Large Scale Conservation Planning and Priorities for the Kavango-Zambezi Transfrontier Conservation Area

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by

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EXECUTIVE SUMMARY

The Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) in southern central Africa covers an area of c. 400,000[1] km^2 – an area slightly larger than that of Zimbabwe, and 1.6 times the size of Great Britain. The Victoria Falls forms a well known central point in the TFCA and is near the meeting point of four of the five participating countries (Angola, Botswana, Namibia, Zambia, and Zimbabwe). Two major river basins, the Zambezi and the Okavango contribute major wetlands, including the Okavango Swamps, to the generally flat to gently undulating KAZA-TFCA landscapes. In palaeo-evolutionary terms the two basins are closely interlinked – a feature that has influenced the biodiversity of the area and which has important implications for wetland species and their conservation.

KAZA encompasses globally significant wetlands and includes large areas of the Miombo-Mopane and the Kalahari-Namib Wilderness Areas. The region carries impressive populations of large mammals and birds, the largest elephant population in the world, two globally threatened large mammals (black rhinoceros and wild dog), several endemic species of plants, reptiles and amphibians, one endemic mammal and one endemic bird species. The TFCA includes a human population in the region 1.5 million people but large areas carry population densities of less than 5 people per km^2.

The mission of the participating countries, expressed in their December 2006 MOU, is:

> *"To establish a world-class transfrontier conservation area and tourism destination in the Okavango and Zambezi river basin regions of Angola, Botswana, Namibia, Zambia and Zimbabwe within the context of sustainable development."*

and the primary objectives are to:

- *a.* *"Foster trans-national collaboration and co-operation in implementing ecosystems and cultural resource management;*
- *b.* *Promote alliances in the management of biological and cultural resources and encourage social, economic and other partnerships among their Governments and stakeholders;*
- *c.* *Enhance ecosystem integrity and natural ecological processes by harmonizing natural resources management approaches and tourism development across international boundaries;*
- *d.* *Develop mechanisms and strategies for local communities to participate meaningfully in, and tangibly benefit from, the TFCA; and*
- *e.* *Promote cross-border tourism as a means of fostering regional socio-economic development."*

[1] The boundary of the TFCA has not yet been set and quoted figures for the area of the TFCA vary considerably. The figure of 400,000 km^2 is the approximate area of the TFCA covered by this report.

This desk study[1] examined large scale conservation planning priorities with an emphasis on resilience of the KAZA TFCA system to climate change and threats to wetlands, ecosystems and conservation areas. Major current and likely future influences and disturbances relating to the TFCA and its components were examined at large, intermediate and local scales with a view to drawing out key vulnerabilities and large scale issues and priorities for the conservation and development of the KAZA TFCA.

Climate change

Present climate change predictions are that the KAZA region will become warmer and drier during the next 50 to 100 years. Human populations are likely to increase at the same time with the result that increased pressure will be placed on water and renewable natural resources. Climatic variability can also be expected to increase and the livelihoods of subsistence farmers will be seriously compromised by declining and erratic productivity. The importance of giving early consideration to adaptive strategies in the development of the KAZA TFCA, its people, and the conservation of its biodiversity cannot be overemphasized.

Large scale drivers

Major **global drivers** that will influence the development of the KAZA TFCA, apart from climate change, include the global economy, international conventions, conservation and development values (which influence tourists and their choice of destinations) and animal diseases and access to export markets. The **regional scale** economy, SADC protocols, disease issues, and national legislation relating to natural resource management, will clearly drive aspects of TFCA development. However, two additional crucial drivers are the inherent ecological constraints that the region faces and water flows into the major wetlands within KAZA. Most of KAZA is underlain by Kalahari sands which are inherently infertile so that intensification of agricultural production (e.g. through irrigation) is unlikely, even in areas of higher rainfall. More importantly the TFCA wetlands depend on water flows from distant highlands Angola, Zambia and the Congo. More than 70% of the water flowing into the Okavango Delta is derived from the Angolan highlands and landuse practices and water withdrawals in the upper catchment of the Okavango Basin will have an important bearing on the future of the KAZA TFCA and its wetlands.

Current and future trends and prospects for the growth of global and regional tourism are clearly an important factor in the development of the KAZA TFCA because much of its development has been predicated on revenue generated from tourism. The central attractions of KAZA revolve around its wetlands but unfortunately these are the features most vulnerable to climate change. As a result there will be a need to diversify both the range of tourism products within KAZA, and their spatial distribution, in order to ameliorate the impacts of projected declines in rainfall and wetlands in the KAZA area.

Harmonizing natural resource management across national boundaries in the TFCA is an explicit objective of the MOU underpinning the development of KAZA. Achieving this will require attention to national legislation and policies in so far as they affect the TFCA. Differences in policy and legislation between the states are probably greatest in relation to the management, use and benefits that may be derived from wildlife by those living on the land

[1] The primary audience for this study is those non-governmental agencies assisting in the conservation and development of the KAZA TFCA.

outside protected areas, i.e. by those who bear the costs of conserving wildlife but realize little of its benefits. I flag this as one of the major issues requiring attention in the context of building adaptive capacity in the face of climate change and sustaining the future development of the KAZA TFCA.

Disease control strategies for subsidized livestock industries have had major impacts on landuse and conservation in southern Africa and in the five KAZA countries during the last century. Much of the impact has resulted from the erection of disease control game fences across vast swathes of country in Namibia, Botswana and Zimbabwe. Game elimination was used to control tsetse fly in northwestern Zimbabwe from 1919 to mid-1970s. There are about 15 wildlife-livestock diseases of concern in the KAZA TFCA region, of which half are transmissible to humans. An important emerging issue is the extent to which climate change will alter the patterns and distribution of diseases across the sub-region and influence zoonotic diseases and the emergence of new human and animal diseases. The interactions between climate change, patterns of land and resource use, and diseases are likely to be complex and form major drivers in the future development and sustainability of the KAZA TFCA.

Intermediate scale drivers

Within the KAZA TFCA region a clear southwest-northeast gradient in annual rainfall from a low of c. 100mm in the south to 1100mm in the north gives rise to a corresponding gradient in large mammal and tree species diversity, with the highest numbers of species occurring in the northeast and east. The associated gradient in vegetation structure, from desert shrubs in the south to forest in the north, provides an indication of the shift in habitats that may occur with a northward shift in rainfall isohyets under climate change, or through desertification resulting from inappropriate landuse.

