African Traditional Knowledge Systems and Biodiversity Management

There is a link between African Traditional Knowledge Systems and the management of Biodiversity. These have been passed over from one generation to the next through oral tradition. The lack of documentation of these systems of managing biodiversity has led to the existence of a gap between the scientifically based systems of managing biodiversity and the traditional methods that have been in existence for years. These are based on traditional ecological knowledge, which is largely based on traditional beliefs, cultures, superstitions and social traditions. Notably, while African traditional methods of managing biodiversity have succeeded in promoting the conservation of certain elements of biodiversity, they have failed to develop conservation knowledge and awareness among societies, because people avoided harvesting resources from sacred areas out of fear rather than with a declared purpose and interest in conservation.

Thokozani Simelane

Thokozani Simelane is head of the Science and Technology Unit at the Africa Institute of South Africa in South Africa.

Introduction

Whilst there are various *ex situ* methods of managing biodiversity (for example, zoos, seed banks and others), conservation areas still remain the major option of the *in situ* method (that is, conservation of biodiversity in its natural place) for managing biodiversity.[1] The success of conservation areas to manage biodiversity is, however, constantly threatened by human-related problems that arise from narrow-focused management approaches[2] that largely neglect the importance of traditional ecological knowledge[3] and also neglect the importance of social support of biodiversity management.[4]

Acknowledging the importance of social support for biodiversity management through traditional knowledge has nevertheless increased during the past ten years.[5] This was strongly emphasised at the World Parks Congress held in Durban, South Africa in 2003, and in the conference of the parties of the Convention on Biological Diversity held in Kuala Lumpur, Malaysia. The point made was that current biodiversity management strategies should seek ways of supporting the economies of the areas around them and

accommodate the inclusion of traditional communities in their management.

Whilst most of the problems faced by conservation areas stem from the history associated with their establishment (that is, forceful removal of traditional communities to establish conservation areas) and the demand for access to natural resources, other problems are perpetuated by the lack of participation in conservation by traditional societies. These factors have reduced the interest in, and appreciation of, conservation areas by these societies.[6] With the acknowledgement of the importance of acquiring the participation of traditional communities in conservation, a need to adopt a community-based conservation approach has been identified.

This approach is derived from the fact that the history of conserving and managing natural resources and biodiversity indicates that conservation consciousness evolved as a social practice through the need to manage and ensure the sustainable use of natural resources.[7] While this serves as a base for the evolution of conservation awareness, traditional methods of conserving and managing natural resources were largely based on traditional beliefs, cultures, superstitions and social traditions.[8] Although these methods were effective in promoting the conservation and management of natural resources used by traditional communities,[9] other methods achieved this by restricting people from harvesting resources in certain areas, such as sacred land, caves or forests.[10] For instance, in southern Asia, many sacred ponds helped to conserve the indigenous fish fauna,[11] as people avoided these ponds out of cultural respect. While these methods succeeded, it can be noted that they are based on fear rather than the expressed interest or awareness of the importance of conservation. Although this is the case through traditional restrictions such as these, the protection and conservation of threatened resources are assured and this directly promotes the conservation of biodiversity through traditional methods.[12] Through this example, it becomes clear that the restrictive nature of traditional methods in managing biodiversity poses a new dimension of conservation management, and conservationists must decide whether or not these methods are relevant for inclusion into strategies for managing biodiversity.

Of important consideration is that while restrictive traditional methods succeeded in promoting the conservation of certain elements of biodiversity, they failed to develop conservation knowledge among traditional societies (that is, those communities that use indigenous knowledge to harvest, manage and conserve resources around them), because people avoided harvesting resources from sacred areas out of fear rather than with a declared purpose and interest in conservation. One can thus say that these methods are therefore not based on an understanding of the biology of the resources.[13] This emphasises the fact that, although there is a call to increase the participation of traditional societies in conservation through community-based conservation, the gap of mutual understanding between the dynamics of current conservation practices and the traditional ways of managing biodiversity poses a challenge as it still needs to be reduced.[14]

