer of the term, Fritz Jahr. Although initially very broad in its meaning, bioethics is now almost exclusively applied to medical ethics, as a consequence *environmental ethics* is now used for the non-human part of the biosphere; also included is a brief history of the last decade of IUBS's Ethics Commission, which is now part of the IUBS *Commission for Biological Education*.

Rob Watts and John Buckeridge deal with the more philosophical concept *In Pursuit of the Biological Imperative: An Intergenerational Approach to Biological Justice* and they challenge us, whenever modeling resource management, to be aware that in nature, justice is inter-temporal and must embrace all life found in the Earth's biosphere. Acknowledgement of this is the biological imperative.

In *Biodiversity and Indigenous Knowledge in South Africa: Developments and Ethical Challenges.*, Mogege Mosimege and Lorna Holtman review the Convention on Biological Diversity <http://www.cbd.int/convention/text> – with special reference to southern Africa, and they include a case study on the use, ownership and rights pertaining to *Hoodia*, an indigenous South African cactus that has important medicinal properties.

An overview of regional conservation in East Africa is given by Raymond Katebaka in *Effective Biodiversity Conservation Challenges in Africa: A Case of East Africa*, who illustrates just how important the natural environment is for the region's economy; he notes similar problems to those in southern Africa – in particular the need to ensure fair distribution of the revenue gained from natural resources.

The concluding paper entitled *Environmental Awareness and Conservation of Biological Resources in Egypt: A Review of Moves to Improve the Ethical Management of Our Ecosystems* by Hussein Salama investigates some of the ethical issues in land conservation in Egypt, including the use of genetically modified organisms; he concludes that there is still much that must be done to educate the community about conservation of ecosystems.

We hope that readers will also consult two previous issues of *Biology International:* in 2002, Bernard-Marie Dupont wrote on "The Ethics of lnnovative Medicine: from the possible to the permissible?" <http://biologyinternational.org/wp-

content/uploads/2011/03/BI-Numero-43a.pdf> and in 1997, a special issue edited by Talal Younes and Derek F. Roberts covered genetic counseling, animal experimentation, genomics, conservation, population genetics, epidemiology, cloning, pharmaceutics, GMO food, and biotechnology <http://biologyinternational.org/wp-content/uploads/2011/04/SPECIAL-ISSUE-351.pdf>. While the Bioethics Commission is now conjoined with the IUBS *Commission for Biological Education*, we want to assure members of IUBS that this long-standing commitment to being concerned with bioethical concerns will be continued into the future.

A Part, Not Apart From Nature: The IUBS Ethics Commission – An Overview of a Journey From 2000-2012.

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This paper explores the development of the way in which humans interact and have interacted with their natural environment. In particular, it places this within the context of the International Union of Biological Science's Ethics Commission, a body established in 2007 to develop ethical norms for bioethics and environmental ethics. The Ethics Commission grew out of what was the IUBS Bioethics Committee – the name change being dictated by confusion about the meaning of the term bioethics – which had recently been captured by the medical profession and was increasingly applied to medical practice alone. The new IUBS Ethics Commission (ICE) had a public presence as the International Centre for Environmental and Bioethics (ICEB), the web page of which was a vehicle to facilitate the provision and dissemination of ideas, news, concerns and case studies about the ethical management of the biosphere. In July 2012, the commission ceased to exist as a stand-alone entity. The reasons for this closure were varied; ranging from a lack of interest, to a belief that the commission was no longer required, to an inability or a lack of willingness to be personally involved in environmental ethics. The ICE is nonetheless still an important part of IUBS – currently as a subcommittee within the Biological Education Commission. The paper finishes with a review of the achievements of the commission over the last few years, and assesses where the critical ethical issues in biological sciences are likely to arise in the next decade: continued environmental degradation, increased intellectual theft and scientific obfuscation.

Key words: Bioethics; ethics; environmental ethics; codes of practice; biodiversity loss; environmental degradation.

Introduction

As a result of environmental degradation, humans are being forced to see themselves not as separate from nature, but as an integral part of it.

Buckeridge, 2007.

Ethics is defined as an application of moral values, particularly in a professional capacity (Buckeridge, 2011). It thus involves developing protocols and making decisions about how humans interact with their environment. This paper explores the manner in which we interact with the natural environment (or biosphere), then focuses on the International Union of Biological Science's Ethics Commission (ICE), a body established in 2007 to develop ethical norms for bioethics and environmental ethics. The ICE arose from what had for many years been the IUBS Bioethics Programme. The Bioethics Committee was however quite unlike most other programmes within IUBS, as it did not have a finite task to complete. Rather it had the broad task of ensuring an

ethos of ethics within the bioscience community. The IUBS Ethics Commission had a public presence as International Centre for Environmental and Bioethics (ICEB), the web page of which was seen as a vehicle to facilitate the provision and dissemination of ideas, news, concerns and case studies about the ethical management of the biosphere. This was undertaken in anticipation that it would lead to the development and implementation of guidelines and best practice systems for the ethically sound and sustainable management of global biota and ecosystems. Although the name *International Centre for Environmental and Bioethics* is rather long, it was judged necessary due to the confusion about terms such as bioethics.

Mankind… a part, not apart from nature

Although the word *bioethics* didn't appear in the literature until the twentieth century, humans have had a long and deep (and necessary) relationship with the natural world. This relationship arose from necessity (i.e. nature provided all), but it was also founded in awe – in the magic, the beauty and the wonder with which humans saw their natural environment.

This wonderment is encapsulated almost two and a half millennia ago by Aristotle (384-321 BC), who in *Parts of Animals* 645[a]: 16 stated: *In all the things of Nature, there is something marvellous...* If this is placed in the context of Aristotle's broader worldview, wherein a good person is one who cultivates virtues such as fairness, honesty, justice and self-discipline, then we have all the elements of environmental stewardship (Buckeridge, 2011). This wonderment was extended during the 13th century, by Saint Francis of Assisi (1181-1226), who envisaged Nature and God inextricably as one. It is recorded that St. Francis had a very intimate and compassionate relationship with living things, and on this basis was made patron saint of animals and plants (Robinson, 1909). Importantly however, this bio-centric attitude is reflected globally and for example, is exemplified through the reverence of nature embodied in Taoism, to the Buddhist compassion for organisms under stress (Sass, 2012).

In addition to wonderment, a growing appreciation of the fragility of the natural world was being recognised by environmentalists such as the American forester, Aldo Leopold (1887-1948). It was Leopold who first advocated an ecocentric or holistic ethic to land management, and this sowed the seeds (no pun intended), which ultimately led to the modern concept of *bio*-ethics (Cramer, 1988). Nonetheless, humans have long wrestled with their inheritance of the natural world, many perceiving it as a thing to deal with as they willed. At this point, it is worth sharing a reflection on mankind's place in the natural realm, made by William Shakespeare – albeit tongue in cheek of course…

> *What a piece of work is a man, how noble in reason, how infinite in faculties, in form and moving how express and admirable, in action how like an angel, in apprehension how like a god! the beauty of the world, the paragon of animals – and yet, to me, what is this quintessence of dust?*
>
> Hamlet 2(2): 303-312.

Shakespeare's next few lines confirm that man (or woman) is not as special as many might believe. This essence is reflected too by biologists. An observation of Charles Darwin, made in 1838, when he visited Jenny, the first orangutan to be shown at London Zoo, is particularly poignant:

Let man visit Ouranoutang in domestication, hear expressive whine, see its intelligence when spoken [to]; as if it understands every word said… see its passion & rage, sulkiness, & very actions of despair; ... and then let him boast of his proud preeminence ... Man in his arrogance thinks himself a great work, worthy the interposition of a deity. More humble and I believe true to consider him created from animals.

Charles Darwin, 1838 (ZSL, 2008).

In search of a *bio*-ethical ethos for the biosciences

Use of the term "bioethics" was proposed in 1927 by the German philosopher and theologian Fritz Jahr (1895-1952). Jahr introduced the term as a moral imperative in his article *Bio-Ethik. Eine Umschau über die ethischen Beziehungen des Menschen zu Tier und Pflanze* [Bio-ethics. An assessment of the ethical relationships between man and animals and plants] (Jahr, 1927, 1928). Jahr was a keen student of Immanuel Kant and saw Kant's categorical imperative (Kant, 1781), as an appropriate model for bioethics (Lolas, 2008). Following Kant, Jahr concluded that the most appropriate guidance for moral action(s) arose from what he termed the *Bio-Ethical Imperative* – i.e. *Respect every living being, including animals, as an end in itself and treat it, if possible, as such!* (Jahr, 1928). There was a subtle difference between Jahr's and Kant's approach: Kant used the term "always", and as such is categorical; but Jahr used "possible", with the statement becoming situational (Sass, 2012). This change has great significance, for it requires us to take into account our obligations not only to each other, but also to the present environment and any *future* environments.

By the mid 20th century Leopold had published his series of essays advocating holistic land management (Leopold, 1949). Leopold, like Rachel Carson (1907-1964), was very aware of the degrading natural environment and the role that humans had had in this degradation (see also Carson, 1962). Both were to have significant and long-reaching influence on environmental movements.

A drift in meaning of bioethics from *bio*-ethics more to *medical*-ethics increased in the 1970s, when Van Rensselaer Potter II (1911-2001) used it to integrate biology, ecology, medicine, and human values. Potter saw biology combined with diverse humanistic knowledge as *forging a science that sets a system of medical and environmental priorities for acceptable survival* (Potter, 1971; 1988).

In 1993, the United Nations established the International Bioethics Committee (IBC), a body of 36 independent experts that *follows progress in the life sciences and its applications in order to ensure respect for human dignity and freedom* (UNESCO, 1993). The first task of the IBC, as listed on their web site, is surprisingly focused: *To promote reflection on the ethical and legal issues raised by research in the life sciences and their applications*. However, exactly what this means is not entirely clear until one goes deeper into their web site, where one finds in bold, under "About the Bioethics Programme" what can be deduced as their primary objective:

Stem cell research, genetic testing, cloning: progress in the life sciences is giving human beings new power to improve our health and control the development processes of all living species. Concerns about the social, cultural, legal and ethical implications of such progress have led to one of the most significant debates of the past century. A

new word has been coined to encompass these concerns: bioethics.

(UNESCO. 1993).

This objective is indeed laudable, but it is certainly not what Jahr, Leopold or Carson would have promoted, for although it has much to do with human health, good laboratory practice and the use (or otherwise) of genetic engineering, it ignores much about how humans should responsibly interact with the natural environment, such as land (and ocean) use, natural resource use, recycling and waste disposal, conservation and biodiversity.

Bioethics for the biosciences

Until 2007, the International Union of Biological Sciences' engagement with ethics was through its Bioethics Committee. The use of the term *bioethics* in this instance was made in the knowledge that *bio* (= life) and *ethos* (= behavior, or the manner in which we interact with the world around us). This apparently covered what biologists would term "good practice".

But as noted, there were problems with the term *bioethics*, for at both the most general and fundamental levels, it had come to mean little more than medical ethics (Buckeridge, 2004). It had everything to do with good practice, but little to do with practice outside the world of physicians and geneticists. This approach was, I believed, not in the best interests of the natural environment, especially because the wider community too had begun to accept this mantra. This change is best encapsulated by Chadwick (2012), who defined bioethics as a field of applied ethics that *studies the philosophical, social, and legal issues arising in medicine and the life sciences. It is chiefly concerned with human life and well-being, though it sometimes also treats ethical questions relating to the nonhuman biological environment.* This was certainly the attitude at the 2004 special session of UNESCO's International Bioethics Committee (IBC), held over 27- 29th April in Paris, where non-human aspects of the "biological environment" were glaringly absent.

On behalf of the IUBS, I took a stand on this issue, my stance being that 'bioethics' was no longer a useful vehicle for issues pertaining to the natural environment and that we had unfortunately strayed from the real meaning and the intent of bioethics (Buckeridge, 2004). In the following months, UNESCO set up a special working group of which I, as chair of the IUBS Bioethics Committee, was a member. Our task was to establish a series of protocols for best practice in environmental ethics, and to have these endorsed by UNESCO. After a rather tortuous few years in gestation, a consensus was finally reached and UNESCO's "Environmental Ethics Theme" was established. It provides a range of activities on environmental ethics that generate intellectual knowledge, plays an advisory role for Member States and offers a basis for reflecting on the relevance of standard-setting initiatives (UNESCO, 2010).

But whilst UNESCO deliberated, IUBS took the initiative and in 2005, closed its Bioethics Committee and established the International Centre for Environmental and Bioethics (ICEB). The ICEB Secretariat was set up at RMIT University, Melbourne, Australia. The ICEB was charged with the development of ethical norms for both bioethics and environmental issues. It was a virtual centre and provided a vehicle for the free dissemination of ideas, news, concerns and case studies about the ethical management of the biosphere. To further strengthen the importance of ethics in biosciences, the IUBS replaced the Bioethics

Committee with a new Ethics Commission (ICE) in 2007. This upgrade to commission status was taken to reflect the importance of ethics; in doing so the new commission joined the other keystone IUBS programme, the Bioeducation Commission.

The Ethics Commission's purpose was to provide guidance on the holistic and sustainable management of the biosphere, and more latterly to provide comment and dialogue on the increasing levels of unethical behavior in research – especially in issues like plagiarism and intellectual theft. This rationale was encapsulated in the following objectives:

1. To support the development of ethics education for researchers in biosciences, through links with the BioEducation Commission.
2. To provide free and accessible environmental ethics teaching and learning materials via the internet.
3. To provide input into the development and implementation of existing global, regional and national protocols and codes of practice for the sustainable management of biological resources, including those in bioengineering.
4. To act as a resource on issues relating to breach of scientific practice in publishing and general research.
5. To encourage dialogue amongst the biological science community in matters ethical.