The KAZA TFCA is characterized by three centrally located clusters of protected areas, namely, (a) Chobe, Moremi, Babwata Luiana, Sioma-Ngwezi and the Caprivi, (b) Hwange-Matetsi-Zambezi, (c) Kafue and surrounding Game Management Areas. Three further outlying clusters include the Khaudom area in the west, Lake Kariba and the Sebungwe in the east and the Mavinga and Liuwa Plains areas in the north. The intervening matrix is characterized by land under communal or traditional tenure by small-scale subsistence farmers with populations that are growing at c. 2 – 3% per year. Demographic changes and increasing human population thus form a potentially important driver of change within the TFCA. In some parts of the KAZA TFCA region land use has moved increasingly towards wildlife and tourism. However, population growth and development of infrastructure can result in rapid changes in land use, as was experienced in the Sebungwe region of Zimbabwe. Here, the human population increased between 1973 and 1993 by between 85% and 182% in the three districts comprising the Sebungwe, with a corresponding increase in the area cleared for cultivation and settlement; the provision of access roads and the eradication of tsetse fly facilitated resettlement from overcrowded areas elsewhere in the country. This analysis emphasizes the importance of establishing appropriate incentives and benefits for local communities from wildlife based land uses if protected areas in the KAZA TFCA are to avoid becoming isolated ecological islands. The importance of developing adaptive co-management arrangements between protected areas and neighbouring areas and communities is also stressed.

Biodiversity and the KAZA conservation area network

Several features of the biodiversity of the KAZA TFCA are summarized in the report. Summaries include: overall and national numbers of species of plants, vertebrates and butterflies, lists of endemic and threatened species, important bird areas and areas of concern for plant conservation. Key Biodiversity Areas have not been identified in the KAZA TFCA although several areas that carry globally threatened species such as the black rhinoceros and wild dog would qualify as such.

The conservation area network is made up of eleven categories of conservation area which range from state protected areas (e.g. national parks and forest areas with no human settlement) through various categories of designated hunting areas (some of which come are unsettled and others which are under communal tenure and subsistence agriculture), to community conservancies. Some 76% of the overall KAZA TFCA area (~ 400,000 km^2) is under some form of conservation area. Of the total KAZA area 22 % is within protected areas in which there is no human settlement[1], 54% is covered by settled hunting areas and community conservancies, and the remaining 34% is covered by communal areas, including small portions of urban and peri-urban development.

Criteria were developed for ranking conservation areas on the basis of their biodiversity and conservation value, their conservation effectiveness, and threats from population growth and agricultural development. The following categories of criteria were used to rank 69 conservation areas within the KAZA TFCA:

Biological Value

1. Size of area
2. Large scale habitat diversity
3. Types of wetland
4. Endemic and threatened plants
5. Endemic and threatened vertebrates
6. Key ecosystem processes

Conservation effectiveness

1. Legal status (official legal security of the area)
2. Historical and traditional status
3. Resources available for protection and conservation action
4. Level of development and implementation of protected area plans
5. Research and monitoring

Threats

1. Land pressures
2. Land capability (potential development pressures)

The scores for each area and the rankings resulting from the additive score of biological value and conservation status provided a preliminary but plausible ranking of conservation areas within the KAZA TFCA. Those conservation areas falling in the top ten were all national parks, apart from the Moremi Game Reserve in Botswana and the Western GMA in Zambia. The priority areas are also, for the most part, clustered in the central area of the

[1] Babwata National Park has a resident San population and its area is not included in this figure.

TFCA. The high rank of the Western GMA suggests that this area merits attention in terms of its biodiversity, wetlands, and potential to form an important corridor area. The high ranking of the Makgadikgadi Pan NP also suggests that this park, and its linkages to the rest of the TFCA, merits greater attention.

Conservation effectiveness of protected areas throughout the TFCA is weak, with the highest score being that for Hwange National Park, returning a score of 14 out of a maximum possible score of 20. This exercise also highlighted the urgent need for greatly improved, up-to-date information on the distribution and status of biodiversity in the TFCA, as well as the need for improved and accessible information on the effectiveness of conservation activities in the protected areas of the KAZA TFCA. The low level of funding available to all of the protected areas in the KAZA TFCA is a matter of concern. An analysis of funding for five major protected areas in the KAZA TFCA from three countries revealed that all were receiving less than 50% of the budgets required for their effective operation with budget deficits ranging between 61% and 91%.

Ecosystem services

The results of valuations of ecosystem services in the KAZA region are available for wetlands in the Barotse Flood Plan, eastern Caprivi and the Okavango Delta, for the relative values of livestock and wildlife-based tourism in Ngamiland, and for safari hunting in the Madumu Complex in the Caprivi. The wetland studies indicate that cattle stocking rates in these areas are about twice as high as they would be in adjacent dry land areas and that wetland services (e.g. fish, reeds, palm leaves, food plants) contribute about 40-50% of net household financial returns. The status (high, medium, low) of wetlands, forests, grazing and recreational services, and of ecosystem intactness was estimated for each conservation area (Appendix1). This crude assessment suggests that the state of these key ecosystem services in the KAZA region is generally depressed. However, the current state of knowledge of ecosystem services in the KAZA TFCA, and indeed in partner countries, is not sufficiently well developed to allow an effective evaluation and ranking of the protected areas within KAZA on the basis of their contribution to ecosystem services in the TFCA and its people. Similar considerations apply to the question of the contribution that wildlife corridors may make to the provision of ecosystem services and to the long term sustainability of the KAZA TFCA. It is suggested that the assessment of ecosystem services in the KAZA TFCA would be more meaningful were it linked to a sustainable livelihoods framework.

Conservation outside protected areas

Although designated conservation areas of one form or another cover an impressive ~76% of the area of the KAZA TFCA the reality is that most of this land is occupied under communal systems of tenure. Only 22.5% of the TFCA falls within unsettled protected areas. A major challenge facing the TFCA is therefore the development of appropriate incentives for rural communities to conserve and protect biological diversity in the matrix between protected areas. Given that resources for state protected areas are inadequate, it is clear that states will not have the resources to protect wildlife in the wider matrix. The devolution of resource access rights and resource management is examined within the framework of scale mismatches between social and ecological scales. Present national policies, with the possible exception of Namibia, effectively tax community wildlife resources and so greatly reduce the potential benefits rural communities might gain from their wildlife. It is concluded that unless those living on the land with wildlife derive the full and appropriate benefits from wildlife-based land uses they will increasingly transform land towards agricultural production. The end result would see protected areas as isolated ecological islands in a sea of transformed agricultural land and a failure of the KAZA TFCA as a conservation and development initiative.