Through human migration and the mixing of cultures, human interaction has brought about an evolution of ideas, philosophies and principles that have guided the practice of conservation to its current form.[15] However, in this process, conservation ideas and practice remain largely dominated by Western philosophies and thinking,[16] and their influence has determined the path and practice of the present form of managing natural resources through

conservation areas.[17] Based on values promoted by these philosophies, conservation has placed a priority on protecting those animal and plant species that are appealing to Western communities, as well as those which were later identified as threatened by human activities.[18] Such Eurocentric-based conservation overlooked the importance of traditional ecological knowledge and values attached by traditional societies to resources within conservation areas. While this is constantly subject to criticism, the success of traditional conservation methods of managing biodiversity has never been critically evaluated and this poses a challenge to proposed new conservation methods (such as community-based conservation) that seek to integrate the Eurocentric and traditional conservation approaches.

Very often, the establishment of conservation areas is associated with the removal of traditional people from their native land.[19] This method of developing conservation areas created a long-lasting grudge and antagonism that still persists between conservation areas and the traditional communities. In addition, the management approaches to conservation areas restricted access by traditional societies to the natural resources, and promoted the non-consumptive use of natural resources within conservation areas.[20] This led to the development of negative attitudes among traditional communities towards conservation areas, as these areas are seen to cater for animals and tourists to the exclusion of local traditional people.[21]

This impasse indicates that there is a need to determine the root causes of the poor relationship between conservation areas and traditional communities, and also to determine the extent of antagonistic attitudes towards conservation areas among traditional communities. Models can then be devised to manage biodiversity through community participation, accommodating the contribution of traditional methods to biodiversity conservation, and evaluating the success of these models in promoting the management of biodiversity both inside and outside the conservation areas.

Paradigm Shift in Biodiversity Management

The realisation that conservation areas cannot exist as islands has prompted international conservation organisations, such as the International Union for the Conservation of Nature (IUCN), World Wide Fund (WWF) and United Nations Educational, Scientific and Cultural Organisation (UNESCO), to propose that conservation areas need to adapt to changes in conservation philosophies to start supporting economic development and to provide benefits to traditional communities around their borders.[22] This proposal has transformed conservation thinking to the extent that conservation now embraces human issues.[23] Conservation emphasis has thus changed from being purely the maintenance of habitats for plants and animal species and processes identified to have critical conservation status, to becoming an integrated or complementary practice that also accommodates issues of human interest.[24]

This shift in conservation approach is, however, associated with some uncertainties.[25] The first uncertainty is whether or not conservation areas will be able to balance the conservation of biodiversity with various human needs.[26] This is of particular concern as the use of more than 90% of the land surface that is available for human exploitation outside conservation areas has rarely been compatible with the maintenance of biodiversity.[27] The second uncertainty is the lack of assurance of being able to maintain biodiversity in the face of the use

of its components by humans.[28] Thirdly, there is uncertainty about the success of achieving social support of conservation, thus ensuring the conservation of biodiversity not only within the conservation areas, but also outside their boundaries.[29]

Of late, the importance of conserving biodiversity both within and outside conservation areas has gained much attention.[30] This has led conservation agencies to intensify the management of all ecological systems that support the conservation of biodiversity.[31] Such intensification is supported by the realisation that conservation of biodiversity has many advantages and benefits for human society.[32] Biodiversity supports the livelihoods of people and constitutes resources upon which families, communities, nations and future generations depend.[33] Thus, the conservation of biodiversity clearly needs to be extended beyond the current limits such that it also incorporates the contribution of traditional knowledge (that is, knowledge that encompasses wisdom, knowledge and teaching of communities which is based on long-standing traditions and practices) to the management of biodiversity.[34] By incorporating traditional knowledge and perceptions into current conservation approaches and biodiversity management, as well as sharing conservation benefits,[35] it is hoped that traditional people will acknowledge the value and importance of managing biodiversity and also appreciate the objectives of its conservation.