The increasing influence of the internet provided an opportunity to develop on-line learning resources. In conjunction with RMIT University, the first of these were launched in 2011, and included a self-paced, self-assessed module, based on a variety of case studies (http://its-wn-web1.its.rmit.edu.au/faculty/resources/ethics/). This package is still available free-of-charge, and as well as biological sciences, a range of disciplines, including engineering, currently uses it.

An ICE Report Card

Over the 12 years during which some form of secretariat functioned at RMIT University, a healthy number of presentations and publications resulted. The 30 written works (Figure 1) were primarily conference and journal papers (*e.g.* Buckeridge & Tapp, 2000; Buckeridge, 2004, 2005, 2006, 2009), although a number of books and book chapters on ethics were also produced – and importantly these had multidisciplinary currency – being used as texts in engineering education as well as science (e.g. Buckeridge, 2011).

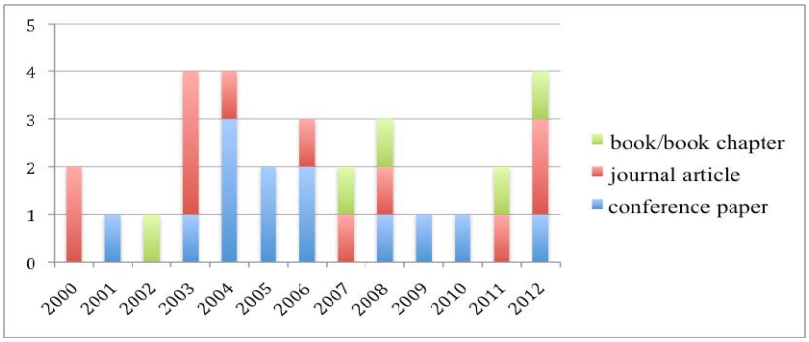

Figure 1: Publications. Written works on bioethics and environmental ethics produced by the IUBS International Centre for Environmental and Bioethics over the period 2000-2012. The vertical axis is the number of outputs per annum. Books/book chapters include the 1st and 2nd editions of *4 Es: Ethics, Engineering, Economics & Environment* and the 2011 course manual for indigenous education as part of *Project Echo Island.*

There has also been extensive international outreach as keynote talks, seminars and workshops, with presentations at many community and scientific colloquia (Figure 2). The importance of targeting young people has been demonstrated through a very successful course, run every year on ethics for aspiring young scientists, as part of the two week Rotary International Science Forum in Auckland, New Zealand. A further initiative, to encourage indigenous children to consider careers in biological sciences and help conserve the natural environment was delivered at Elcho Island, situated in the Arafura Sea, NE of Darwin, Australia. This three-day course aimed to extend the scientific knowledge of Aboriginal children as well as to reinforce the relevance of traditional indigenous knowledge in resource management. A brief report on the project and the course manual are available as downloads from *Biology International* volume 50 (http://biology international.org/wp-content/uploads/2012/ 03/Buckeridge-manual.pdf. In addition, a poster has been printed with government support, and is being circulated to junior schools in Australia's Northern Territory.

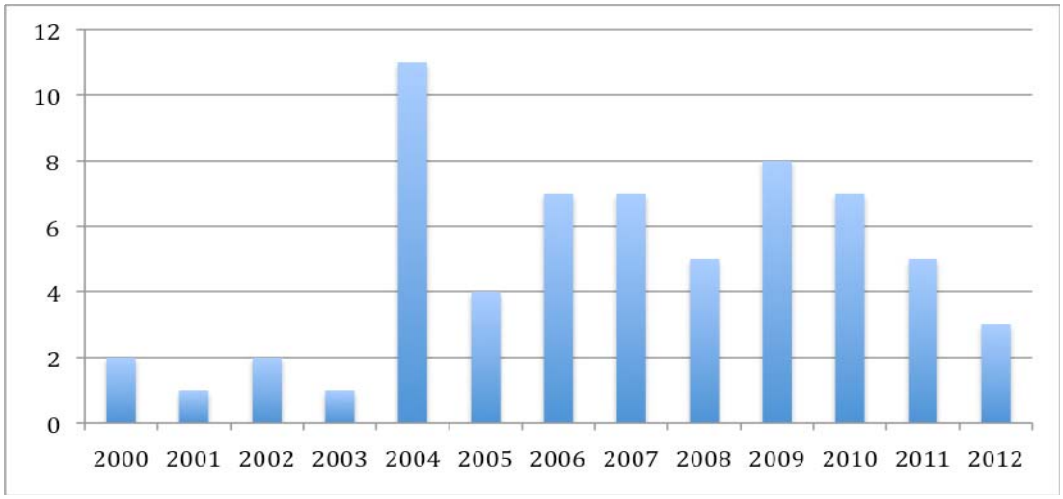

Figure 2: ICE Outreach 2000-2012. IUBS presentations on environmental ethics, bioethics and professional ethics have been delivered in Australia, Brazil, China, England, Fiji, France, Germany, Hong Kong, Malaysia, New Zealand, Norway, Scotland, Singapore, South Africa, Sweden, Thailand and the United States of America. An annual workshop/seminar for secondary school students run at Auckland's Rotary International Science Forum has consistently been voted as one of the most interesting and provocative courses of the forum.

ICE funding has come from a small annual stipend provided by IUBS, which in latter years rose to €7,500.00 (c.AUD9,000.00). With in-kind support from RMIT University this sustained the office, established the web site and over the last two years even provided airfares for delegates from Africa and Asia to attend environmental ethics meetings, ensuring a depth in cultural exchange that would otherwise have been absent from these meetings.

In July 2012, the ICE and the ICEB ceased to exist as stand-alone entities. The reasons for this closure were varied; ranging from a lack of interest, to a belief that the commission was no longer required, to a lack of willingness, or inability to be personally involved in environmental ethics. Even though we had implored commission members to send case studies for the web site from their own regions, none were received – the ICE Secretariat at RMIT University developed all of the case studies

and the self-paced learning modules. This lack of unwillingness to provide material and to be involved (beyond membership of the commission) effectively sealed the fate of ICE. Nonetheless, many ethical issues in biology remain unresolved. There are increasing pressures on scientists, especially academics, and these pressures include greater expectations that staff will win large research grants. Unfortunately research grants in bioethics and environmental ethics are rare…

The future

It is evident that our natural environment is still degrading. Guidance on issues such as sustainable practice and environmental ethics are just as necessary now as they have always been. In addition, increased pressure on university staff to *serve industry* has removed many from partaking in the essential role that they once undertook. For in serving industry they have become partial – i.e. a conflict of interest now precludes many from functioning "as critic and conscience of society" (Buckeridge, 2012). There is also pressure, much more pressure, on emerging academics to publish, and to do so in quantity. Not surprisingly, the availability of technology has tempted many to cheat, with the universities currently facing alarming levels of plagiarism and intellectual theft.

There will also be continuing pressures on ecosystems as a result of human population growth; in Australia this is no more effectively demonstrated than in the ongoing competition for space between humans and our extraordinary endemic marsupials (Figure 3).

Figure 3. Biodiversity under pressure. In Australia, nature is under pressure from both increased land subdivision and changing fire regimes due to human intervention. Even if arboreal mammals like the koala survive forest fires, the impact of diminished food sources may still kill. A: The koala - an iconic marsupial of Victoria obtains both its food and moisture from the leaves of eucalypts. These were unavailable for some weeks after the devastating forest fires of February 2009. B: Regrowth 8 weeks after the 2009 forest fire near Marysville, Victoria.

In light of the above, perhaps ICE should not have been decommissioned. Clearly there remains a need for IUBS to demonstrate leadership in the manner in which we manage both natural and human environments. In light of this, an invitation for the commission to exist as a subcommittee within the Biological Education Commission was grasped enthusiastically; indeed, it seemed that much of what ICE had done, and should be doing, lay within the broad domain of education. A gap however still remains – the absence of any formal IUBS structure for guidance on environmental and professional ethics. Although it can be argued that this service is provided (at least in part), by other institutions such as UNESCO and ICSU, there was something special about having a commission dedicated to biology… A decision on whether to pursue this role within the union is something that future IUBS leaders must address.

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In Pursuit of the Biological Imperative
An Intergenerational Approach to Biological Justice

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This paper analyses the relationships between ethics and biology – particularly within the context of the Earth's degrading biosphere. We assess the manner in which humans have valued, and should value past and future human generations – from rational perspectives and as consequence of natural justice. We argue that life on Earth is more than likely unique within the universe, and that as a consequence of this, there is a duty for humans to exercise greater environmental stewardship. On the basis of this, the moral obligations that we have to future generations and ultimately future environments are debated, then confirmed. We conclude with a new biological imperative, in which it is asserted that in nature, justice is inter-temporal and must embrace all life found in the Earth's biosphere.

Key words: environmental ethics; environmental values; ecosystem collapse; environmental justice; biological imperative.

Introduction

> *Society … becomes a partnership not only between those who are living, but between those who are living, those who are dead and those who are to be born.*
>
> Edmund Burke, 1790/2005: 54

Today when biologists contemplate morality, they are as likely as not to believe that human morality or ethical thinking either needs to be, or can be *explained* biologically. It is the kind of sentiment on offer in middlebrow journals like *The Economist* when it asked:

> *Whence morality? That is a question which has troubled philosophers since their subject was invented. Two and a half millennia of debate have, however, failed to produce a satisfactory answer. So now it is time for someone else to have a go … Perhaps [biologists] can eventually do what philosophers have never managed, and explain moral behavior in an intellectually satisfying way.*
>
> (*The Economist,* 21st Feb. 2008)

Contemporary adherents of socio-biology like Jasper Ridley, Richard Dawkins and Sam Harris take something E.O. Wilson said over three decades ago seriously, when he suggested that *the time has come for ethics to be removed temporarily from the hands of the philosophers and biologicized* (Wilson 1975: 562). As Hall (2010) notes, this has merit as there may well be important discoveries to be made or insights gained that help to explain why humans engage in

ethical conduct. Yet the reference by *The Economist* to 'explaining moral behaviour' points to the way the modern socio-biological frame consistently muddles the questions that matter.

The contemporary pursuit by socio-biologists of an explanation for why humans have moral ideas is essentially irrelevant to various western ethical traditions like 'Judaeo-Christianity', virtue ethics, deontic ethics, and utilitarianism. Occasionally, members of the various western ethical traditions have asked where does human ethical practice 'come from'. Over several thousand years various explanations have been offered ranging from 'God', through communal values (e.g., Hegel's *sittlichkeit*), to Bentham's account of rational self-interest. Yet we need to acknowledge how advocates for the variety of rival versions of moral inquiry from Socrates, Plato and Aristotle through St Thomas Aquinas, Spinoza, Bentham, Kant, Mill or Nussbaum have all engaged in a project designed to tease out the core elements of practical reasoning. Practical reasoning takes as its central question the core question of human practice: *What ought I (or we) do?* The archive of the western ethical traditions offers us a treasure trove of ideas, styles of reasoning and guides to good conduct.

That exercise is far removed from the modern socio-biologist project. This is exemplified when Harris *et al.* (2009) argue that the use of fMRI machines identifies the material substrata of ethical decision-making processes. Harris (2010) goes further, claiming that evolutionary neuro-science will actually start to guide our practical choices and that *science can determine human values*. This is a reductionist and narrowly 'rationalistic' exercise designed to show how human affairs in general, and ethical thinking in particular, is essentially the product of objectively observable, measurable and predictable evolutionary and/or neurological structures or processes. Tallis (2011) demonstrates how this makes fundamental mistakes or relies on quite basic logical fallacies. The net effect of this neuro-scientific project is to convert rational inquiry into what we ought to do, into a deterministic and reductionist account of ethical thought represented as a consequence of physiological processes. Just one of the fallacies being perpetrated is illustrated by the analogical proposition that we somehow 'explain' the thought or beauty of a Shakespearean sonnet we are reading on a laptop, only when we can identify 'its' presence in a sequence of electrical pulses in the microprocessor or else in the circuits of the microprocessor. None of the possible explanatory relationships (of causality, correlation or identity) are at play here; just plain old muddled thinking (Tallis, 2011).

Yet this does not mean that there is no connection between ethics and biology. Rather we just need to get that relationship right. In effect rather than biologicize ethics, *we need to ensure that biological science understands its ethical obligations to life.* We argue here that the current relationship between biology and ethics needs to be redefined, and that biologists need to be both more thoughtful and clearer about their moral ideas about the value of life in all of its forms.

This paper has been written essentially for an audience of practicing biologists or life scientists, mindful of the continued salience of what C.P. Snow (1959) called the 'two cultures problem'. In it we engage in a translation exercise to suggest why this large community of scientists might want to more consciously draw on a tradition of environmental ethics that has been evolving since the late 1920s (Jahr, 1927). In

particular it spells out why an ethical framework based on a conception of the intrinsic value of life leads rationally to certain ethical obligations that constitute an ethical biology. We then make the case for an intergenerational approach to securing the future of the biosphere. We start by first clarifying the nature of the ethical.

What is ethical?