Linkages and wildlife corridors

The separation of clusters of conservation areas in the KAZA TFCA raises the question of potential linkages between conservation areas and what purpose these may serve. The following functions may be important in terms of the KAZA TFCA and its sustainability in the face of climate change:

a. Migration corridors that serve to maintain regular seasonal movements of animals between alternative areas or habitats.
b. Dispersal corridors that serve to allow the dispersing component of particular species populations to move to other suitable areas or habitats.
c. Adaptive response corridors that provide for both fauna and flora to shift, or disperse, along ecological gradients in response to changing climatic conditions.

Migrations: There is presently no evidence of transboundary migrations of large mammals in the KAZA TFCA. However, regular internal migrations of wildebeest and zebra occur (or occurred) in two areas of Botswana, namely, between the Linyanti and Savuti, and in the Makgadikgadi area. A regular wildebeest migration occurs to the north of the TFCA across the Liuwa Plains.

Dispersal corridors: Attention has so far focused on providing corridors for elephants to disperse from high density areas. However, there are dangers in spreading elephant impacts into sensitive habitats that are still intact – particularly riparian fringes that provide important habitat and corridors for a wide range of species in the system. The role of wildlife corridors in the dispersal of predators within the KAZA TFCA has received little if any attention.

Adaptive response corridors will be needed as climate change alters the distribution and plant species and habitat structure. However, given that a vast number of species are involved and that their likely responses to climate change are largely unpredictable, the only fail-safe strategy that can be applied under present circumstances is to avoid, as far as possible, foreclosing options on potential linkages along the north-east and easterly gradients suggested earlier.

Options and priorities for establishing wildlife corridors in the KAZA TFCA were examined and nine potentially important corridors were identified. Potential impediments or barriers to their establishment (e.g. fences, dense human settlement, highways, conduits for disease or the spread of alien species) were tabulated. Three priority corridors are considered to be those linking: (a) Chobe NP – Babwata NP – Liuana – Sioma-Ngwezi, (b) Chobe NP – Zambezi NP-Matetsi-Hwange NP complex, (c) Caprivi-Zambezi NP – Kafue NP. Other important corridors are the link in the west between Babwata and Khaudom national parks, in the south between Chobe, Nxai Pan and Makgadikgadi national parks, and between Hwange and Makgadikgadi national parks. In the north the possible links between Mavinga and Liuwa plains and their links to the south will merit examination.

Resilience, adaptability and sustainability

Concepts of resilience, adaptability and sustainability were briefly outlined before examining the evolutionary history of drainage basins in south central Africa. There have been major changes in river flows during the last three million years that have a direct bearing on the biodiversity of the KAZA region and that have implications for maintaining linkages between wetlands within the region in relation to climate change. A summary is provided of time lines for major shocks, disturbances and drivers that impacted on the KAZA TFCA region over the last 2,000 years. These underscore the major current vulnerabilities facing the KAZA TFCA at the large, intermediate and local scales that were identified in earlier sections. In summary these were as follows:

Large scale, external drivers:

- the state of the global economy
- international conventions
- conservation and development values
- issues relating to disease and international markets

Drivers external to the TFCA, but within the region:

- water flows
- disease
- national legislation relating to conservation and natural resource management in particular
- SADC protocols
- national and regional economies

The major drivers within the TFCA itself are those relating to:

- land use and tenure
- human population growth and increasing pressures on natural resources and ecosystem services
- governance and access rights to natural resources and benefits from wildlife
- insufficient investment in the protected areas system

All of these factors, across the full range of scales, are likely to be impacted by **climate change** which is predicted to result in a warmer and drier KAZA TFCA.

Attention is drawn to the persistent failure of large, top-down, sectoral driven development projects and the need to engage with emerging development models, particularly those relating to natural resources that focus on processes with the following characteristics:

a) place a premium on, and invest in higher valued land uses, diversification, and intensification (e.g. irrigation, cash cropping, high value tourism where appropriate and sustainable)

b) decouple wealth creation from primary production

c) match land use and ecological process scales

d) develop policy and supporting legal frameworks that enable, rather than stifle, innovation, experimentation and adaptability at local and regional scales

These approaches require information, learning, strong feedback, and the freedom to adapt (i.e. to use experiments, learning and experience) at several levels. In considering conservation action in relation to climate change McClanahan et al[1] provide a helpful framework that scales environmental susceptibility against social adaptive capacity as a basis on which to assess and guide needed action. Finally Levin's[2] eight commandments for sustainability are briefly introduced. These are: 1. Reduce uncertainty, 2. Expect surprise. 3. Maintain heterogeneity, 4. Sustain modularity, 5. Preserve redundancy, 6. Tighten feed-back loops, 7. Do unto others as you would have them do unto you.

Priorities and recommendations

The following major priority areas emerge from this short study:

1. Water flows and wetlands
2. Natural resource governance and benefits to rural communities. A release from central command and control approaches to natural resource management and conservation is needed
3. Diversification and adaptive co-management
4. Biodiversity linkages and conservation planning
5. Improved basic inventories of biophysical and social components of the system, monitoring, and participatory science

Each of these is enlarged upon briefly below:

1. Water flows and wetlands.

The centre piece of the KAZA TFCA is its wetlands. These are focal areas for a large part of the human population residing in the TFCA. They support a wide range of important wetland dependent species and play a key role in the region's tourism development. But the wetlands within KAZA are vulnerable not only because of impending climate change but also because they depend on water derived from distant highlands. As a result it will be vital for the TFCA to:

- Promote integrated catchment management and support and influence the work of catchment management authorities.
- Pay early attention to land use changes in the high water-yielding upper reaches of the major rivers flowing into the TFCA and explore ways of providing incentives to those in the upper catchments to maintain equitable water flows (e.g. payments for ecosystem services) into the future.
- Minimize land use practices that degrade wetlands within the TFCA. This requirement will depend very largely on resolving a range of natural resource governance and related livelihood issues.

These are large-scale, multi-faceted and complex issues that will require investment in ongoing information gathering, monitoring, and capacity building at the interface between biophysical and social sciences and policy. And, because policy change and needed societal

[1] McClanahan, et al (2008) Conservation action in a changing climate. *Conservation Letters,* **1**, 53-59.
[2] Levin, S. (1999) *Fragile dominion: complexity and the commons*. Perseus Publishing, Cambridge, Massachusetts.

change can be slow, both immediate and long term commitment by governments, NGOs and civil society will be needed.