Methods of Conserving Biodiversity

The conservation of natural resources has long been practised by African communities.[36] Over the years, African communities have developed traditional techniques that were aimed at sustaining food resources and their production.[37] These methods were primarily focused on the management of those resources that were preferred for food and other uses essential for human survival. They included the protection of breeding females, supplementary feeding and habitat modification.[38] Such methods have evolved independently among African societies.[39]

An example of the African traditional management of resources includes the taboos that prohibited people from entering sacred areas such as forests, caves or springs, or using certain plants or animal species.[40] This ensured that biodiversity within such areas was well conserved. Unfortunately, most of these methods and belief systems have been abandoned due to human cultural development, changes in belief systems and the emphasis by conservation agencies on Eurocentric values.[41]

The demise of these traditional methods has led to the over-exploitation of natural resources, which has caused the destruction of habitats, extinction of species and the decrease in the quality of life of traditional communities.[42] It has also left them without alternative strategies that would ensure the sustainable harvesting of traditional resources[43], and has created a gap between current conservation strategies and their understanding by traditional communities. There is thus a need to bridge this gap and to improve conservation understanding by traditional communities so that they can fully participate in the conservation of biodiversity and the protection of the natural resources that they use.[44]

Two conventional methods of conserving biodiversity are currently used.[45]

- *Ex situ* conservation methods (gene banks, zoos, botanical gardens and aquaria)
- *In situ* conservation methods (nature reserves, national parks, conservancies, private wildlife ranches, etc).

Ex situ conservation methods are effective in maintaining species and genetic diversity, although generally at great expense. On the other hand, *in situ* conservation methods are effective in conserving all levels of biological diversity, including species and genetic diversity, habitats and ecosystem processes.[46] *In situ* conservation is generally regarded as an effective way of conserving biodiversity in its natural place.[47]

Each of these two methods, however, has its limitations. *Ex situ* conservation methods are plagued by many shortfalls. They are not practical options for the conservation of more than a small fraction of threatened species.[48] Depending on the technology used, these methods are vulnerable to pests and diseases, physical damage to facilities resulting from natural causes such as fire, flood and storm, and human-related events such as war, economic decline and policy change. Furthermore, the maintenance of these facilities is extremely costly.[49]

In situ conservation methods, which comprise habitat protection or infield conservation, are confronted by three major limitations.[50] The first limitation is the insufficient information on the conservation status and habitat requirements of individual species or populations. The second is the considerable economic cost of maintaining habitats and ecosystems. The third limitation is the lack of human involvement, which may lead to an ongoing conflict between conservation areas and their neighbouring communities. The last shortcoming is important, as it determines the future success of the *in situ* method of conserving biodiversity.[51] Conservation areas, particularly in developing countries, have still not yielded sufficient benefits to satisfy the demands of their local communities.[52] This leads to ongoing conflict between conservation areas and the local traditional communities.[53]

Are Conservation Areas the Sole Option to Manage Biodiversity?

One of the critical requirements of biodiversity management is the maintenance of interactions between those ecological processes and systems that support the performance and functioning of ecosystems. Conservation areas achieve this through the maintenance of habitats of plant and animal species identified to have critical conservation status to as near a pristine condition as possible. This indirectly ensures the maintenance of associated ecological processes and systems provided by these habitats and species. Although this was not given much consideration during the early proclamation of conservation areas, where emphasis was placed on saving animal species identified to be threatened by human actions, the growing need for conservation areas to protect biodiversity increased the need to adopt a holistic view of the ecological processes and systems which support biodiversity in these areas.

As communities around conservation areas continue to exact pressure by demanding access to natural resources and grazing land, the understanding of the impact of traditional forms of resource uses such as wood fuel harvesting and grazing as a preferred form of land use on ecosystems and biodiversity of conservation areas, demands that contrasts between traditional forms of land uses and conservation be further investigated.

It has been argued, for example, that grazing is one of the key processes in terrestrial ecosystems, but that this can be provided by both indigenous and domestic ungulates. This raises the question of whether a traditional form of land use such as grazing for domestic stock, can support the maintenance of biodiversity in the same way as conservation areas do with wildlife, and if not, to what extent it alters the systems and processes that support biodiversity.