In a striking intervention Emanuel Levinas derives the primacy of ethics from the experience of the encounter with the Other. Levinas concludes that it is only in the presence of another person [the Other] that the horizons of our ethical obligations become clear (Levinas, 1961). He is worried about the rationality of any enquiry, in this case, into ethical matters and noted that everyone will readily agree that it is of the highest importance to know whether we are duped or not by morality (Levinas, 1961). Our sense of self or our subjectivity, Levinas argued, is primordially ethical, not theoretical: that is to say, our responsibility for the other is not a derivative feature of our subjectivity, but instead, constitutes our sense of being a particular kind of person in the world by giving it a meaningful direction and orientation. Levinas' account of an 'ethics as first philosophy' means that the traditional philosophical pursuit of knowledge is secondary to a basic ethical duty to the other. For Levinas, the irreducible relation, the epiphany of the encounter with another is a privileged phenomenon: The Other precisely reveals himself in his alterity [otherness] not in a shock negating the I, but as the primordial phenomenon of gentleness. Levinas clearly intends that 'the Other' he has in mind applies to other humans. However, do other life forms constitute such an Other?

Here we confront the long-standing anthropocentric or human-centered dispositions of western ethical thought. Our ethical perspectives either assign intrinsic value to human beings alone (which is a robust form of anthropocentrism) or else insist that humans have more important needs than other life forms, such that promoting human interests or well-being at the expense of nonhuman things is almost always justified – which is a weak anthropocentrism. Further, where the older western traditions have thought about ethical issues affecting non-human life it tended to value things simply as means to further some other ends, rather than to value things as ends in themselves. Conventional western ethical thinkers have had trouble saying what is wrong with the cruel treatment of nonhuman animals or why, except to the extent that such treatment may lead to bad consequences for human beings, which is to say there is a pervasive instrumentalism at work: Kant (1963) suggests that by being persistently cruel towards a dog might encourage development of a character which would be desensitized to cruelty towards humans. From this standpoint, cruelty towards nonhuman animals would be instrumentally, rather than intrinsically, wrong.

It is a truism that biology is the study (or logia- λογία) of life (bios – βιο). To make the case for an ethical biology is to understand that one core question about the study of life is this: what is the value of life – in all of its dimensions and forms?

In light of the current interest in finding intelligent extra-terrestrial life, Paul Davies (2011) makes the point that for all intents and purposes, the nature of life on our planet is unique. Using a Bayesian probabilistic analytic frame, Spiegel and Turner (2011:1) sensibly conclude given the absolute absence of evidence of life anywhere else in the universe that there is an arbitrarily low

intrinsic probability of abiogenesis for plausible uninformative priors. That is, given the complete absence of any evidence to the contrary, the probability that there is another planet 'out there' with intelligent life on it is not much greater than 0. The implication is simple yet striking… the splendid variety of life on Earth is both unique and of incalculable value. The case for an ethical biology rests on this proposition.

Yet more is needed than this blank assertion. We need to consider the project of rationality itself and how a conception of justice might become central to modern biology.

What is rational?

The idea of rational enquiry has a long and complicated history. Scientists working in life and physical sciences may be inclined to define the scientific method as a progressive growth towards truth. This idea was given credence by Popper's (1974) insistence that falsificationism was fundamental to good science. Yet, the basis of this faith has been eroded in the second half of the twentieth century, when societies ceased to host any significant theoretical or moral consensus about the criteria available to assess either factual-truth or practical-ethical claims. Not surprisingly, Habermas (1996: 97) recognises a present-day 'post-metaphysical crisis' where justification of practices 'simply by calling attention to the contexts in which they were handed down' is unacceptable. This is evidenced in controversy about climate change, genetics and the persistent creationist vs. evolutionist debate. As Regh (in Habermas 1996: 8) notes, this is the problem of dealing with a social reality on the one side and a claim of reason (which is sometimes belied by the reality) on the other.

As sanctioned by MacIntyre (1990) rationality is a project most likely to flourish when people enjoy the conditions of freedom of enquiry that define a public space such as a university.

When it is demanded of a university community that it justify itself by specifying what its peculiar and essential function is, that function which if it were not to exist, no other institution could discharge, the response of that community ought to be that universities are places where conceptions of, and standards of rational justification are elaborated, put to work in the detailed practices of enquiry, and themselves rationally evaluated, so that only from a university can the wider society learn how to conduct its own debates, theoretical or practical in a rationally defensible way.

When this constant process of renewal of the capacity for thoughtfulness is nourished and sustained, then those who have access to the university can engage in those distinctive forms of reflexive and deliberative practices that define a democracy whose members engage in and value active citizenship. This formulation while seemingly abstract matters deeply. It may facilitate finding answers to those perpetual questions that affect our capacity to live well (or not so well). For this helps us to determine whether a course of action is truly a good choice:

> *… distinctions between the real and imaginary, the true and the untrue, the good and the bad. Only when such distinctions are deeply embedded in the processes by which individual and social identities are formed is it then possible to deal with the 'real' world as an array of particular social facts and institutions such as the state or the economy.*
> *Hansen* (1993)

Habermas (1996) argues that rationality involves a process of discursive deliberation where ethical claims that might inform normative conduct can be established to arrive at a rational consensus. In determining the facts, Habermas has had to acknowledge the reality of a world that exists and about which truth claims need to be made successfully, while accepting as Kant did, that we can never have direct access to the world without linguistic mediation.

As to the nature of the rationality involved, Dahlberg (2000: 5) says it is possible to formally specify this as 'communicative action', drawing on a formal method in the Kantian sense of attempting to reconstruct the conditions of possibility of communicative interaction. 'Understanding' (verstandigung) is central to communicative action'. At its most basic level, it simply means mutual comprehension, i.e. that people are using the same words with the same meanings so as to achieve a degree of shared meaning and mutual comprehension. At its most elevated, 'understanding' means a shared consensus about the universal validity of claims people make to speak the truth or to know the good. This accomplishment requires that participants need to believe that a rationally motivated agreement could in principle be achieved *…provided e.g. that the argumentation could be conducted openly enough and continued long enough* (Habermas, 1984: 42).

Communicative action firstly requires that everyone potentially affected by an activity be taken into account (Fultner, 2003). Only then can reciprocal testing of problematic validity claims be made. Secondly communicative action presupposes a formal and discursive equality among participants, implying that all parties be given equal opportunity to make claims and question any assertion. Thirdly this entails social equality, a lack of which can affect the capacity of people to fully participate (Habermas, 1996: 308).

Communicative action also requires certain attitudes. So reflexivity is also a condition, for people must be willing to change their minds as they critically examine their own prejudices and beliefs. Finally Habermas (1996: 34) requires that participants in the ideal-speech setting will bring good will to bear – an assumption of honesty, impartiality and respectful listening – to seek to understand rather than provoke disagreement.

These protocols point to ways of ensuring that scientific and ethical discourse might be made to work. We also need to consider how an ethical biology might make a conception of justice central to its practices. If we accept that we need to treat the variety of life in all its forms on our planet as both unique and as possessing inestimable and incalculable value, then we may also accept that justice is at stake in the relationship between the biosphere and ourselves. Though there are many relevant conceptions of justice, one that deserves attention and seems especially relevant to our biosphere is intergenerational justice. When deeply contemplating justice, we confront the need to find a point of 'reflective equilibrium' between description and evaluation Finnis (1980). This requires a descriptive-evaluative anthropology of the goods which inform the good life to be conjoined with a capacity to understand what is really good for humans and what is necessitated by practical reasonableness, i.e. we need also to have clarity about the nature of justice.

What is justice?

Perhaps justice is best understood by asking the question: What do we owe to each other? (Scanlon 2000) At stake here are two issues: who is the 'we'? And what does the idea that we owe something imply? In defining 'we' it may be asserted that as well as the living, the 'we' includes those who are either dead or who are yet to be born. However there is a deep-seated prejudice in favour of excluding both these (Feinberg, 1980; Thompson, 2009). Irrespective of this, justice is inter-temporal – we live in time – and this is embodied in our legislative systems, for justice and lawfulness must extend across time, with the relevant principles, rules and practices moving from the past and into the future. This assumes that there is a temporal intentionality with the operating principles of justice that will extend into the indefinite future. The implications of this, especially in the British System, are simple: legal rights are routinely attributed to persons not yet born.

In light of this there is the presumption that until it is amended, any given law that regulates the conduct of persons alive and future, assumes that the latter have a variety of rights and obligations. Similarly the vast body of common law practice and principles is assumed to codify rules and principles like habeas corpus, the use of juries in various kinds of courts and cases, or the rules about admissible evidence with application out into the future. Subject to the proviso that laws may be amended from time to time, the premise operating is that these basic legal statements are designed and intended to operate into the future with the clear expectation that rights enunciated in a constitution drafted in say 1900, will enunciate those rights for generations yet to be born. Some, like the Constitution of the United States of America (1787), specifically state that the document was ratified to secure the blessings of liberty to ourselves and to posterity. Thus, if legal systems have no trouble in conceiving of the persons not yet born enjoying the benefits of current legislation, it is not clear why some philosophers would override this.

Our justice system enshrines obligations owed to those who have died, those who are alive, and those yet to be born because the practice of justice as temporarily transformative. However, the presence or absence of persons still matters because it affects what we can legitimately expect as we extend our regard for moral obligations, rights and interests beyond the present and look backwards and forwards. At stake here are the choices open to us about the best practice and the goodness of our thinking about why we have chosen this or that kind of justice. Choosing in this case between the kinds of justice we want to enact or practice requires uncommon expertise.

Intergenerational justice: obligations to the not yet born

John Rawls' Theory of Justice marked the proper initiation of obligations to future generations as a topic of salient philosophical interest. More recently, what Barry (1977:204) asks reinforces this intergenerational quality of justice:

> … *can it be said that we should be behaving unjustly if we neglected their interests in deciding how much to use up finite resources, how far to damage the environment in ways that are irreversible or at any rate extremely expensive to reverse, and how much to invest in capital goods or research and development of new technologies (e.g. into non-exhaustible energy sources)?*

Intergenerational justice demands that when opportunities are denied to future

generations because of depletion or other irreversible damage to the environment, others should be created, even if at some cost. There are nonetheless, extraordinary difficulties with this idea of intergenerational justice. Laslett & Fishkin (1992) whilst acknowledging that a good deal of political theory has been produced in the past (and the present) within the grossly simplifying assumptions of a timeless world, conclude that:

> *Principles of justice, equality and utility that yield reasonable conclusions for fixed population sizes over short periods begin to produce bizarre results once cohort sizes or total populations sizes or both vary over time. The implicit contractual relations among generations fail for the same reason.*
> (Laslett & Fishkin, 1992: 6)

There is however a very real problem of knowing precisely whose interests or rights we wish to promote among future generations. That is, how can you attribute rights to people not yet born and who do not exist? In light of this, Beckerman (2004) argues that any sensible conception of rights or justice cannot be applied to persons not yet born. His argument rests on the premise that rights are a property, like being green or owning something. The flaw in this is the fallacy of misplaced concreteness (or reification), which involves treating an abstraction, in this case rights, as if they are a real physical entity or a real event. However:

> … if that were the case, then neither human idiots nor wee babies would have any legal rights at all. Yet it is manifest that both of these classes of intellectual incompetents have legal rights recognized and easily enforced by the courts. Children and idiots start legal proceedings, not on their own direct initiative, but rather through the actions of proxies or attorneys who are empowered to speak in their names.
> Fienberg (1980: 154)

If there is no problem here why should there be in the case where a proxy makes a claim on behalf of people who are not yet born?

But there are issues that this objection raises. For we cannot hope to fully comprehend the cultural values of future generations, although it is highly likely that they will value 'health, longevity, liberty, opportunity and a sustainable natural environment'. Thus the ontic fact is that humans have aims, desires and beliefs, many of which which transcend the present confers upon them their right bearing status (Feinberg 1980).

This is evidenced by a propensity to make a will, stating what is to happen to our body and our property after our death; and the law ensures that posthumous status does not abolish our interests or our rights upon death. Any action we anticipate arises because there is both a legal obligation and a moral obligation.

Finally, when considering obligations to the unborn we should note that contractarians since Rawls (1971: 126-30) have drawn on what Rawls called Hume's 'circumstances of justice' to deny that we have any. Thus, as we have no obligations to such people, they cannot be parties to our contract. This is because there is no possibility of mutually advantageous interaction between those of us alive and those who will be born in the next millennium. While it can be said that the quality of life of future generations depends to a very large extent on the decisions we take, our quality of life cannot be affected at all by the decisions taken by people born in 2050. This objection argues while we can do a great deal for 'posterity',

'posterity' cannot do anything to (or for) us. This was a problem for Rawls who rested his contractualism on the pursuit of self-interest behind the 'veil of ignorance'.

However, it should be noted that Scanlon's (2000) contractualism bypasses this by assuming that all of us are moral agents motivated by a desire to justify ourselves to others. There is no reason why those others need to be people who are currently alive, or perhaps even if they are humans. When deciding how to act, there is no problem in asking whether people born in 2050 will be affected by my actions by rejecting the principle I am relying on to permit those actions. For example, I may want to construct a factory that will release low-level radiation and it seems entirely reasonable to ask whether those who will suffer as a result in the 2050s might reasonably object to my behaviour. Because it works with the possibility of reasonable rejection - rather than actual bargaining - Scanlon's contractualism easily accommodates obligations to future and as yet unborn people.

This brings us full circle. We conclude by defining a moral imperative that places humans a part of (rather than apart from) nature, for it is evident that we have obligations to future generations, and it follows that we have an obligation to not irreversibly compromise their environment (Buckeridge, 2012). Thus the consideration to be adopted in any working model for resource management must be that *in nature, justice is inter-temporal and must embrace all life found in the Earth's biosphere.*

Acknowledgement of this is the biological imperative.