2. Natural resource governance

The dominant form of land use in the KAZA TFCA is subsistence agriculture under communal tenure in nutrient poor, mostly semi-arid systems. The potentially rich biodiversity of the area and its wetlands are undervalued, mostly because those living on the land are unable to realize the full value and benefits of this rich heritage. This is very largely a result of inappropriate institutions governing resource access rights and benefits streams, and associated mismatches between social and ecological scales. The success of the KAZA TFCA as a conservation and development initiative rests squarely on the extent to which rural communities will benefit from wildlife-based land uses. Reforms in tenure and resource access rights will be crucial to the sustainability of the KAZA TFCA and a critical comparative analysis of the trade offs of alternative policies and of scenarios for future development is an immediate priority.

3. Diversification and adaptive co-management

The maintenance and generation of diversity is accepted as a fundamental characteristic of resilient systems. This is true whether it be species, ecological communities, or social systems. The more homogenous systems become, the more susceptible they are to shocks and surprises. The important issue for KAZA is – how can these principles be translated into conservation action?

On the ecological front, the major disturbances that are likely to generate homogeneity in the system are human land use practices, elephants and fire. The replacement of multispecies systems of large wild mammalian herbivores with single-species livestock systems, together with fences across much of the landscape, is a case in point. The ‘homogenizing’ impacts of high elephant densities and fires on woodland and forest resources in the region are well established and require attention.

Similar concerns apply to the social systems in terms of their development within the region. The recently proposed ban on safari hunting in much of Ngamiland and Chobe Districts in Botswana will immediately curtail diversity in the tourism industry. Very constrained models of community based conservation throughout the region will also do so.

Tackling these linked social-ecological issues will require influencing policy and practice in natural resource management from national to local levels. This will need greatly improved information on the current status and trends in landuse and land cover change, on biodiversity, livelihoods and natural resource use, demographics and disease, the tourism industry, and so on. As noted in the previous section, reducing uncertainty is a primary consideration in developing system sustainability.

Associated with the importance of maintaining and generating diversity is the need to develop policy frameworks within KAZA that encourage experimentation and diversification in all fields, and that foster the development of adaptive capacity.

4. Biodiversity linkages and conservation planning

The broad-scale southwest-northeast rainfall and biodiversity gradients in the KAZA region indicate how habitats may change along these gradients under climate change. Associated with these projected changes will be the need to maintain ‘adaptive response corridors’ along these biodiversity gradients. Counterbalancing the creation of wildlife corridors and linkages, however, will be the need to maintain a measure of modularity within the larger landscape of the KAZA TFCA. We currently lack the information needed to make well informed specific recommendations in this regard.

There is, as yet, little evidence of investment in systematic conservation assessment and planning. Planning for pattern and persistence and ecosystem processes in the development and management of the KAZA TFCA also appears to be lacking. New and powerful approaches have been developed to tackle these problems in the last two decades and surely merit investment in, and application to, the development of conservation planning in KAZA[1].

5 Information and participatory science

An overriding impression in conducting this study has been how little current, sound information is available and accessible on a wide range of topics for the KAZA TFCA. Major gaps that need to be filled include the current distribution and status of plant and vertebrate taxa throughout the TFCA, but particularly in Angola and Zambia. The status of the few endemics, particularly the herpetofauna, urgently needs to be assessed. Some of these species and areas would almost certainly merit Alliance for Zero Extinction (ACE) ranking.

Information on protected areas (check lists, numbers or status, distribution, habitats, budgets, staff levels, etc.) and on their performance is not generally available. The setting up of an open web-based but quality controlled “Wiki” directory on the protected areas in the KAZA region may assist in filling many of the gaps.

Similar gaps exist in the information base on forest areas and on ecosystem services throughout the KAZA region.

The region has universities and research departments in its conservation agencies that, with appropriate support, could readily be enlisted in contributing towards an improved knowledge base for the KAZA TFCA.

The development of a more participatory culture between governments (both central and local), NGOs, the private sector, and the range of stakeholders living within the TFCA, in terms of research and information sharing, is also urgently needed.

6 Specific priorities

In addition to the large scale priorities which apply across the KAZA TFCA the following specific priorities merit attention and action by government and non-governmental conservation agencies.

1. Harmonising conservation legislation and developing policies for transboundary natural resource management. This was listed as an objective by the parties to the TFCA MOU.

[1] Here I refer particularly to the work of Richard Cowling and Andrew Knight and their colleagues in South Africa in the Cape, the Valley Bushveld and the Cederberg, and the recent work of Smith et al in the Maputaland TFCA

2. A re-examination of the role of veterinary control fences in the control of animal diseases over large landscapes and exploring the social, economic and environmental costs of alternative disease management strategies.
3. A critical examination of polices and incentive structures relating to wildlife as a landuse – particularly as these relate to conservation and wildlife outside state protected areas.
4. A detailed examination (including ground surveys and mapping) of the basis for, and the feasibility of, establishing the priority wildlife corridors of (a) Chobe – Luiana – Sioma-Ngwezi, (b) Chobe – Hwange, and (c) Sioma-Ngwezi – Kafue – Zambezi NP.
5. Developing more sustainable and adequate funding streams for the effective management of protected areas in the TFCA, possibly through public-private-community partnerships.

For each of the above priorities there is scope for conservation NGOs, aid agencies and the private sector to engage with governments to effect progress and improved conservation and livelihoods in the KAZA TFCA.

The signing of an MOU by five participating countries to establish a TFCA of nearly 400,000 km^2 provides a unique window of opportunity through which to explore and develop innovative approaches to conservation in large landscapes in the region – it is an opportunity that needs to be seized by all involved.