With the need to provide answers to questions like these, the understanding of the success of conservation areas over traditional forms of land uses and management has become critical as this will help to determine if conservation areas need to be regarded as the sole option of managing biodiversity.

Threats to Biodiversity

One of the phenomena that threatens biodiversity is 'extinction proneness'[54], which renders populations vulnerable to environmental change and reduces taxonomic groups to one or a very few threatened species.[55] These phenomena, which are also referred to as deterministic extinction are, however, less significant. They pose little threat to biodiversity, as they occur naturally and over a long period of time.

Human contribution to these extinction processes is the principal threat to biodiversity. This includes habitat destruction, desertification, fragmentation, industrial development, unsustainable resource exploitation and other activities, and these lead to environmental changes like pollution, global warming and acid rain.[56] Although habitat destruction is known to account for more than 82% of present species loss[57] and is widely regarded as the main human-related cause of extinction, the processes of extinction through traditional resource use have not yet been well explored.[58] This is precisely why special attention must be paid to relationships and the support of conservation areas by traditional communities as tools to reduce biodiversity loss.

Traditional natural resource exploitation, which includes the hunting of animals, harvesting of plants for food and the collection of medicinal plants and wood fuel, poses various threats to biodiversity.[59] For instance, hunting has exterminated many endemic animal species[60] and has led to the demise of certain species within confined habitats.[61] Similarly, the over-harvesting of plants for food, shelter, traditional medicines, dyes, oils, intoxicants, beverages, fibres, tools and fuel, has also increased the loss of biodiversity by decreasing the populations of targeted species in the wild and reducing their genetic variation.[62]

The synergistic nature of threats to biodiversity demands that all perceived threats are studied meticulously. Therefore, scientific inputs that will highlight even the subtle impacts on biodiversity associated with the harvesting of natural resources (particularly the traditionally used resources) from conservation areas, are important.[63]

Although traditionally used resources are assumed to occur in abundance within conservation areas, little has been done to investigate the impacts that may be associated with their harvesting. This is despite the fact that their management within the conservation areas has been largely through legal control.[64] Thus, strategies are required that will reduce the perceived threats while, at the same time, promoting the support of conservation of traditionally-used resources both inside and outside conservation areas.[65]

Conclusion

The World Conservation Strategy acknowledges that biodiversity management is compatible with human development, achieved through a wider distribution of benefits by making fuller use of people's knowledge, labour, capabilities, motivation, and creativity (Section 20 of World Conservation Strategy – 54). In implementing this strategy, various innovations in conservation policies and management of conservation

areas have been introduced in Africa.[66] The management of conservation areas in Africa now reflects some of these changes.[67] However, in implementing some of the innovations, various conservation agencies for example, South African National Parks, Kenya Wildlife and many others in Africa, have encountered certain problems. Some of these include:

- Lack of understanding of biodiversity, its broader value and conservation by traditional communities
- Existence of uncertainty about the possible incentives that could be used to ensure the continuous participation of traditional communities in conservation management, as well as developing social support of biodiversity management.

In view of these challenges this article suggests that there is a critical need for:

- Seeking ways of developing conservation strategies to be used to implement community-based conservation strategies and to increase social support of management of biodiversity
- Developing strategies that can sustain good relationships between conservation areas and local traditional communities
- Identifying resources available within the conservation areas that are regarded as traditionally used natural resources
- Investigating impacts that may be associated with the harvesting of traditional resources from conservation areas, as well as investigating other impacts on biodiversity that are associated with the different traditional forms of land use around the conservation areas.

In a broader context, the author argues that there is a dire need to increase contribution to conservation biology and current thinking about the contribution of traditional knowledge to the management of biological resources. This can be achieved by highlighting both the role of conservation areas in conserving traditionally used natural resources and the threats on biodiversity that are associated with the traditional uses of these resources.