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Biodiversity and Indigenous Knowledge in South Africa: Developments and Ethical Challenges

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The Convention on Biological Diversity (CBD) emphasizes conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources. The CBD has implications for the development of national, regional and international strategies for the conservation and sustainable use of biological diversity. This paper reflects on national developments in South Africa with respect to the conservation of biodiversity, focusing on how researchers, research managers, policy makers and the community and knowledge holders have related to and dealt with various ethical issues related to biodiversity.

The paper also reflects on the establishment of the Intergovernmental Committee on Intellectual property and Genetic Resources, Traditional Knowledge and Folklore (IGC) at the World Intellectual Property Organization (WIPO), exploring how the discussions on genetic resources have advanced and addressed concerns related to biodiversity. The debates on genetic resources are reflected upon together with the developments on traditional knowledge.

The example of the *Hoodia* plant and the related indigenous knowledge in the South African and Southern African contexts is discussed, exploring how the related knowledge has been developed, exploited and protected and in some instances misused and misappropriated. In this context, the developments in indigenous knowledge systems (IKS) in South Africa are reflected upon, analyzing how both the IKS and biodiversity protection have developed in the past few years, indicating how some of the ethical challenges are still not resolved.

Keywords: biodiversity, indigenous knowledge, intellectual property, South Africa, *Hoodia* sp.

The Convention on Biodiversity and its implications

The Convention on Biological Diversity (CBD) was inspired by the world community's growing commitment to sustainable development. It recognizes that the conservation of biological diversity is very important for humankind and is an integral part of the development process. It represents significant progress in the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources. The Convention covers, among others, the following:

- Measures and incentives for the conservation and sustainable use of biological diversity,

- Regulated access to genetic resources and traditional knowledge (indigenous knowledge), including prior informed consent of the party providing resources,
- Sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the Contracting Party providing such resources,
- Access to and transfer of technology, including biotechnology to the governments and local communities that provided indigenous knowledge and biodiversity resources,
- Education and public awareness and
- National reporting on efforts to implement treaty commitments.

The CBD entered into force on 29 December 1993. National Biodiversity Strategies and Action Plans (NBSAPs) are the principal instruments for implementing the Convention at the national level. Article 6 of the Convention, which deals with General Measures for the Conservation and Sustainable use, requires each country to:

(i) Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect *inter alia*, the measures set out in the Convention relating to the Contracting Party concerned, and

(ii) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

The Nagoya Protocol on Access to Genetic Resources and the fair and equitable Sharing of Benefits arising from their Utilization was adopted on 29 October 2010 in Nagoya, Japan. The Protocol is a supplement to the CBD, intended to create greater legal certainty and transparency for both providers and users of genetic resources. The Protocol does not only cover the genetic resources covered by the CBD, but it also covers Traditional Knowledge (TK) associated with the genetic resources that are covered by the CBD and the benefit sharing arising from its utilization. In this paper, we will look at South Africa's response to the Action Plans and illustrate the issue of benefit-sharing and indigenous knowledge research protocols using the *Hoodia* sp. indigenous plant.

Hoodia gordonii found at appetitesuppressantsreviews.com (Accessed on 29 October 2012)

The South African National Biodiversity Strategy Action Plan

South Africa signed and ratified the Convention on Biological Diversity in 1995. The National Biodiversity Strategy and Action Plan (NBSAP) was developed in the period 2003-2005 by the Department of Environmental

Affairs and Tourism (DEAT). It sets out a framework and a plan of action for the conservation and sustainable use of South Africa's biological diversity and the equitable sharing of benefits derived from this use.

The goal of the NBSAP is to conserve and manage terrestrial and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa, now and in the future. In support of this goal, five strategic objectives (SOs) have been identified, each with a number of outcomes and activities.

Strategic Objective 1:
An enabling policy and legislative framework integrates biodiversity management objectives into the economy.

Strategic Objective 2:
Enhanced institutional effectiveness and efficiency ensures good governance in the biodiversity sector.

Strategic Objective 3:
Integrated terrestrial and aquatic management minimizes the impacts of threatening processes on biodiversity, enhances ecosystem services and improves social and economic security.

Strategic Objective 4:
Human development and well-being is enhanced through sustainable use of biological resources and equitable sharing of the benefits.

Strategic Objective 5:
A network of conservation areas conserves a representative sample of biodiversity and maintains key ecological processes across the landscape and seascape.

The NBSAP is very important in the context of South Africa (and Southern Africa). Three globally recognized biodiversity hotspots (areas with especially high concentrations of biodiversity which are under serious threat) are found in South Africa, namely, The Cape floral kingdom, Succulent Karoo (shared with Namibia), and the Maputaland-Pondoland Albany Centre of endemism (shared with Mozambique and Swaziland). Without proper governance and management of the biodiversity resources in these hotspots the ecosystems are under serious threat. Benefit sharing of resources coming from these areas is crucial not only in sharing of 'riches' but also to instill a sense of 'ownership' of conservation areas.

Succulent Karoo found at ekapa.ioisa.org.za (Accessed on 29 October 2012)

Biodiversity Act

The National Environmental Management: Biodiversity Act No. 10 of 2004 was promulgated in South Africa in 2004. The Objectives of the Act are:

(i) To provide for the management and conservation of biological diversity within the Republic and of the components of such biological diversity

(ii) To provide for the use of indigenous biological resources in a sustainable manner

(iii) To provide for the fair and equitable among stakeholders of benefits arising from bio-prospecting in-

volving indigenous biological resources

(iv) To give effect to ratified international agreements relating to biodiversity which are binding on the Republic

(v) To provide for co-operative governance in biodiversity management and conservation

(vi) To provide for a South African National Biodiversity Institute to assist in achieving the objectives of the Act.

Chapter 3 of the Biodiversity Act provides for the integrated and coordinated biodiversity planning, monitoring the conservation status of various components of South Africa's biodiversity, and promotes biodiversity research.

The Intergovernmental Committee on Intellectual Property, Genetic Resources and Folklore

The Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC) was established by the World Intellectual Property Organization (WIPO) Assembly in October 2000 to consider intellectual property in relation to genetic resources, traditional knowledge and folklore. The IGC has met on 22 occasions; the twenty second session took place from 09 – 13 July 2012. Some of the issues that the IGC has been involved in and discussed at the 22 sessions are:

(i) A study on the operational definitions relevant to Traditional Knowledge (TK)

(ii) A review of existing national systems of Intellectual Property (IP) for TK

(iii) An analysis of the elements for a possible *sui generis* system for the protection of TK

(iv) The use of databases to promote defensive protection

(v) The development of an IP management toolkit for the documentation of TK.

The IGC has also provided a platform for countries to share their experiences in IKS. For instance, India has been able to share their experience in the development of the Traditional Knowledge Digital Library (TKDL). The IKS Policy by South Africa was submitted to and discussed at the 9th Session of the IGC in April 2006.

Despite the 22 sessions of the IGC, there is still no consensus about the protection of intellectual property emanating from and related to IKS. This can be partly attributed to individual country interests, those who have benefited from IKS without the willingness on their part to recognize the owners and holders of such knowledge, or even just to appropriately acknowledge the origins of the IK that has served as a basis of modern development. It looks like this impasse will still take some time (an expense!) to be resolved.

Developments in Indigenous Knowledge in South Africa

The present efforts and thrust of Indigenous Knowledge Systems (IKS) can be traced back to an audit of indigenous technologies in South Africa in the period 1996 – 1998. This audit, which was initiated by the Portfolio Committee of Arts, Culture, Science and Technology and carried out under the auspices of the Council

for Scientific and Industrial research (CSIR), was carried out by 9 universities covering 7 Provinces of South Africa. The Universities involved were: University of Venda, University of Limpopo – Turfloop Campus, North West University – Mafikeng Campus, University of Pretoria – Mamelodi Campus, University of South Africa, University of The Free State – Qwaqwa Campus, University of Zululand, Walter Sisulu University, and University of Fort Hare. These audits were guided by the Objectives which were designed jointly by the Portfolio Committee and the CSIR and shared with all the research teams at each participating university (Mosimege, 2003). The 7 provinces in which the audit was carried out are Limpopo, Mpumalanga, North West, Gauteng, Free State, KwaZulu-Natal, and Eastern Cape.

Maputaland-Pondoland Albany Centre of endemism found at http://www.eoearth.org/article/Biological_diversity_in_Maputaland-Pondoland-Albany (Accessed 29 October 2012)

One of the major challenges that emerged in this ground-breaking audit was how to recognise and affirm indigenous knowledge and interact appropriately with knowledge holders. Without doing this correctly, the researchers were facing a challenge of getting very little cooperation from those who hold the knowledge. This could lead to doubts and incorrectness in the data collected. In fact, stories have been told in which knowledge holders deliberately gave incorrect information in order to mislead researchers and in the process protect their knowledge from undue exploitation, bio-piracy, misappropriation and misuse.

Some of the challenges that the research teams in the audit of indigenous technologies faced were:

(i) The role of traditional leaders in the process of interacting with knowledge holders

(ii) The role of knowledge holders and the appropriate ways of interacting with them

(iii) The training of students in research protocols and methodologies that would enable them to:
- interact appropriately with the elders and knowledge holders;
- adequately record knowledge that covers various areas of specialization;
- work collaboratively with students from a variety of disciplines;
- use various indigenous languages necessary for recording the knowledge.

(iv) The recording of the knowledge without violating intellectual property rights of the knowledge holders, and

(v) The appropriate benefit sharing mechanisms on benefits that accrued from the knowledge and the leads provided by knowledge holders.

These challenges still continue to face most of the researchers in IKS. All the issues mentioned above are equally a challenge to researchers in mathematics, science and technology

education who conduct research related to indigenous knowledge.

Among some of the things that emerged at that early stage of research into IKS in South Africa was the composition of research teams. One of the characteristics of IKS is that it is cross cutting, as a result most research teams are comprised of researchers from a variety of focus areas and disciplines. For instance, some of the research teams in the Audit of Indigenous Technologies were comprised of Chemists, Sociologists, Science Educators, Historians, Microbiologists, and Physicists. For mathematics, science and technology education, there needs to be a combination of researchers from disciplines such as biology education, mathematics education, physics education, and others to reflect the cross cutting nature of such disciplines in relation to IKS based research. These kinds of cross-cutting studies are most likely to do justice to the breadth of IKS and would be more meaningful for learners' classrooms experiences.

Since 2000, the Department of Science and Technology (DST) has been supporting research into IKS by making money available through the National Research Foundation (NRF). Most of the researchers who have received financial support for IKS from the NRF have not received it on an individual basis but as part of a research team. The challenge arising out of this development is how to choose or put together a research team that can guarantee greater representation with respect to the focus of research.

The researchers also need to consider the role of knowledge holders and the extent to which they can be actively involved in recording and publishing their knowledge. One of the arguments and concerns that have been consistently voiced by the IKS Unit in the DST since its establishment in 2001 has been about a completely new view with respect to the role of knowledge holders. The challenge and pressure faced by researchers at universities to publish the results of their research tends to force them to disregard the importance of dealing appropriately with knowledge holders and to publish their work without due recognition of the knowledge holders. Research in IKS suggests strongly that it cannot be business as usual in this respect. At the minimal level researchers are called upon to fully acknowledge the sources of their information and where benefits accrue from the research and publication thereof, the knowledge holders also derive benefit.

The *Hoodia* plant: An Example of the challenges and interphase between Biodiversity and IKS

An example that has dominated debates in IKS in South Africa (and other Southern African countries like Botswana, Namibia, and Angola) is that of the *Hoodia* cactus. This case has succinctly brought into focus the issues relating to IKS and appropriate benefit sharing with the knowledge holders. Maharaj, Senabe and Horak (2008) indicate that the *Hoodia* illustrates the potential of bioprospecting produce significant economic and social benefits for a nation. It has also clearly demonstrated the importance of collaboration between countries on protection of indigenous knowledge.

Since time immemorial, the succulent *Hoodia* has grown in the Kalahari Desert in Southern Africa and has been eaten by San community members during their long hunting trips. It is a

good example of a plant that all generations of San have learnt about from their forebears. The *Hoodia* sap can be used to treat eye infections, the brew of boiled *Hoodia* pieces can be used to treat severe stomach pain, the *Hoodia* suppresses hunger and helps to maintain a high energy level (Kxao Moses + Oma, 2003). In 2001, the CSIR patented the active ingredient of the *Hoodia gordonii* succulent as an appetite suppressant. In March 2003, after many rounds of negotiations, the CSIR signed a benefit sharing agreement with the San Council which stated that the CSIR would pay the San 8% of all milestone payments it receives from its licensee, UK-based Phytopharm plc, as well 6% of all royalties that the CSIR receives once the drug is commercially available. This benefit-sharing model ensures that the San will receive equitable benefits if the drug is successfully commercialised, and is based on established international benefit sharing models for the pharmaceutical industry.

The Cape Floral Kingdom found at nedbank.co.za (Accessed on 29 October 2012)

In an analysis of the Benefit-Sharing Agreement between the CSIR and the San Community, Wynberg (2004) points out that one of the major concerns regarding the Agreement is that it prevents the South African San from using their knowledge of the *Hoodia* in any other commercial application. So even though the Agreement was an important milestone in terms of benefit sharing, it had other effects that disempowered the San Community.

At the beginning of December 2010, newspapers in South Africa reported that Phytopharm had handed the commercialization rights to the *Hoodia* plant back the CSIR. The CSIR had to decide whether future research was viable after safety concerns were raised by Unilever two years before. It is also important to note that the San Community has received milestone payments of R500m thus far. In our opinion, part of benefit sharing should also involve uplifting and empowering of communities in more ways than just "paying" communities for their IK. How do communities deal with the sudden "wealth" and what are the long term impacts of the monies on the community?