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Abbreviations and Acronyms

ACE	Alliance for Zero Extinction
ADMADE	Administrative Management Design for wildlife
AHEAD	Animal Health for Environment and Development
Ang	Angola
AWF	African Wildlife Foundation
BTB	Bovine tuberculosis
Bw	Botswana
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CBNRM	Community based natural resource management
CBPP	Contagious bovine pleuropneumonia
CC	Community Conservancy
CHA	Controlled Hunting Area
CITES	International Convention on Trade in Endangered Species
FAO	United Nations Food and Agriculture Organisation
FEWS	Famine early warning system
FMD`	Foot and Mouth Disease
FR	Forest Reserve
GDP	Gross domestic product
GIS	Geographical information system
GLTFCA	Great Limpopo Transfrontier Conservation Area
GMA	Game Management Area
GR	Game Reserve
IBA	Important Bird Area
IGBP	International Geosphere-Biosphere Program

IPCC	International Panel on Climate Change
IUCN	International Union for the Conservation of Nature and Natural Resources
KAZA	Kavango-Zambezi
KBA	Key Biodiversity Area
LIRDP	Luangwa Integrated Rural Development Project
MA	Millennium Ecosystem Assessment
Na	Namibia
NACSO	Namibian Association of CBNRM Support Organisations
NP	National Park
OKACOM	The Permanent Okavango River Water Commission
OUZIT	Okavango Upper Zambezi International Tourism Initiative
PR	Partial Reserve
RP	Recreational Park
RAMSAR	RAMSAR Convention on Wetlands of International Importance
SABONET	Southern Africa Botanical Diversity Network
SA	Safari Area
SADC	Southern Africa Development Cooperation
SES	Social-ecological system
WCMC	World Conservation Monitoring Center
WMA	Wildlife Management Area
WWF	World Wide Fund for Nature
TFCA	Transfrontier Conservation Area
ZACPLAN	Zambezi River System Action Plan
ZAWA	Zambia Wildlife Authority
Zm	Zambia
Zw	Zimbabwe

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1.

INTRODUCTION

The Kavango- Zambezi Transfrontier Conservation Area (KAZA TFCA) is situated in southern central Africa (**Fig. 1.1**) and covers an area of about 400,000[1] km^2, i.e. an area slightly greater than that of Zimbabwe and nearly four times the size of Malawi. It is centered on an area near the Victoria Falls where the boundaries of four out of the five participating countries meet. The countries concerned are Angola, Botswana, Namibia, Zambia, and Zimbabwe. The area also sits astride two major catchments. The Zambezi catchment, to the north and east, drains into the Indian Ocean while the western and southern part of the TFCA falls within the endoreic Okavango basin within which the Okavango swamps, in northern Botswana, form an outstanding feature. In palaeo-evolutionary terms the two basins are closely interlinked; a feature that has influenced the biodiversity of the area and which has important implications for wetland species and their conservation.

KAZA encompasses globally significant wetlands and wilderness areas. The Okavango swamps are registered as a major wetland site under the 1971 RAMSAR Convention on Wetlands of International Importance, and a large part of the TFCA falls with two of the 24 major terrestrial wilderness areas remaining on earth (Mittermeier et al 2003). The World Wide Fund for Nature (WWF) have identified it as a key area within the Miombo ecoregion, itself a global priority, and it is one of the African Wildlife Foundation's (AWF) priority heartlands. Mittermeier et al (2003) classified globally important wilderness areas as those areas greater than 10,000 km2, in which more than 70% of the habitat was intact and where rural human population densities were less than 5 people per km^2. The KAZA TFCA includes areas of the Miombo-Mopane (3.2 people/km^2) and the Kalahari-Namib (0.62 people/km^2) Wilderness Areas. Several plant, reptile and amphibian species, one mammal and one bird species are endemic to the KAZA area.

An early mission statement for the TFCA adopted by a ministerial meeting of the five participating countries (Transfrontier Conservation Consortium, Final Report: Pre-feasibility Study 2006a) was as follows:

> *"To establish a world-class transfrontier conservation area and tourism destination in the Okavango and Zambezi river basin regions of Angola, Botswana, Namibia, Zambia and Zimbabwe within the context of sustainable development."*

The primary objectives of the KAZA TFCA, as expressed in an MOU between the signatory countries on the 6 December 2006 (Transfrontier Conservation Consortium 2006a) were as follows:

f. *"Foster trans-national collaboration and co-operation in implementing ecosystems and cultural resource management;*

[1] The boundary of the TFCA has not yet been set and quoted figures for the area of the TFCA vary considerably. The figure of 400,000 km^2 is the approximate area of the TFCA covered by this report.

g. *Promote alliances in the management of biological and cultural resources and encourage social, economic and other partnerships among their Governments and stakeholders;*

h. *Enhance ecosystem integrity and natural ecological processes by harmonizing natural resources management approaches and tourism development across international boundaries;*

i. *Develop mechanisms and strategies for local communities to participate meaningfully in, and tangibly benefit from, the TFCA; and*

j. *Promote cross-border tourism as a means of fostering regional socio-economic development.*

In the period leading up to the signing of a treaty that will formally establish the KAZA TFCA, the partner countries will refine these objectives to make them specific to the KAZA region. These refined objectives will form part of the treaty."