The premise on which this is based is threefold. Firstly, if conservation is a spontaneous practice that is linked with human culture and tradition,[68] then all communities have a natural interest in conserving natural resources and biodiversity.[69] A sense of conservation consciousness can thus be instilled among traditional societies by emphasising the role that is played by conservation areas in conserving the traditionally used natural resources and other aspects of cultural significance. Secondly, conservation areas support the conservation of traditionally used resources that can be used as a flagship to increase the support of the management of biodiversity by the traditional societies.[70] Thirdly, making use of traditional ecological knowledge and increasing the participation of traditional communities in the management of natural resources and conservation areas, can enhance the understanding of biodiversity by traditional societies as well as support for their conservation areas.

Notes and Reference

1 S Braatz, G Davis, S Shen & C Rees, 'Conserving Biological Diversity: A strategy for protected areas in the Asia-Pacific region', World Bank Technical Paper No 193. The World Bank, Washington, DC, 1992.

2 C Alan, 'Medicinal plants, conservation and livelihoods'. *Biodiversity and Conservation* Vol 13, No 8, 2004, pp 1477–1577; H Else & J du P Bothma, 'Developing partnerships in a paradigm to achieve conservation reality in South

Africa'. *Koedoe* Vol 43, No 1, 2000, pp 19–26;.

3 A Agrawal, 'Dismantling the divide between indigenous and scientific knowledge', *Development and Change* Vol 26, No 3, 1995, pp 413–439; M De La Engels La Torre-Cuadros and G Loleabe, 'Traditional ecological knowledge and use of vegetation in south-eastern Mexico: A case study from Solferino, Quintena Roo,' *Biodiversity and Conservation* Vol 12, No 12, 2003, pp 2455–2476; H Huntington, 'Using traditional ecological knowledge in Science: methods and applications,' *Ecological applications* Vol 10, No 5, 2000, pp 1270–1274; J Kuusipalo and J Kangas, 'Managing biodiversity in a forestry environment,' *Conservation Biology* Vol 8, No 2, 1994, pp 450–460.

4 C Brokectt, *Land power and poverty: Agrarian transformation and political conflict in Central America*, Boston, USA: Unwin Hyman; RF Noss, 'Sustainability and wilderness,' *Conservation Biology* Vol 5, 1991, pp 120–122.

5 V Bosetti and D Pearce, 'A study of environmental conflict: the economic value of grey seals in southwest England,' *Biodiversity and Conservation* Vol 12, No 12, 2003, pp 2361–2392.

6 PR Ehrlich and GC Dailey, 'Science and management of natural resources,' *Ecological application* Vol 3, 1993, pp 558– 560; CS Holing, 'Improving research for sustainability,' *Ecological applications* Vol 3 No 4, 1993, pp 552–555.

7 JB Alcorn, 'Indigenous peoples and conservation,' *Conservation Biology* Vol 7, 1993, pp 424–426; TJ Du Toit, 'Wildlife harvesting guidelines for community-based wildlife management: a southern African perspective,' *Biodiversity and conservation* Vol 11, No 8, 2002, pp 1403–1416; M Gadgil, F Berkes and C Folke, 'Indigenous knowledge for biodiversity conservation,' *Ambio* Vol 22, 1993, pp 151–156; LS Hamilton and HF Takeuchi, (eds) *Ethics, Religion and biodiversity,* The White Horse Press, Cambridge, UK, 1993.

8 Ibid.

9 JG Castley, 'Role of small mammals as seed dispersers in the Alexandria Dunefield,' *Unpublished MSc thesis*, University of Port Elizabeth, 1992; MG Stevenson, 'Indigenous knowledge in environmental assessment,' *Arctic* Vol 49, No 3, 1996, pp 278–291; NJ Turner, MB Ignace, and R Ignace, 'Traditional ecological knowledge and wisdom of aboriginal people in British Columbia,' *Ecological Applications* Vol10, No 5, 2000, pp 1275–1287.