Ethical Challenges for Southern Africa

The following two anecdotes help to reveal some of the protocols and ethical considerations necessary when doing research in IKS.

At the Provincial IKS workshops that were held in 1997 and 1998 by each University involved in the audit (these provincial workshops were held prior to the first National Workshop on IKS at the Mafikeng Campus of North West University in September 1998), some students reported that they could not get any assistance from knowledge holders if they did not indicate clearly that they had received permission from the Traditional Leader (Chief of the community) to visit the communities and conduct the research. Most students who followed appropriate protocols that prevail when doing research in such communities, found a lot of support and information from the knowledge holders.

In 1998 and 1999 the Portfolio Committee on Arts, Culture, Science and Technology undertook a visit to

communities in Limpopo, Mpumalanga, and North West Provinces to meet and interact with a variety of traditional leaders and knowledge holders. Some of the comments that were made by community members and various knowledge holders indicated that without prior permission of the traditional leaders they would have found it very difficult to cooperate with us. In fact, some of the knowledge holders refuse to cooperate with researchers or refused to provide the correct information regarding their knowledge when these protocols were breached.

The protocols mentioned in the two anecdotes suggest that when IKS related research is conducted, there are certain minimum requirements that need to be followed and observed if any meaningful contribution is to result from the interaction. One of the minimum requirements is observation of protocol with respect to the role of traditional leaders in access to knowledge holders and the protection and promotion of indigenous knowledge.

In 1993, the Royal Commission on Aboriginal Peoples (RCAP) in Canada, with the advice of Aboriginal and non-Aboriginal researchers, formulated a set of ethical guidelines to guide its research (RCAP, 1996). The guidelines included the following:

(i) Aboriginal peoples have distinctive perspectives and understandings, which are derived from their knowledge, culture, and history and which are embodied in Aboriginal languages. Those researching Aboriginal experiences must respect these perspectives and understandings.

(ii) Researchers must observe appropriate protocol when communicating with Aboriginal communities.

(iii) The oral traditions and teachings of Aboriginal peoples must be viewed by researchers as valuable research resources, along with documentary and other sources.

(iv) Proficiency in Aboriginal languages should always be an issue in Aboriginal research projects.

Even though these guidelines were designed for interaction with Aboriginal Peoples in Canada, they largely apply to any indigenous community in any part of the world. Linguistic competence is a requisite for research in indigenous issues. Battiste and Henderson state it very strongly and correctly that:

> "Researchers cannot rely on colonial languages to define indigenous reality…Indigenous languages offer not just a communication tool for unlocking knowledge, they also offer a theory for understanding that knowledge and an unfolding paradigmatic process for restoration and healing (2000:133)."

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Effective Biodiversity Conservation Challenges in Africa: A Case of East Africa

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In Africa over seventy percent of the population depends on natural resources for their livelihoods. Natural resources play a critical role in providing food, shelter, and income for rural populations. In Uganda, eighty-eight percent of the population lives outside urban areas and relies on natural resources to some degree for their livelihoods. Despite this wealth of natural resources however, many local populations remain poor and marginalized. Natural resource revenues traditionally accrue to central governments rather than local governments or local populations. These poor populations in natural resource rich districts are often the stewards and guardians of these resources, but central government remains the major beneficiary. Decentralization reforms are often promoted as a means to rectify this imbalance and to ensure that local governments and local institutions receive some of the benefits of their natural resources. The drive to support current human needs in the contemporary world places multiple and often competing demands on ecosystems. Despite significant environmental change, Africa still has a considerable significant store of biodiversity. However, the challenges today are key in promoting sustainable natural resource use and to ensure that the rate of extraction including development process remains within the limits of sustainability. Strategies to ensure sustainability may rely on a combination of protection strategies including protected areas and conservation measures within *in situ* and *ex situ*. Governance affects within the institutional frameworks in the East Africa region requires a coherent approach to effectively conserve biodiversity. Current developments of non-renewable resources increase pressure on fragile ecosystems in their deposits. The implementation of CBD is inadequate in the region. There is a need to harmonize development requirements with necessary legal regimes.

Keywords: Biodiversity, conservation challenges

Introduction

The Convention on Biological Diversity (CBD) defines biodiversity as the range of organisms present in a particular ecological community or system. However, this is further interpreted as the totality of genes, species and ecosystems (CBD, 1992). Accordingly, biodiversity is a measure of the abundance and diversity of organisms within a system, i.e., including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Biodiversity is a widely recognized priority for global conservation and a focus for environmental studies. It is thus broadly applied in different contexts encompassing all life on earth and the contexts may overlap depending on legal, political, social, economic or cultural contexts (Medley, 2009).

While human life unquestionably depends on healthy ecosystems that supply life-sustaining resources and absorb wastes, current growth and consumption patterns in East Africa are placing increasing stress on

ecosystems. Land degradation, biodiversity loss, deforestation and wetland destruction are among the most visible indicators of stressed ecosystems. The relationship between poverty and environment in Africa is best understood in the context of people's livelihoods, especially the poor who constitute a considerable percent of the population (Pain *et al*, 2005, Tabuti, 2006, Chapman *et al*, 2009). Land degradation, biodiversity loss, deforestation and wetland destruction, are among the most visible indicators of stressed ecosystems. The relationship between poverty and environment in Africa is best understood in the context of people's livelihoods, especially the poor who constitute a considerable percent of the population (Appleton, 2001, Molleman *et al*, 2004). The activities of the rural poor have significant implications on the environment. The poor generally live off the land on which they grow crops for subsistence and sale, graze their livestock, and obtain wood for cooking, lighting and construction of houses. Since they depend on the land for most of their needs, they tend to use the land intensively, leading to degradation. As the land deteriorates, the poor become poorer (MFPED, 1999a). This leads to the well-known vicious circle of poverty (WSSD, 2002).

Status of biodiversity in East Africa

East Africa comprises three countries: Uganda, Kenya and Tanzania (Figure 1). Of these Uganda is a land locked country, located in an area where seven of Africa's distinct biogeographic regions or phytochoria converge (White, 1983). Given Uganda's location in a zone between the ecological communities that are characteristic of the drier East African savannas and the more moist West African rain forests, combined with high altitude ranges, the country has a high biodiversity. Updates on the 2001 status of environment assessment include less known taxa such as Fungi (Amori *et al*, 2011). Updates on the 2001 status of environment assessment include less known taxa such as Fungi (Ipulet and Ryvarden, 2005), fish, earthworms and others. Because of various threats, several species are included on IUCN Red lists. Uganda remains exceptionally important in terms of biodiversity occurrence of 18,783 species (NEMA, 2006). Amori *et al*, (2011), further urges that some of the biodiversity that accounts for over 50% of the total number of species is overlooked and threatened at a global scale currently.

Although the country covers just 241,551 km^2 and accounts for only 0.18% of the world's terrestrial and freshwater surface, Uganda harbors 4.6% of the dragonflies, 6.8% of the butterflies, 7.5% of the mammals, and 10.2% of the bird species globally recognized. Uganda has more species of primates than anywhere else on Earth of similar area. For example, Kibale Forest National Park covering 760 km^2 has 12 species of primates. In two Ugandan forests only (Bwindi Impenetrable Forest and Kibale Forest National Parks) 173 species of Polypore Fungi, which is 16% of the total species known from North America, Tropical Africa and Europe are reported. Some components of biodiversity in Uganda such as belowground biodiversity are poorly known. Work on these groups is only at the initial stages, carried out mainly by universities and research institutes but constrained by a shortage of research funds. Improved knowledge of such elements of biodiversity could raise biodiversity levels

considerably and need to be better understood.

Over time, a high proportion of the vegetation of Uganda has been modified by cutting, cultivation, burning, grazing and other anthropogenic actions, and many of these vegetation types have been significantly reduced in quality and range over time. The National Biomass Study (1996) shows how much this has changed and what remains. The situation has no doubt deteriorated further from the natural state since 1996. In terms of biodiversity conservation, it is the remaining naturally vegetated areas that contain the bulk of the species and ecosystems of particular concern. Many of these remaining natural areas are found only where they have been protected from human encroachment and other disturbances in officially designated protected areas or areas of protected private/public land. The remaining natural areas of Uganda include various subsets of forests, wetlands, grasslands/savannas and open water. However, ongoing development of mining in different parts of the country, particularly in the Albertine rift and other parts of the country, threatens biodiversity current status. Moreover, Uganda's critically endangered plants are threatened by habitat loss and degradation from small-holder farming (Tabuti, 2007), large-scale plantations, clear-cutting wood extraction, infrastructure development and local and international harvest and trade (IUCN *et al*, 2004, Chapman *et al*, 2010).

Kenya's biological resources are diverse, with an estimated 35,000 known species of animals, plants and micro-organisms (Burgess *et al*, 2005). As Kenya gears itself towards industrial development, the importance of its biological resources cannot be overemphasized. Whether in the provision of food, industrial inputs, pulpwood, firewood, construction materials, medicines, ecosystem functions, or aesthetic, the conservation and sustainable utilization of biodiversity is a key factor in the country's stated goal of industrializing early in this century. These resources form the basic source of livelihood for the country's population especially in view of the fact that about 80% of the country's population directly or indirectly relies on biodiversity for survival. Kenya is rich in nature reserves and national parks where wildlife is protected. In the Mara region in the south of the country, the Masai face a double challenge: they must share space with the wild animals that bring in the tourists and make a living from the land. It is hard to strike a balance between the rival claims of biodiversity and economic and social development.

Tanzania is located between 1^{O}S to 12^{O}S and 30^{O}E to 40^{O}E in Eastern Africa. It is composed of Mainland Tanzania and Zanzibar with a total area of 945,087 km^2. It shares borders with Kenya and Uganda in the North; Rwanda, Burundi and Democratic Republic of Congo in the West; Zambia and Malawi in the Southwest and Mozambique in the South; and Indian Ocean in the East. Some 40km offshore are the islands of Zanzibar (Unguja and Pemba) and Mafia (to the South), plus numerous smaller islands. The natural ecosystems of forests, savannah, pastures and rangelands, wetlands, rivers, lakes and the ocean of Tanzania form the basis of its natural resource wealth. Measures of biodiversity show that the country is very rich biologically, but it is one of the fourteen biodiversity hotspots in the world (Kariuki *et al*, 2008).

Out of 25 globally known biodiversity hotspots, Tanzania harbors six: the Eastern Arc old Block-Mountain Forests (Usambara, Nguru, Uluguru, Ukaguru and Udzungwa Mountains); the Coastal forests such as Pugu, Rondo; the Great Lakes for Cichlid fishes (lakes Victoria, Tanganyika and Nyasa); the marine coral reef ecosystems; the ecosystems of the alkaline Rift-Valley Lakes such as Natron and Eyasi; and, the grassland savannas for large mammals, for example, harboring the famous Serengeti National Park. About a quarter of Tanzania's land area is covered by unique ecosystems in form of forest reserves, national parks and game reserves. Tanzania has also registered increasing biodiversity loss due to inadequate alternatives of energy sources, poverty, and low level of awareness, deforestation, wetland degradation due to population growth and encroaching human settlements, selective tree harvesting for wood products, poaching and inappropriate fishing gears and harmful techniques such as use of poisonous chemicals (NEMC, 2001).

Biodiversity directly and indirectly affects human development even though it is rarely linked to the development index of human populations (Moyini and Yaroni, 2001). According to some reports, 40% of the global market of goods and services are sustained by biodiversity. The World Commission on Forests and Sustainable Development views the continued focus on short-term economic growth at the expense of long term sustainability to be a futile exercise. This is because biodiversity underpins human development. It impacts natural processes thereby impacting human life in different ways. Indeed, all people somehow depend on biodiversity components for their food, shelter and clothing. Further, biodiversity provides intangible benefits, among them: spiritual and aesthetic values, supporting knowledge systems, education, industrial raw materials and processes and innovation.

Effective ways of biodiversity conservation in East Africa

The East African Community has been revitalized in the last decade in attempting to integrate regional development programs. This integration has helped country members to bring environmental issues at the fore in their national development plans.

In Uganda, Moyini and Yaroni (2001) recorded that the contribution of biodiversity to economic growth is not adequately recognized because much of the economic value that it generates is unrecorded in official statistics. According to Uganda Investment Authority (UIA, 2012), Uganda has placed 240,000km^2 of land under protection with 10 national parks and 12 game reserves, with a further 2.4 million hectares under forestry. Policies such as that of environment, forestry, wetlands, land use, wildlife policies among others have been developed. Governance systems in Uganda have seen a progressive process of institutionalization and autonomous management. Some of these include Forest Department to National Forest Authority, Department of Game parks to Uganda Wildlife Authority, Department of Environment to National Environment Management Authority in the last two decades.

Kenya has put aside a total area of 12.3% under protected area (IUCN 2003). Under this area there is known information on numbers of total known species, threatened species, breeding birds, mammals, higher plants and status of species. Kenya harbors UNEP headquarters that has given her and

the whole region a unique exposure on environmental information and management of natural resources. International conventions and agreements have been ratified such as CITES, Ramsar convention, CBD to mention but few (Earth trends 2003). Further steps have been undertaken and developed indicators and grouped them in such a way that they assess changes in forest quality, cover, presence and abundance of threatened species, national legislation and ecosystem services, changes in extraction intensity, human population and fire frequency changes in forest management effectiveness, actions and research targeting key species and investment in the region of the biodiversity in the East Africa (Kairuki *et al,* 2008). East African countries have used the environmental assessment tools to assess impacts of the development projects on the physical, biological, socio-economic and cultural aspects of the environment; site specific biodiversity loss has been increasing in the development project implemented areas. Article 111(1) of the Treaty for the Establishment of the EAC recognizes that development activities may have negative impacts on the environment, often leading to degradation and depletion of natural resources and that a clean and healthy environment is a prerequisite for sustainable development. This is reflected in Development Objective 1.15: Establish sustainable environmental management and economic utilization of natural resources (SO5).