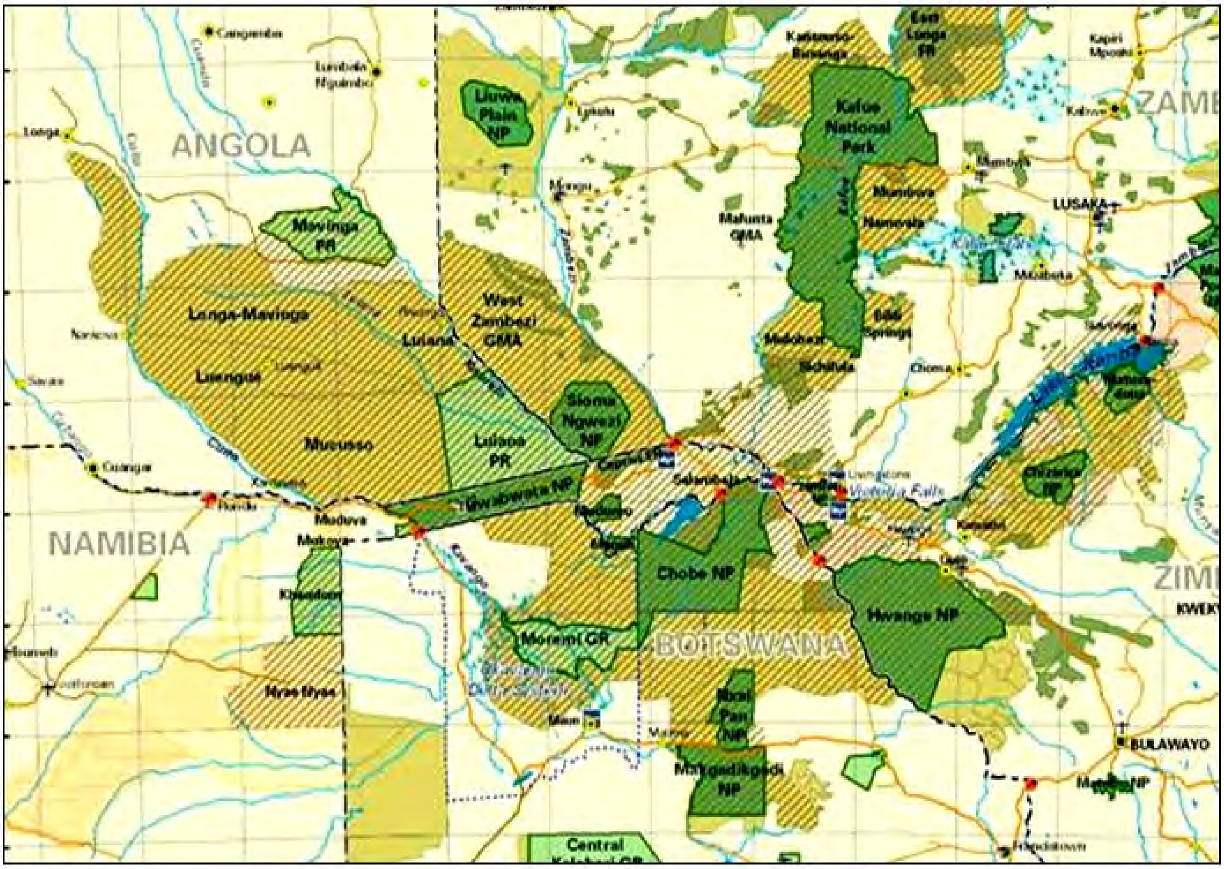

Fig. 1.1 General map of the KAZA TFCA region and the proposed TFCA area (cross hatched) (Map adapted from Transfrontier Conservation Consortium 2006 Final Report: Pre-feasibility Study of the proposed KAZA TFCA)

Although enhancing ecosystem integrity and ecological processes are included in the objectives, it is noteworthy that there is apparently no mention of conservation, biodiversity or sustainability in the MOU. However, each participating country includes conservation aims and objectives within its national legislation, as does the SADC protocol on Wildlife Conservation and Law Enforcement in Southern Africa (SADC 1999, Jones 2008). The protocol encourages the conservation and sustainable use of wildlife resources in each country and specifically endorses the establishment of TFCAs in Article 5, paragraph (f) as follows:

> "*f) promote the conservation of shared wildlife resources through the establishment of transfrontier conservation areas;*"

A key objective of the Zambian integrated development plan for their component of the KAZA TFCA is explicit on the point, namely, *"to join fragmented wildlife habitats into an interconnected mosaic of protected areas and transboundary wildlife corridors, which will facilitate and enhance the free movement of animals across international boundaries."* (Zambia Wildlife Management Authority 2008, page 3)

An initial impetus for the development of the TFCA arose from regional spatial development plans (Okavango Upper Zambezi International Tourism Initiative – OUZIT) that identified the Victoria Falls as an important, if not outstanding, tourism hub in southern Africa. The hub included ready access to major protected areas (e.g. Chobe, Kafue and Hwange National Parks, as well as the Moremi Game Reserve, the Okavango Swamps and Lake Kariba). In addition there are many smaller national parks, forest reserves, and an increasing number of community conservancies within the nominal boundaries of KAZA. The area is covered by a wide range of approximately 70 conservation areas that cover more than 300,000 km^2, or three-quarters of the overall KAZA area[1]. Nearly 22% (~ 92,000 km^2) of the KAZA TFCA area is covered by state protected areas that exclude human settlement.

The KAZA TFCA includes components of five partner countries, people of many cultures and languages and governance systems, a multitude of ecosystems, land uses, protected areas, and plant and animal species. The human population of KAZA is approximately 2 million. Population density is generally low at less than 5 people per km^2. Areas with higher population densities (5 to 25 people per km^2) include the Caprivi, the Barotse flood plain areas upstream of Mongu in Zambia, the communal lands of the Sebungwe region to the south of Lake Kariba in Zimbabwe, and the area around Maun in Botswana. The region encompassed by the TFCA is in effect a complex, linked social-ecological system (SES) that is continually changing an adapting.

The KAZA TFCA Pre-feasibility Study (Transfrontier Conservation Consortium 2006a & 2006b) identified the following as contemporary threats to the development of KAZA:

- *Seasonality of tourism*
- *Vulnerability of tourism to international terrorism*
- *Competition from Africa's established regional tourist destinations*
- *Global recession*
- *Other regions competing for investment*
- *Inconsistencies in economic policies of partner countries*
- *Global warming*
- *Poverty*
- *External ecological impacts*
- *Crime, conflict and corruption*

The southern African component of the Millennium Assessment (Biggs et al 2004, Scholes and Biggs 2004) examined the current state of ecosystems and the goods and services they

[1] This study suggests that the area is closer to 400,000 km^2 instead of the usually quoted figure of 300,000 km^2.

provide. These studies also explored alternative scenarios on how the above may fare in the face of increasing populations, land use change and climate change. Water, in all its uses (potable, agricultural, industrial, maintaining natural river processes, wetlands and dependant species) emerged as a major concern.

A key developmental issue for KAZA is the sustainability of its conservation values and the ecosystem goods and services it can provide to an expanding human population and a growing tourism industry, especially in the face of looming climate change. So, how resilient is the KAZA TFCA likely to be in the face of global and local climate change and the host of related shocks and surprises that are sure to accompany it? How can adaptive capacity be developed within the KAZA SES system? Can large scale planning at this early stage be developed to build adaptive capacity and resilience to mitigate the effects of climate change?

This report first outlines the current climate change predictions for the region that include the KAZA TFCA (Section 2), with a focus on temperature and precipitation and the likely impacts, in broad terms, on landuse, livelihoods and conservation in the TFCA. The following three sections then examine key factors, drivers and issues likely to impact the development of KAZA TFCA from differing scales, namely, from the perspective of the southern African region, from an intermediate scale and perspective within KAZA, and at the local scale of individual protected areas within KAZA. Larger scale external influences on KAZA, including ecological constraints to productivity in the region, are examined in Section 3 and include KAZA's dependence on water derived from catchments outside its boundaries and wider economic, governance and political influences, and disease issues.

An intermediate scale perspective of KAZA is adopted in Section 4 where the larger clusters of conservation areas are examined together with gradients in biodiversity across the region and issues of human population growth and drivers of landuse change within the KAZA TFCA area. Section 5 then takes a 'smaller-scale' look at the biological diversity within and the conservation area network of the KAZA TFCA. It deals with species numbers, endemics and threatened species of plants and vertebrates, and categories of protected areas. Criteria for ranking individual conservation areas in terms of their biological value and conservation status are developed and applied to an inventory of more than 70 protected areas in the TFCA. The value and ranking of conservation areas is linked to a summary characterization of the full range of these which is contained in Appendix 1.