10 Gadgil, Berkes, and Folke 1993.

11 VH Heywood, (ed), *Global biodiversity assessment*, Cambridge University press, New York, 1995.

12 ZA Ombe, 'Indigenous land use management in lower Changene Chibuto: sacred and profane recovery,' *Indilinga African Journal of Indigenous Knowledge Systems* Vol 2, 2003, pp 1–9.

13 EA Smith and M Wishnie, 'Conservation and subsistence in small-scale societies,' *Annual Reviews of Anthropology Vol* 29, 2000, pp 493–524.

14 Du Toit 2002; TC Phutago, 'Traditional knowledge and community-based natural resources management: Lessons from a Botswana wildlife management area,' *Applied Geography* Vol 24 No 1, 2004, pp 57–76.

15 RF Noss and AY Cooperrider, *Saving nature's legacy-protecting and restoring biodiversity.* Island Press, Washington DC, 1994.

16 Castley 1992.

17 W Beinart, 'The politics of colonial Conservation,' *Journal of South African Studies* 15, 1989, pp 145–161; H Gichochi, 'Functional relationships between parks and agricultural areas in East Africa: The case of Nairobi National Park,' In HHT Prins, JG Grootenhuis, and TT Dolan, (eds), *Wildlife Conservation by sustainable use*, Kluwer Publishers, London, 2000; D Goulet, *Biological diversity and ethical development* In LS Hamilton, and HF Takeuchi (eds), *Ethics, Religion and biodiversity.* The White Horse Press, Cambridge, UK, 1993; R Grove, 'Scottish Missionaries, Evangelical discourse and origins of conservation thinking in southern Africa: 1820–1900,' *Journal of South African Studies* Vol 15, 1989, pp 165–187.

18 Hamilton and Takeuchi 1993; MB Usher, (ed) *Wildlife conservation evaluation.* Chapman & Hall Ltd, New York, 1986.

19 J Carruthers, 'Creating a National Park, 1910 to 1926,' *Journal of South African Studies*, Vol. 15, 1989, pp 188–216; D Hales, 'Changing concepts of national parks,' *In D Western and C Pearl (eds), Conservation for the 21st Century.* Wildlife Conservation International, New York, 1989; JA McNeely, *Economics and biological diversity: developing and using economic incentives to conserve biological resources*, IUCN, Gland, Switzerland, 1988; JA McNeely, *Expanding partners in conservation*, Island Press, California, 1995; B Willers, 'Sustainable development: A new World deception,' *Conservation Biology* Vol 8, No 4, 1994, pp 1146–1148.

20 J McNeely and D Pitt, (eds) *Culture and conservation: Human dimension in environmental planning*, Croomhelm, Sydney, 1995.

21 J Fourie, 'Comments on national parks and future relations with neighbouring communities,' *Koedoe* Vol 37, 1994, pp 123–136; D Simberloff, *Design of nature reserves*, In M Usher(ed), *Wildlife conservation evaluation*, Chapman & Hall Ltd, New York, 1986.

22 SK Eltringham, 'Wildlife carrying capacities in relation to human settlement,' *Koedoe* Vol. 33, 1990, pp 89–96; IUCN, 'Resolutions and recommendations of the general assembly of IUCN (World Conservation Union), at its 19th session in Buenos Aires, Argentina.' IUCN, Gland.

23 BR Döös, 'Environmental degradation, global food production and risk for large-scale migrations,' *Ambio* Vol 23, 1994, pp 124–130; Hales 1989; Huntington 2000.

24 J Amstrong and I Abbott, 'Sustainable conservation: A practical approach to conserving biodiversity in Western Australia,' In GC Grigg, PT Hale, and D Lunney (eds), *Conservation through sustainable use of wildlife*, University of Queensland, Brisbane, 1995; AA Brubidge and KJ Wallace, 'Practical methods for conserving biodiversity,' In RE Bradstock, TD Auld, RT Keith, D Lunney, and RP Silvertsen (eds), *Conserving Biodiversity: Threats and Solutions*, Surrey Beatty, Sydney, 1995.

25 Ombe 2003.

26 Heywood 1995.

27 *Ibid.,* WCMC .