Tanzania is currently addressing four challenges to wildlife and biodiversity conservation, identified as priority issues in the country. These include natural resource extraction, interaction of human livelihoods, sustainable development and conservation, climate change and land use and land cover change. In order to address these challenges the Wildlife Conservation Society has set key five objectives in the coming few years: to investigate the potential implications of climate change on biodiversity in key sites across; to identify and assist in the conservation of key wildlife corridors; to explore and develop the efficacy of the Payment for Ecosystem Services conservation tools; to further to develop marine/lacustrine components; assist the Government in the design and setting of herpes to fauna export quotas.

Methods

Location of East Africa

The three countries of East Africa region, Uganda, Kenya and Tanzania, border with Southern Sudan in the north, Democratic Republic of Congo (DRC) in the west, Malawi and Mozambique in the south and Indian ocean in the east (Figure 1). There are unique main land mark features in the region and they include, Mt. Kilimanjaro, Mt. Kenya, Rwenzori Mountains, Lake Victoria, Lake Tanganyika, River Nile, and East African Great Rift Valley. Generally, East African region supports a total human population of about 117.1 million people. Among this population there are area communities that have unique cultures, such as the Maasai tribe that is shared between Kenya and Tanzania. While Uganda tropical rain forests in the Albertine rift were once dominated by gorillas, now the pygmies (Batwa) and Kalamajong dominate in the semi area desert of north eastern Uganda. The area receives an average rain fall of 1000mm annually and supports agricultural production (Figures 2 & 3).

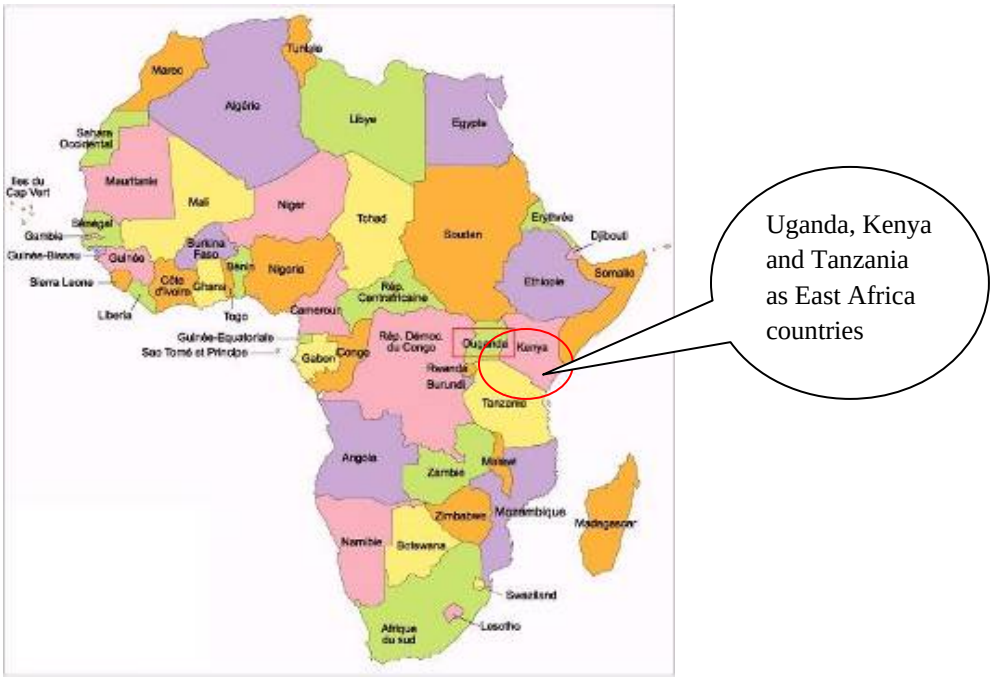

Figure 1: A map of Africa a red ring indicates location of East Africa region

Biodiversity in East African countries


Figure 2: The biodiversity of Albertine Rift, left is the Silverback Gorilla in Bwindi Impenetrable Forest Uganda.



Figure 3: African Giraffe dominant in Katavi National Park Tanzania and Carnivores in Nairobi National Park in Kenya

Some observations and questionnaires were circulated to different organizations that are members of the African Union Conservationists (AUC) to respond in East Africa though the respondents' number was very small and statistical analysis was disregarded. The data regarding biodiversity was derived from a literature analysis. Challenges were discussed by masters' students of Natural Resource Assessment and Management at the Institute of Resource Assessment, University of Dar es Salaam. The effective conservation in East Africa, as it supports human development and its impacts, follows. Most respondents recorded that biodiversity is the basis for life on three East Africa countries. In the last section, the paper presents proposals on best practices that support biodiversity conservation in the three countries and beyond.

Results

Challenges

Increased consumption patterns per capita has accelerated tremendous pressure on biological resources due to inadequate knowledge about its importance and value. This has led to unsustainable exploitation of Earth's biological diversity, exacerbated by climate change, ocean acidification, and other anthropogenic environmental impacts (Uprety, 2005, Rands *et al*, 2010). In Africa, there is increasing pressure on biodiversity from various sources, and as forests neither speak nor retaliate immediately, infrastructure development projects have increased forest fragmentation and degradation (Katebaka *et al*, 2010). Furthermore, nobody pays for forest loss as forests are a public property. In such a case, the tragedy of commons started and continues. Most of the projects are either implemented or pass through the forests and they mostly emphasize clear felling of plants. This has not only dissected/fragmented the habitat but also has accelerated the loss of species without knowing their present and future values (FAO, 2010).

Key East Africa challenges are met by many environment and development organizations especially non-government organizations. Some of these lack sufficient time and resources to undertake a genuine analysis of existing environmental, biodiversity, natural resources challenges in areas they work in, including the underlying causes. It is difficult to start mainstreaming biodiversity, without focusing on relations in local communities which generally possess deeply embedded social, political and cultural structures. Addressing these requires a long-term and careful approach. Quite often many existing tools and guidelines on environment management in institutions are non-specific. They are not easy to apply to the local contexts in which organizations work. In reality, conservation issues are complex and highly context-specific. However, the international community has also made significant contributions to encourage national governments and non-governmental organizations to expand activities in conserving biodiversity.

Nowadays, with rising expectations, greater productivity is expected. Consequently, agricultural landscapes are changing, gradually in some places but rapidly in others, through the conversion of natural vegetation into fields and pastures, rendering the remaining natural habitats smaller, more fragmented, and less diverse, inevitably leading to the loss of biodiversity (Bolwig *et al*, 2004, Tabuti, 2007, Chapman *et al*, 2010). The economics of biodiversity attempts to find ways to meet people's

current needs equitably and efficiently without diminishing the amount and diversity of scarce biological resources available for future generations (Reinjntjes *et al*, 1992). Today, the question of agricultural production has evolved from a purely technical one to a more complex one characterized by social, cultural, political and economic dimensions. Sustainable agriculture is a relatively recent response to the decline in the quality of the natural resource base associated with modern agriculture (McIsaac and Edwards 1994, Tabuti, 2007). A wider understanding of the agricultural context requires the study between agriculture, the global environment and social systems given that agricultural development results from the complex interaction of a multitude of factors. It is through this deeper understanding of the ecology of agricultural systems that doors will open to new management options more in tune with the objectives of a truly sustainable agriculture whilst conserving biodiversity.

Incorporating biodiversity concerns into economics involves introducing concepts of sustainability into the basic economic problem of unlimited wants and scarce resources. Rapid biodiversity loss in most parts of East Africa is part of a general shift in the bundle of ecosystem services towards increasing supplies of food (and feed and fiber) at the expense of benefits derived from other services, such as the provision of nonfood goods (genetic resources, fresh water, fuel wood), regulation of ecosystem processes (climate, disease and flood control), cultural benefits, and life supporting services (soil formation, nutrient cycling, pollination) (Millennium Ecosystem Assessment, 2002). How to minimize such trade-offs and at a reasonable cost is a key challenge for achieving sustainable development of the region.

Many civil society organizations in Africa are acknowledged for the important role of advocacy in their work on environmental conservation and development issues. At the same time, they have demonstrated key expertise and they are struggling to find practical ways to start addressing biodiversity conservation in their specific field of work. However, challenges remain such as being considered alarmists within the local existing systems.

Success of biodiversity conservation

East Africa has given utmost importance to biodiversity conservation over the last two decades. This can be observed in the large number of civil society organizations engaged in the conservation work. Changes in the ecosystems are gradual and in principle detectable and predictable, yet, the monitoring biodiversity trends and outcomes has been particularly challenging to the global conservation fraternity (World Bank, 2004). However, Uganda has successfully implemented the CBD by considering assessment and providing a country-driven consideration of the status and trends of biodiversity. This follows Article 14 of the CBD – urging parties to conserve biodiversity through impact assessment.

Relative to the resources available, Kenya conducts a wide range of effective identification and monitoring activities, coordination and direction. This results mainly from a situation of overlapping mandates without any umbrella. Consequently, they are currently implementing the Environment Management and Coordination Act 2000, with two articles of particular relevance. However,

Uganda and Kenya implemented a FACE project in Mt. Elgon that enhanced effective biodiversity conservation. There is some considerable collaboration to monitor biodiversity between Kenya and Tanzania in critical ecosystems. These have been standardized for sustainable biodiversity monitoring system in the Eastern Arc Mountains and Coastal forests of Kenya and Tanzania region (Kariuki *et al*, 2008). Ultimately, it is hoped that in the long-term actual biodiversity monitoring will be embedded into future core and routine conservation and research activities/ programmes by governments, and other conservation agencies and community based organizations operating across the region.

Conclusion

Increasing human activities are currently threatening biodiversity, for example, failing conservation initiatives and agricultural intensification clearly lead to a loss of species. However, it is still important to note that agriculture entirely depends on biodiversity interaction such as pollination. This enhances the ecosystem services and is of major significance. Globally, 'pollination services' have an estimated annual value of US$112 billion (de Marco & Coelho, 2004) but specific data for Africa are very sparse. Therefore, agricultural practice that allows co-existence of biodiversity should be promoted.

All East African countries are rich in terms of mineral resources with Uganda currently leading in oil and gas development in the Albertine Rift where most of the Africa's endemics have been recorded. Tanzania is even richer with vast mineral deposits. The current trend of mineral development is increasingly threatening biodiversity since most of conservation areas are rich in mineral deposits. Infrastructure development such as roads, hydro-power dams, hotels in the protected areas will almost certainly impact badly on biodiversity. Developments that place emphasis on biodiversity conservation are much needed in the region.

Poverty is related to population increase where the poor derive most of their livelihood directly from environment. Whilst 'win-win' situations are politically attractive, present evidence, for example, (Nkonya & Pender, 2003), has found few strategies that would lead to higher household incomes without, are at the same time, degrading natural resources. Some sorts of agroforestry may be exceptions, but much more needs to be known about which kinds, and what prospects they have for being widely adopted. Some agricultural practices, such as organic farming and minimum tillage, as well as crop diversity, may be beneficial both to farmers and to biodiversity. Rands *et al*, (2010) argue that effective conservation of biodiversity is essential for human survival and the maintenance of ecosystem processes.

Despite some conservation successes (especially at local scales) and increasing public and government interest in living sustainably, biodiversity continues to decline. Therefore, good conservation planning must be reinforced and adequately financed. In addition, more radical changes are required that recognize biodiversity as a global public good, that integrate biodiversity conservation into policies and decision frameworks for resource production and consumption, and that focus on wider institutional and societal changes to enable more effective implementation of policy.

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Environmental Awareness and Conservation of Biological Resources in Egypt: A Review of Moves to Improve the Ethical Management of Our Ecosystems

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During the past three decades, Egypt has paid increasing attention to environmental issues at both official and popular levels aiming to improve the ethical management of our ecosystems and which are affected by many factors. The Egyptian environmental affairs agency (EEAA) was developed in 1980 for setting and implementing national environmental policies including conservation of biological resources and natural heritage, and, preservation of genetic resources of living species, animals or plants that are threatened with extinction. Challenges facing nature conservation include an absence of public awareness, which necessitates raising the efficiency of environmental education. A network of 27 protected areas of protectorates, extending over 15% of the total area of Egypt, is now established and these include over 20,000 flora and fauna species. Problems facing these protectorates and their management are discussed. The introduction of genetically modified crops (GM) is still limited due to the uncertain impact on the environment and biodiversity. Methods to raise the efficiency of the current management policy of our ecosystems are discussed.

Keywords: ethical management, ecosystems, protectorates, biological resources, biodiversity, GM crops

Introduction

Since prehistoric times, Egypt has relied upon its wealth of natural resources to sustain its civilization. In the 21st century, biodiversity has come to be recognized as integral to the health, human welfare and prosperity of the country. The challenge facing Egypt is how to balance the needs of a populous developing nation with protection of its biodiversity. Egypt has made great strides in relation to environmental issues aiming to improve the ethical management of our ecosystems. Environmental education and ethics represent the central focus of this study; importantly, these vary from culture to culture and are influenced by many factors. There is growing recognition among many that environmental awareness alone is not enough. Education that provides the knowledge, skills and motivation to take individual and collective action is needed to improve the environment and create equality of life that is sustainable.

Environmental Education in Egypt:

Environmental education (EE) focusing on the whole ecosystem leads concretely to the quality of life today and for future generations. This is a critical component in Egyptian Government development policies. The importance of environmental education is emphasized everywhere as one of the most effective ways to meet the different complicated problems of environment.