Ecosystem goods and services in the TFCA, particularly for wetlands, are reviewed in Section 6. The paucity of information on the current status of ecosystems and ecosystem services in KAZA is such that a comparative evaluation of the contribution of particular conservation areas to ecosystem services, apart perhaps from the major wetlands, is not feasible at this stage.

A key to the development of the KAZA TFCA is what happens in the matrix between the largely disconnected state protected areas that form the core of the TFCA and Section 7 briefly examines some critical policy issues relating to conservation outside the boundaries of state protected areas.

The examination of conservation areas, ecosystem services, and the insights derived from a consideration of scale issues, are then brought to bear on questions of wildlife corridors, linkages and connectivity across the five participating countries (Section 8), building resilience and adaptive capacity (Section 9), and, finally, outlining priorities for the development and sustainability of the TFCA (Section 10). A characterization of each protected area in the TFCA is provided in Appendix 1.

2.

CLIMATE CHANGE

KAZA falls within the zone in southern Africa that has experienced 1 - 2°C rise in temperature over the period 1970-2004 while the projected increase through to 2100 is a likely further 2-3°C (IPCC 2007a). The IPCC 2007 broad scale scenarios for Africa indicate a major drying out over the western half of southern Africa that is centered on the Caprivi – Okavango area. This will be further reflected in a 20% reduction in the growing season by 2050 in much of the area covered by KAZA, and some countries in the region could be facing a reduction in yields from rainfed agriculture of up to 50% by 2020. These changes will clearly have implications for habitats and their productivity as well as for human welfare and food security in the region and in the KAZA TFCA in particular.

Several regional assessments predict emerging changes in the hydrology of major water systems in the region and notably in the Okavango basin. These are likely to be due to both climate change and direct anthropogenic effects through landuse and land cover change (e.g. Biggs et al 2004, Anderssen et al 2006, Boko et al 2007, and **Figs. 2.1 and 2.2**).

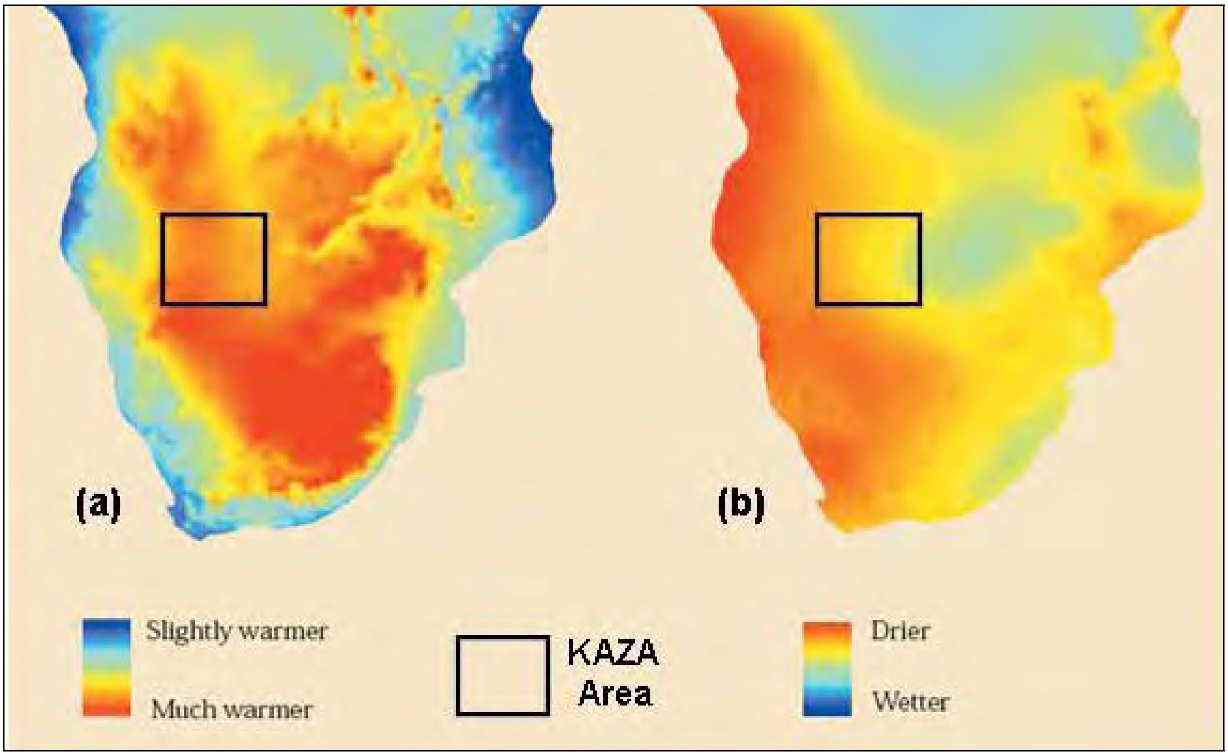

Fig. 2.1 Predicted changes in (a) temperature and (b) rainfall in southern Africa (Source: Scholes and Biggs 2004) (HADCM3 climate model projections in a) temperature, b) precipitation for 2050 relative to mean conditions over southern Africa 1961-1990 under the ICC SRES A2 (high emissions scenario).

On an Africa-wide scale the Intergovernmental Panel on Climate Change (IPCC) report for 2007 report suggests that:

> *"Agricultural production, including access to food, in many African countries and regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent. Local food supplies are projected to be negatively affected by decreasing fisheries resources in large lakes due to rising water temperatures, which may be exacerbated by continued over-fishing."* (IPCC 2007b)

Thus, not only is the KAZA TFCA likely to be directly affected by rising temperature and increased aridity but climate change will also have multiple impacts on the countries in the region, with knock-on effects on the development and sustainability of this and other TFCAs.