28 McNeely 1995.

29 IUCN, 'Resolutions and recommendations of the general assembly of IUCN (World Conservation Union), at its 19 h session in Buenos Aires, Argentina.'

IUCN, Gland; D Ludwig, R Hillbron and C Walters, 'Uncertainty, resource exploitation and conservation: Lessons from the history,' *Science* Vol 260, 1993, pp 17–36; M Norton-Griffiths and C Southey, 'The opportunity costs of biodiversity conservation in Kenya,' *Ecological Economics* Vol 12, 1995, pp 125–139.

30 RF Grumbine, (ed) *Environmental Policy and Biodiversity*' Island Press, Washington DC, 1994; Heywood 1995; IUCN, 'Resolutions and recommendations of the general assembly of IUCN (World Conservation Union), at its 19th session in Buenos Aires, Argentina,' IUCN, Gland; D Takacs, *The Idea of Biodiversity*, The Johns Hopkins University Press, Baltimore, 1996.

31 R Grumble and M Laidler, 'Biodiversity management and local livelihoods: Rio Plus 10,' *Natural Resources Perspective* Vol 73, 2002, pp 1–137; IUCN/UNEP/WWF/FAO/UNESCO, *Global Biodiversity Strategy: Guidelines for Action to Save, Study and Use Earth's Biotic Wealth Sustainably and Equitably*, World Resources Institute, Washington; McNeely 1995.

32 PR Ehrlich and EO Wilson, 'Biodiversity studies: science and policy,' *Science* Vol 253, 1991, pp 758–762; Heywood 1995; N Salfsky, R Margoluis, KH Redford and JG Robinson, 'Improving the practice of conservation: A conceptual framework and research agenda for conservation Science,' *Conservation Biology* Vol 16, No 6, 2002, pp 1469–1479.

33 G Davies, 'Bush meat and International Development,' *Conservation Biology*. Vol.16 No 3, 2002, pp 587–589; Heywood 1995;RA Wynberg, 'Decade of Biodiversity Conservation and Use in South Africa: Tracking Progress from Rio Earth summit to the Johannesburg World Summit on Sustainable development,' *South African Journal of Science* Vol 98, No 5, 2002, pp 233–243.

34 Wynberg 2002.

35 M Thibault and S Blaney, 'Sustainable Human Resources in Protected Areas in Southern Gabon,' *Conservation Biology* Vol 15, No 3, 2001, pp 591–595.

36 Gadgil, Berkes, and Folke 1993.

37 Carruthers 1989.

38 JD Majer, 'Costs of biodiversity assessment,' In *Rapid Biodiversity Assessment Workshop, 3–4 May 1993*, Macquarie University, Sydney, Australia, 1993, pp 35–39.

39 DA Posey, 'Indigenous management of tropical forest ecosystem: the case of Kayap Indians of the Brazilian Amazon,' *Agroforestry Systems,* Vol 3, No 2, 1985, pp 139–158; Gadgil, Berkes, and Folke 1993.

40 Posey 1985.

41 Gadgil, Berkes, and Folke 1993.

42 *Ibid.*

43 *Ibid.*

44 *Ibid.*

45 McNeely 1995.

46 Heywood 1995.

47 *Ibid.*

48 RF Noss and LD Harris, 'Nodes, Networks and MUMs: Preserving Diversity at all Scales,' *Environmental Management* Vol 3, 1986, pp 27–37.

49 CD James, J Landberg and SR Norton, 'Ecological Functioning in Arid Australia and Research to Assist Conservation of Biodiversity,' *Pacific Conservation Biology* Vol 2, 1995, pp 126–142.

50 Heywood 1995.

51 BJ Huntley, (ed), *Biotic diversity in southern Africa-concepts and conservation*, Oxford University Press. Cape Town, 1989.

52 Heywood 1995.

53 H Gichochi, '*Functional relationships between parks and agricultural areas in East Africa: The case of Nairobi National Park*,' In HHT Prins, JG Grootenhuis, and TT Dolan (eds), *Wildlife Conservation by Sustainable Use*, Kluwer Publishers, London, 2000.