The main goals of environmental education are to:

- Foster clear awareness of and concern about economic, social, political and ecological

interdependence in urban and rural areas.

- Provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.
- Create new patterns of individual, group, and society behavior as a whole that shows concern for the environment and understands the means of its proper management.

The Egyptian environmental action plan has specifically considered environmental education and environmental awareness as major lines of activity (UNESCO, 1999). It has been a concern ever since the Stockholm Conference (1972) and environmentally oriented curricula have been planned and implemented in the education system at all levels. Environmental ethics are influenced by societal, theological and environmental factors. These ethics are reflected in values that avoid causing any harm to human, plants, animals, and natural systems. Legislation and regulations related to the conservation of the environment have been issued and mass media releases have heavily stressed these values.

Concern over the environmental situation in Egypt has taken the form of fostering environmental awareness in schools and other formal settings. A policy was adopted to encourage the establishment of departments and chairs in the university for environmental studies. Courses given to university students have dealt with basic environmental sciences covering issues of ecosystems, water, human settlements, pollution, energy, biodiversity and environmental management. These courses clarify the future responsibilities of the students whether they will be engineers of different specialties, medical doctors, lawyers, agriculture extension service, engineers, social workers or economists. Graduate institutes have been established for environmental studies. Research in some universities offer diplomas, masters, and Ph.D. degrees in environmental sciences with different specialties. At university administration level, a vice presidential post was initiated few years ago and this person is responsible for the environment and extended services of society. Another post has been also added at the college level for a vice-dean for environmental affairs.

The success of this trend and its impact however is still limited. There is lack of awareness among citizens as to the interrelated nature of all human activities and the environment. Unwise use of resources, all sorts of pollution, imbalance between population growth and available resources, spread of many diseases, destruction of land and its abuse are just a few examples (USAID, 2010).

Environmental education must be a continuous lifelong process, beginning at the pre-school level and extending through all formal and non-formal stages.

Environmental Problems

In Egypt, there are some major environmental problems: Egypt has undergone huge changes during the last few years with a rise of population to over 80 million today. It suffers from rapid expansion of urban centers and these have placed great stress on the environment, health and quality of life in general (USAID, 2010). The main problems are as follows:

- Dramatic population explosion has led to greater demands for food production, housing, education, health services, land use and water resources and this has a long lasting

impact on the environment and natural resources.

- Industrialization has resulted in a rapid deterioration of environment due to improper choice of locations for new industrial centers and this places great stress on the environment, health and quality of life.
- Intensive agriculture has led to widespread use of agricultural chemicals, in the form of fertilizers and pesticides; residues have seeped into irrigation and drainage systems leading to habitat destruction of many species of wild plants and animals.
- Excessive hunting of animals and harvesting of plants is a major source of threat to biodiversity, and has led to several species of resident and migratory birds and number of hoofed animals becoming endangered (*e.g.* gazelles and ibex).
- Climate change is expected to contribute largely to degradation and loss of biodiversity.
- Agricultural lands are disappearing beneath urban sprawl.
- Water quality is diminished by lack of sanitation facilities as well by industrial pollution, and run-off from agricultural lands.
- Water quantity is an issue. The volume of water released by the high dam is set at 55 billion cubic meters of water per year (the Nile is the principal water source), less than the global recommended daily minimum requirement per person/year. Yet, the demand for water from all sectors is ever increasing.
- Air quality is also a challenge despite the significant efforts to curb vehicle and industrial emissions and to reduce the practice of burning agricultural wastes in the fields.
- Solid waste is a challenge. Despite large-scale commercial ventures and individuals who reuse and recycle this waste, full success is not achieved.

It is evident that many of these problems are caused by a lack of environmental awareness. Several non-governmental organizations have been working in this area but efforts have been scattered and not of sufficient scale to gain support for environmental education. There is a need to increase public sensitivity to environment problems and sense of personal responsibility at all stages of education.

Available Resources

Despite all these problems, Egypt has major comparative advantages, which should dictate investment priorities for sustainable development: its climate, with its 360 days of solar radiation and powerful winds is becoming a substantial source of clean renewable energy. Its large coastal and maritime zones are among the most valuable resources of the future. In addition to tourism, dry land technologies open new avenues for valuable investments in coastal zones. As marine technologies for exploiting and farming the sea are rapidly developing, marine resources may prove to be prime economic assets. The country's historic and cultural heritage as a major world civilization, and its people - the heirs of cultural values and the wisdom and resilience of their ancestors, also represent valuable resources.

Egypt covers a land area of over 1 million km2with an annual rainfall in most parts of less than 50 mm. It possesses a wide range of habitats and species representing both tropical and Mediterranean environments in

addition to other heritage resources of value to all mankind. Some are geological – such as the skeletons of whales in Western Desert, while other sites represent the Stone Age about 10,000 years ago. These resources have been affected by development pressures in recent years including disposal of solid waste, over fishing and over grazing, habitat fragmentation and invasive species. There are also many species of global importance. Efforts have been made to assess the current state of biodiversity in Egypt to follow up any losses. This includes preparation of an Egyptian faunal and floral inventory that includes habitat diversity, species distribution and an assessment of the abundance and vulnerability of all taxa – including microorganisms.

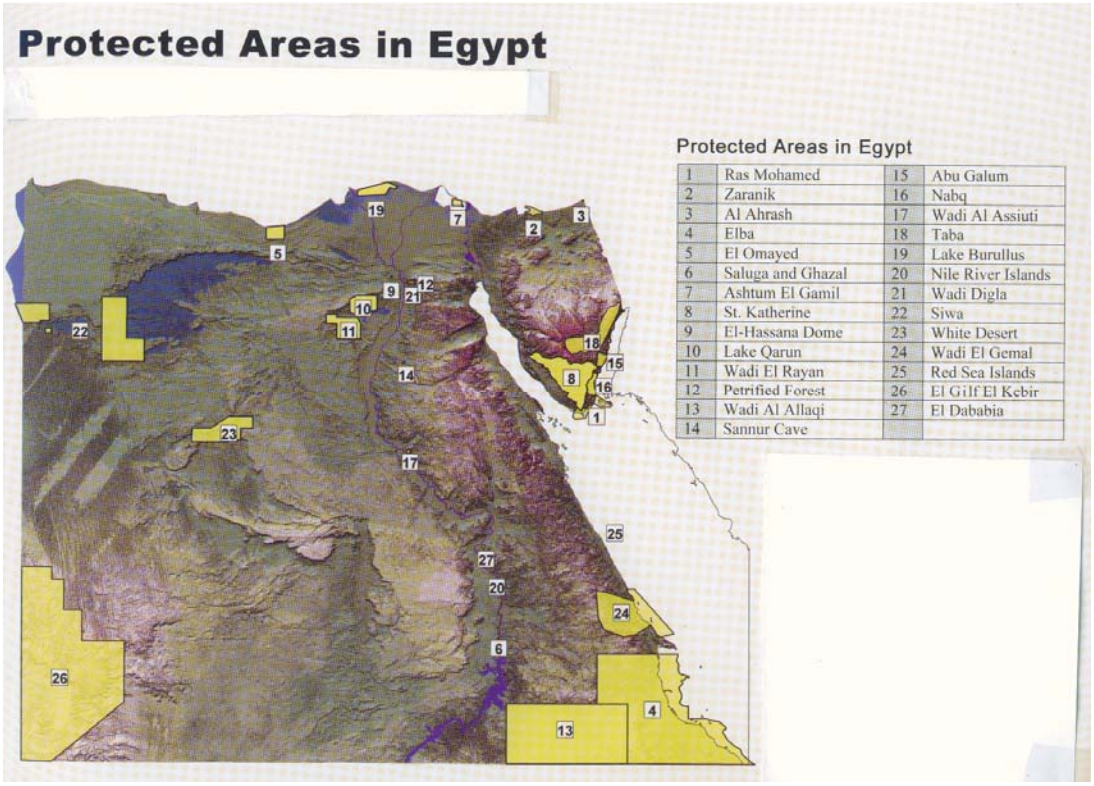

Fig. 1: Distribution of Protectorates in Egypt (from Francis Gilbeert & Samy Zalat) (2007).

Biodiversity Conservation Strategies

In 1982 Egypt energetically began formulating the national body responsible for environmental issues in collaboration with all other concerned bodies; this is the Egyptian Environmental Affairs Agency (EEAA) (El-Badry, 1996). This represents the primary legislation for environmental management. It is of interest to note that ancient Egyptians were among the first to adopt measures for nature conservation.

A national biodiversity strategy was established aiming to conserve and to sustainably manage our natural heritage. Conservation of critical ecosystems and biodiversity has been mandated by regional and international conventions that necessitate the establishment of a network of protectorates to protect and conserve ecosystems, representative habitats, threatened species, cultural heritage sites and traditional knowledge. Today there are 114,000 protected areas around the world,

covering 12% of the world's land surface. Egypt's experience with protected areas is rather young and goes back to 1983 with the passage of Law 102/83. Currently, much experience has been gained concerning the administration of these protectorates. Ras Mohamed National Park in South Sinai was the first protectorate in Egypt; by 2010 27 protectorates were established (Figure 1) extending over 15% of the total area of Egypt (EEAA, 2006a). These protectorates encompass 5121 and 17,309 flora and fauna species respectively, including endemic and many rare or endangered species; but this is less than the actual number as many species are not finally recorded. Still there are many unique ecosystems, important biological resources and outstanding landforms, which are not represented in the existing, protected areas and which are rapidly being lost or degraded. As a consequence, it is planned to expand the network of natural protectorates to reach 40 in 2017. Reef-based coast tourism in the Red Sea (snorkeling, diving) has expanded exponentially to the point where it makes a major contribution to the national economy. It is mandatory to protect these coral reef resources and manage them sustainably. In Egypt's case, the opportunities for financial gains through the promotion of ecotourism to protected areas are enormous. There are exceptional wild resources (coral reefs, spectacular desert land forms, rich fossil deposits and vast bird migrations) that underpin the economy and offer it a comparative economic advantage in the massive and growing nature based tourism industry. (Figures 2 & 3).

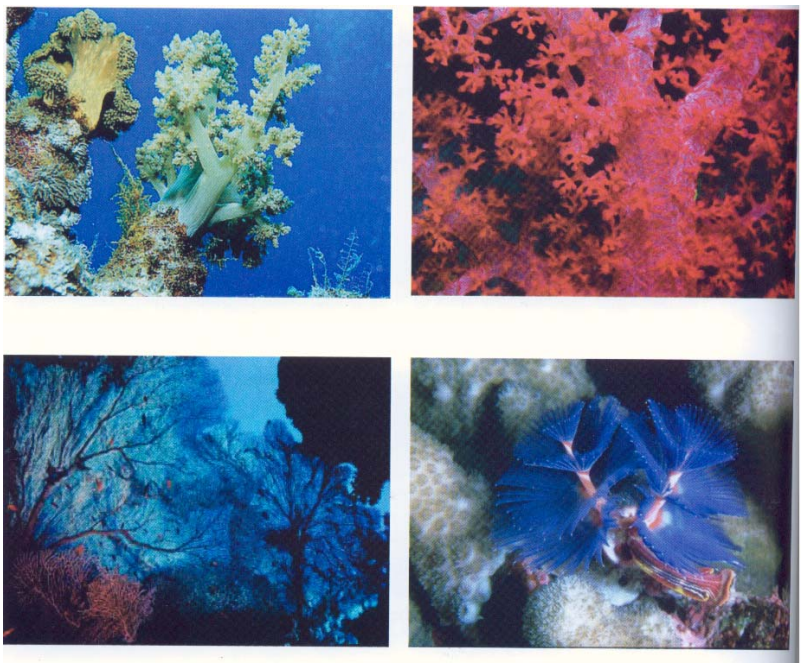

Fig. 2: Showing sea corals (From EEAA, NCS Report (2006 b)

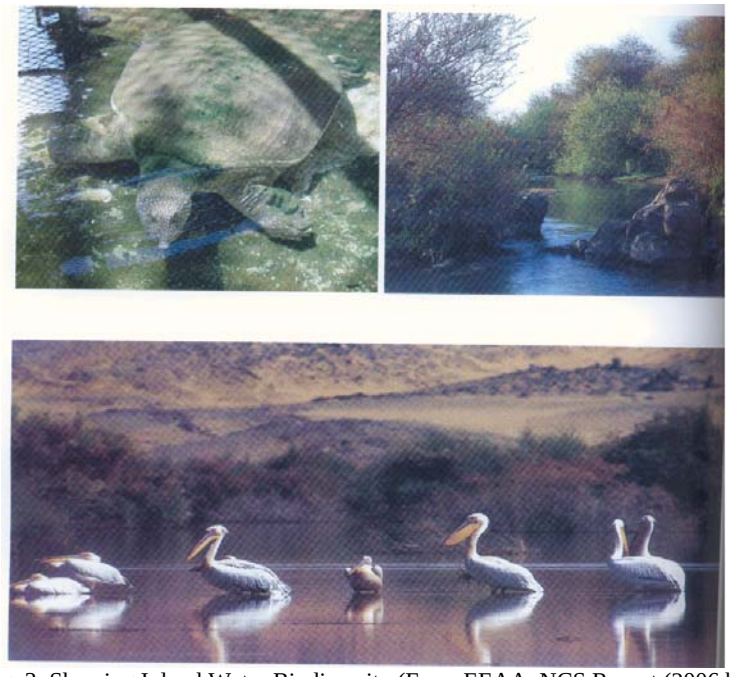

Fig. 3: Showing Inland Water Biodiversity (From EEAA, NCS Report (2006 b)

Management of Protected Areas

In order to manage the protected areas more properly, EEAA was restructured in 1992 and the Nature Conservation Sector (NCS) was created for its management. However, its staff size is still very small (500 persons) compared to the global average of protected area staffing which is up to 5 times greater for an area the size of Egypt's protected areas (IUCN, 1999). The management policy is concerned with the following:

- Rapid development in Egypt is putting unprecedented pressures on natural heritage resources, degrading many areas and threatening some with complete eradication. Among those are pollution, degradation of natural types, hunting and spread of invasive species. These resources have become prone to extinction due to their current depletion as a result of intensifying agricultural and industrial activities and development of scientific and technological capacity to transform or destroy such resources to satisfy needs of population, *e.g.* the possible extinction of the world's smallest butterfly *Pseudophilotes sinaicus*. Legislative efforts have been made to rehabilitate endangered species within protectorates. Climate changes and habitat extinction seem to be the greatest challenge contributing to degradation of biodiversity.
- NCS undertakes proactive conservation action through rehabilitation programmes that can be adopted when there is a need to restore a habitat, *e.g.* Egyptian tortoise, acacia, impacted coral reefs and mangroves. (Figures 4 & 5).
- In some areas, there may be a need to restore a habitat or to reintroduce a species that has been lost or threatened by human activities. *e.g.* preservation of the Egyptian tortoise. In St. Katherine protectorate, Bedouin communities realized that very few acacia were found and a rehabilitation program was started. So too with impacted coral reefs and mangroves.

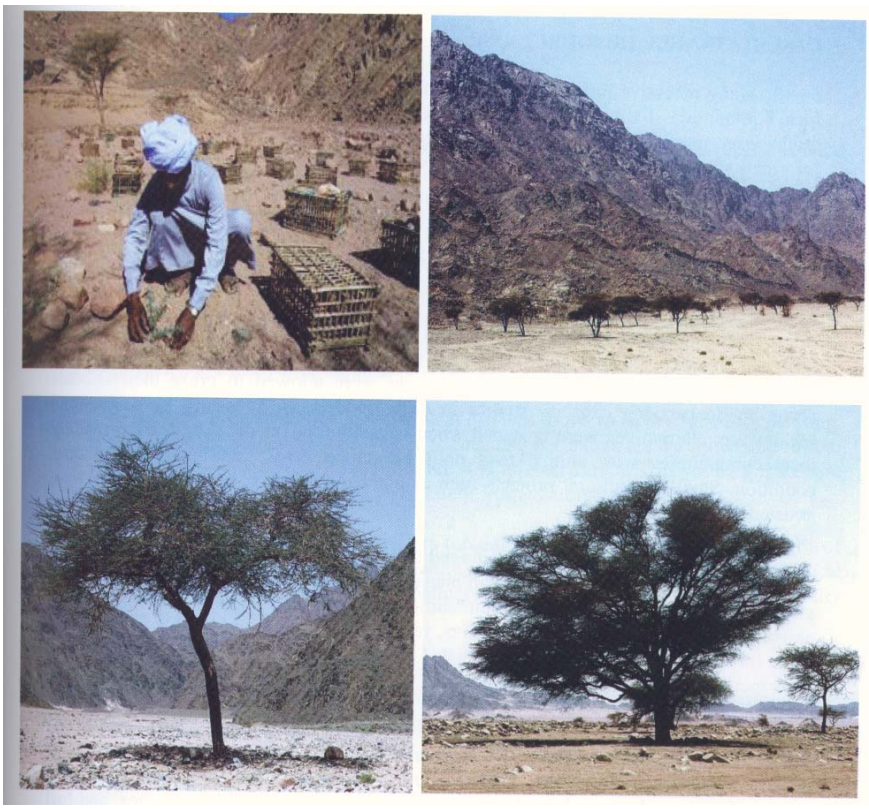

Fig. 4: Acacia Shrubs (From EEAA, NCS Report (2006 b)

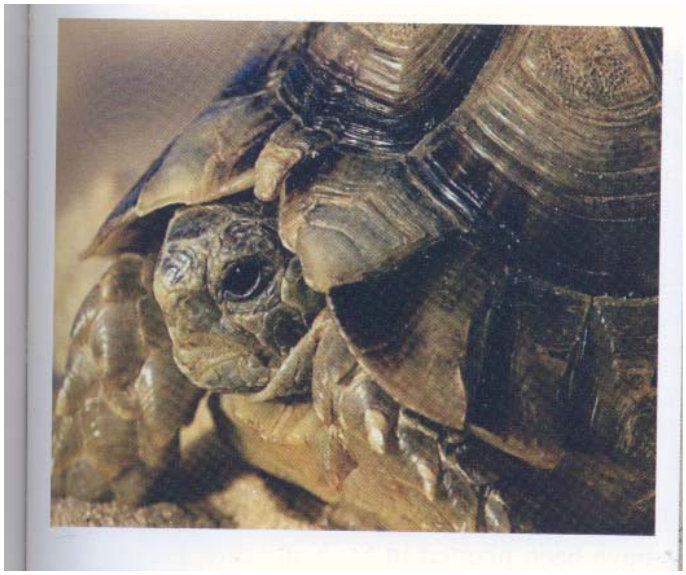

Fig. 5: Egyptian Tortoise (Testudo Kleimmanni) (From EEAA, NCS Report (2006 b)

- Invasive species are one of the major causes of extinction and biodiversity loss and have considerable socioeconomic and health impacts. (EEAA, 2006b). During the past 200 years, accidental plant invasions have occurred *e.g.* the water hyacinth *Echorma crassipes* is an example of a floral invasive species (Figure 6-A) that causes blockage of waterways

where irrigation and drainage are important. Considerable efforts have been made to clear water but no results have been achieved. Also the introduction of GM crops may represent an issue in the future.

- Many animal invasive species have been introduced to Egypt including fish, birds, insects, mollusks, crustaceans and others. The crayfish, introduced 20 years ago, was brought to Egypt for aquaculture (Fig. 6-B) but when the venture failed, the owner disposed of them in the Nile, which resulted in incredible loss of native fish and invertebrate species. The red palm weevil, the snail intermediate host for *Schistosoma haematobium* and fruit fly are all invasive species affecting biodiversity. Sincere efforts are being made against these problems.
- The coastline of Ras Mohamed in South Sinai, have some of the most spectacular coral reefs in the world. The coastal tourism depends upon intact reefs, but in the meantime it is also an important cause of their degradation and this should be taken in consideration.

Fig. 6: Examples of Invasive Species in Egypt: A - water hyacinth blocking waterways
B – Crayfish (From EEAA, NCS Report (2006 b)

Impact of Agricultural biotechnology on the environment

Genetic engineering programs in Egypt started in 1990 and procedures for commercializing GM crops were established in 1998 by ministerial decree. Most of the environmental concerns about GM technology in plants follow from the possibility of gene flow to close relatives of transgenic plants, the possible undesirable effects of the exotic genes or traits (*e.g.* insect resistance or herbicide tolerance) and the possible effect on non-target organisms.

Generally, public awareness about biotechnology is limited and often misconceived or misunderstood. There is currently a debate centered on ethics, morals, rights, farmers' opinions, consumers and future generations. Nonetheless, cultivation and commercialization of a *B.t.* maize variety in an area of 2000 hectares has been approved. Increased productivity of *B.t.* maize can offset the annual importation of 4.5 million tons.

Currently, most of the research and field trials in Egypt is carried out by the Agricultural Genetic Engineering Research Institute (AGERI) and these are concerned with the development of an insect resistant

long staple cotton, potatoes and squash; virus resistant sugarcane and figs; drought resistant rice and wheat. The slow passage of GM crops from experimental, to trial, to commercial stage includes the lack of capacity to negotiate licenses, to use genes and research techniques patented by others – especially for crops with export potential that must also meet regulatory requirements (Mansour, 2009).

Conclusion

The foregoing review clearly indicates the importance of the environment for our survival and the pressing need for maintenance of nature in a state that supports human life. Promoting awareness and improved ethical management of our ecosystems for development is essential and this includes various issues such as atmosphere, land resources, agriculture, biodiversity, sea and fresh water resources, toxic chemicals, hazardous wastes, solid wastes and sewage. In order to ensure successful management of the current policy of the ecosystem, the following is proposed:

1. There is a necessity to upgrade level of EE at all levels of education and to train the staff to be responsible for making effective decisions in an environmentally compatible scheme that copes with globalization demands.
2. Support of EEAA to undertake various awareness programmes and activities for the public through magazines, seminars and TV programmers. The impact of these activities is slowly gaining ground but is still insufficient in view of the massive efforts that the present situation requires.
3. A new robust legal framework for conservation of various components of biodiversity should be developed. The procedures for enforcement of existing and new laws should be proposed to assure their effectiveness.
4. Encouraging the captive breeding programmes in protectorates is necessary. A centre that serves the dual purpose of breeding endangered forms and conducting research on threatened forms needs to be established.
5. A national natural history museum should be established as a central institution for taxonomic research, preserving specimens and supporting it with well-trained scientists and technicians.
6. The NCS has to be adequately staffed, equipped and financed to ensure its effectiveness.
7. The national bank for genes has to be established for biodiversity conservation. Seeds of threatened plants have been selected, processed and stored in the bank and 35,000 specimens of plant genetic origin are now available.
8. Laws must be enacted to prevent killing and trade in wild birds and to forbid hunting in protected areas. We must stop collecting sea cucumbers, and apply techniques for conservation of marine animals, sharks, reptiles, corals and mangroves. Also, enforcement must be devised to improve regulation of the import and export trade in wildlife products. Populations of many wild animals and plants, both terrestrial and marine have declined and a number of species are on the verge of extinction. So, a hunting management unit has been established to manage these problems in the protectorates.
9. There are 63 species of butterflies recorded in Egypt. The Sinai Baton

blue, *Pseudophilotes sinaicus*, and Sinai hairstreak *Satyrium jebelia* are considered to be critically endangered due to climate change, overgrazing and the over-collection of medicinal plants. In general, 80% of the butterfly population in Egypt is not in a bad situation but evaluation and follow up of its population is recommended and its function has to be activated.

10. On the national heritage list are many endemic species of medicinal plants, which are found in protected areas; these are on a database that includes their distribution, abundance and phenological features. A total of 592 species have been collected from the Western and Eastern deserts and Sinai. An encyclopedia of these plants is being prepared. Careful programmes for their conservation however are still required. Medicinal plants have traditionally been used as a source of affordable and accessible primary health care in Saint Katherine by the Bedouins. The dry processed medicinal plants are being sold to tourists with benefits returning back to the Bedouin community.
11. Banning erosion of farmland topsoil or construction thereon and protection of the Nile against pollution are major issues. New technologies have been adopted to minimize air pollution, upgrade and enhance efficiency of sewage networks in cities and villages. Also, there is a need to preserve the heritage resources related to geological times such as the skeleton of whales in Western Desert, and other sites which represent the Stone Age of 10,000 years ago. These resources have been affected by many factors such as grounding, overgrazing, habitat fragmentation and solid waste.
12. Search for the best and most efficient procedures for doing GM environmental risk analysis and biosafety with regard to the environment and food use. A new policy should be formulated. Access to modern biotechnology needs to be facilitated.
13. Breeding threatened and endangered species of animals, birds, reptiles in captivity and their release into protectorates will contribute significantly to their increase.

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Biology International considers articles from a wide variety of interest areas and a diverse spectrum of biological disciplines. The International Union of Biological Sciences has major concerns about conservation, biodiversity, sustainability, health, agriculture, bioethics, indigenous knowledge, and biology education. We have a long history of working with universities, museums, herbariums, zoos, national parks, forest reserves, industries, NGOs, and governmental bodies in addressing these concerns. Particular issues have required IUBS to work closely with representatives of member countries, such as the maintenance and taxonomy of biological specimens, responsible collection and curation of biological organisms and artifacts, curbing trade of exotic specimens and abuses of bioprospecting and biopiracy, promoting bioremediation, respecting diverse cultures and historical legacies, promoting learner-center reforms in contemporary biology education and responsible development of biology educators, cultivating better standards of bioethical practice, and preventing destruction of ecosystems or the introduction and spread of invasive species If you are a biologist or biology educator who is convening an international conference that is addressing a subject of major interest to membership of the International Union of Biological Sciences (such as those identified above), please contact the Editor (John R. Jungck at <jungck@beloit.edu>) with a prospectus that lays out the theme, potential authors, and timeframe to initiate a discussion about a potential future issue of *Biology International*.

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The International Union of Biological Sciences is a non-governmental, non-profit organization, established in 1919. Its objectives are to promote the study of biological sciences, to initiate, facilitate, and coordinate research and other scientific activities that require international cooperation, to ensure the discussion and dissemination of the results of cooperative research, to promote the organization of international conferences and to assist in the publication of their reports.

The membership of the IUBS presently consists of 45 Ordinary Members, adhering through Academies of Science, National Research Councils, national science associations or similar organizations, and 80 Scientific Members, all of which are international scientific associations, societies, or commissions in the various biological disciplines.

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CUBA – Academia de Ciencias de Cuba
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ISRAEL – Academy of Sciences and Humanities
ITALY – Consiglio Nazionale delle Ricerche
JAPAN – Science Council of Japan
KOREA, Republic of – Korean Association of Biological Sciences
LEBANON – National Council for Scientific Research
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SWITZERLAND – Swiss Academy of Sciences
TUNISIA – Association Tunisienne des Sciences Biologiques
UNITED KINGDOM – Institute of Biology
USA – National Academy of Sciences/National Research Council
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