54 *Ibid.,* JC Nagle, *The Law of Biodiversity and Ecosystem Management*, Foundation Press, New York, 2002; Noss and Harris 1986.

55 C Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, John Murray, London, 1859.

56 PR Ehrlich and AH Ehrlich, 'The Value of Biodiversity,' *Ambio* Vol 21, 1992, pp 212–218.

57 Castley 1992; G Caughley, 'Directions in the Conservation Biology,' *Journal of Animal Ecology* Vol 63, pp 215–244; JA McNeely, M Gadgil, C Lveque, C Padich and K Redford, 'Human Influences on Biodiversity,' In VH Heywood and RT Watson (eds), *Global Biodiversity Assessment*, Cambridge University Press, New York, 1995; O Huber, 'Conservation and Environmental Concerns in the Venezuelan Amazon,' *Biodiversity and Conservation* Vol 10, No 10, 2001, pp 1627–1643; GM Carpaneto and A Fusari, 'Subsistence Hunting and Bush Meat Exploitation in Central-western Tanzania,' *Biodiversity and Conservation* Vol 9, No 11, 2000, pp 1571–1585; A Barbosa, 'Hunting Impact on Waders in Spain: Effects of Species Protection Measures,' *Biodiversity and Conservation* Vol 10, No 10, 2001, pp 1703–1709.

58 Heywood 1995.

59 EO Wilson, 'The Biological Diversity Crisis,' *BioScience* Vol 35, 1985, pp 700–706; N Myers, 'Threatened Biotas: 'Hot Spots' in the Tropical Forests,' *The environmentalist* Vol.8, 1988, pp 187–208; Thibault and Blaney 2001.

60 SL Olson, 'Extinction on Islands: Man as a Catastrophe,' In D Wastern and NC Pearl (eds), *Conservation for the 21st Century*, Oxford University Press, Oxford, 1989.

61 M Colchester, 'Beyond 'Participation': Indigenous Peoples, Biological Diversity Conservation and Protected Area Management,' *Unasylva* Vol 186, No 47, 1994, pp 33–39; PK Muchaal and G Ngandjui, 'Impact of Village Hunting on Wildlife Population in the Western Dja Reserve, Cameroon,' *Conservation Biology* Vol 13, No 2, 1998, pp 385–396.

62 Colchester 1994; AB Cunningham, 'Integrating Local Plant Resources and Habitat Management,' *Biodiversity and Conservation* Vol 3, 1994, pp 104–115; C Fabricius and M Burger, 'Comparison Between a Nature Reserve and Adjacent Communal land in Xeric Succulent Thicket – an Indigenous Plant User's Perspective,' *South African Journal of Science* Vol 93, 1997, pp 259–262; MB Usher, (ed) *Wildlife Conservation Evaluation*, Chapman & Hall Ltd, New York, 1986.

63 Cunningham 1994.

64 J Carruthers, 'Police Boys and Poachers – African Wildlife Protection and National Parks, the Transvaal 1902–1950,' *Koedoe*, Vol 36, No 2, 1993, pp 11–21.

65 Cunningham 1994.

66 R Peart and K Govender, 'Natural Resources Policies for New Millennium:

is South Africa Moving Towards a More Sustainable Path?' *South African Journal of Environmental Law and Policy* Vol 8, No. 1, 2001, pp 39–76; Wynberg 2002.

67 S Stoll-Kleemann and T O'riordan, 'From Participation to the Partnership in Biodiversity Protection: Experience from Germany and South Africa,' *Society & Natural Resources* Vol. 15, No 2, 2002, pp 161–187.

68 Gadgil, Berkes and Folke 1993.

69 BJ Richardson, 'Indigenous Peoples, International Law and Sustainability,' *Review of European Community and International Law,* Vol 10 ,No. 1, 2001, pp 1–12.

70 F Figge, 'Bio-folio: Applying Portfolio Theory to Biodiversity,' *Biodiversity and Conservation* Vol. 13 No. 4, 2004, pp 827–849.