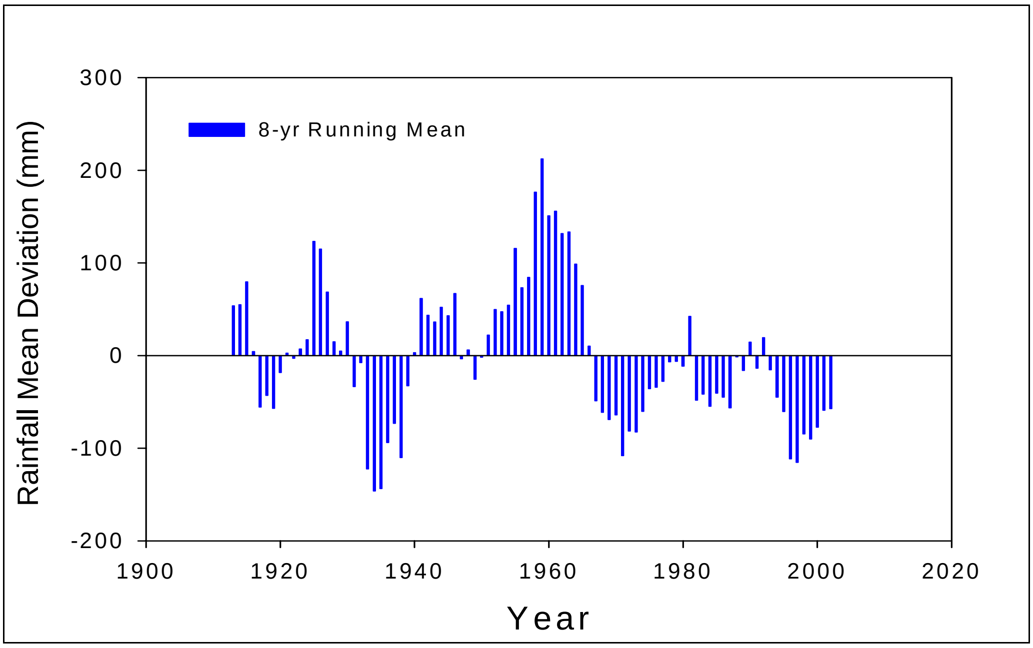

Fig. 2.2 Victoria Falls rainfall. Deviation of the 8-year running mean rainfall from the mean annual rainfall for the period 1905 to 2003. (Based on annual rainfall records from Department of Meteorological Services, Harare, Zimbabwe)

The importance of giving early consideration to adaptive strategies in the development of the KAZA TFCA and the conservation of its biodiversity cannot be overemphasized.

The southern African Millennium Ecosystem Regional Assessment (Biggs et al 2004, Scholes and Biggs 2004) examined the current state of a range of ecosystem goods and services for the mainland SADC countries (i.e. from the Congo and Tanzania southwards). The assessment also explored likely trends in ecosystem services based on future climate change and four alternative development scenarios. The mapping of many of these at a regional scale provides an indication of potential changes and trends in the area that is covered by the KAZA TFCA and these indicative trends or changes are summarised in **Table 2.1.**

Studies of likely changes in large mammal faunas as a result of climate change and land transformation suggest that arid areas, such as the Kalahari, may experience a significant decline in species richness while impacts on species richness and species survival will be less marked in moister savanna regions (Erasmus et al 2002, Thuiller et al 2006). However, several large mammal species of particular concern in the KAZA TFCA area are wetland dependent species and the risk of their loss from the system may be greater than predicted by more generalized predictions.

Table 2.1 Summary of the direction and possible magnitude of changes for environmental parameters and ecosystem services in the KAZA TFCA area based on the regional assessment of ecosystem services in southern Africa conducted as part of the Millenium Assessment (Data from Scholes and Biggs 2004)

	Parameter/Characteristic	Expected or predicted change
1	Temperature	Much warmer by 2050 (IPCC predictions indicate a 1-2°C rise in mean annual temperature in southern Africa)
2	Precipitation	Drier
3	Population growth	The average for the 5 countries = 2.06 % per annum
4	Urban population (%) 2030	55.4% of total population
5	Trends in scenarios[(a)] a) African Patchwork b) Partnership	 Biodiversity, food security, fresh water, biomass fuel, air quality – all show downward trend, nature tourism – upward trend Biodiversity – initial decline then stable, food security – improves, freshwater and biomass fuel - initial decline then stable, Air quality – decline followed by improvement, nature tourism – upward trend.
6	Map – deforestation	No deforestation in KAZA area (but elephant impacts not included)
7	Projected land cover change	SE Angola, Western Zambia and parts of NW Zimbabwe converted to agriculture or extensive grassland
8	Livestock grazing pressure	Overgrazing in Barotseland and Caprivi
9	Vulnerable areas to biodiversity loss	Much of the KAZA area. However, the remaining wild areas in southern Africa, and "seed areas" (i.e. refugia) for southern Africa occur in the KAZA area particularly in southeastern Angola.
10	Cereals	Productivity meets demand in KAZA area (but FEWS assessments indicate that production does not meet demand)
11	Distribution of cattle	High densities in Caprivi and Barotseland
12	Water supply	Adequate for KAZA area even during the driest months of the year except in Hwange and south to the Makgadikgadi region
13	Ground water	Varies between low-high and moderate-high availability for the KAZA area
14	Water demand	Drier conditions exacerbate demand
15	Woodfuel demand	Adequate supplies in the north but not in the southern part of KAZA nor in parts of Barotseland
16	Acid deposition	Northern parts of Kafue Area show some degree of sensitivity to acid deposition (probably as a result of emissions from copper mines?)

(a) Trends in scenarios. These were two scenarios developed by the Southern Africa Millenium Assessment in which characteristic features of the *Patchwork Scenario* were: ineffective governance in most countries, regional fragmentation, informal sector dominates, little investment in health and education, ongoing localized military conflicts. Features for the *Partnership Scenario* were: strong, effective central government, regional cooperation and integration, **s**trong formal economic sector, technological development and modernization, significant reduction in poverty, significant investment in health and education.

Overall, the results of the Southern African Millennium Ecosystem Assessment (Biggs et a. 2004, Scholes and Biggs 2004) imply increased pressure on natural resources throughout most of the sub-region with particularly high pressures on freshwater resources and wetlands.

3

LARGE SCALE:

REGIONAL CONTEXT AND EXTERNAL DRIVERS

The KAZA TFCA is obviously embedded in a wider regional context within which a range of factors and drivers external to the TFCA will affect and influence its development and the achievement of its objectives. These factors may be global, regional or national and this section will examine those considered to be important in any plans to increase resilience and adaptability of the KAZA social-ecological system. Because so much of the southern African economy is agrarian in nature and based on renewable natural resources it is important to be aware of the basic ecological constraints the region faces and this subject forms the starting point for this section. The more important external factors that impinge on the KAZA TFCA, and that are considered here, include transboundary water issues, potential external influences on tourism, a range of international treaties and agreements, and national legislative frameworks governing natural resource management **(Fig. 3.1)**

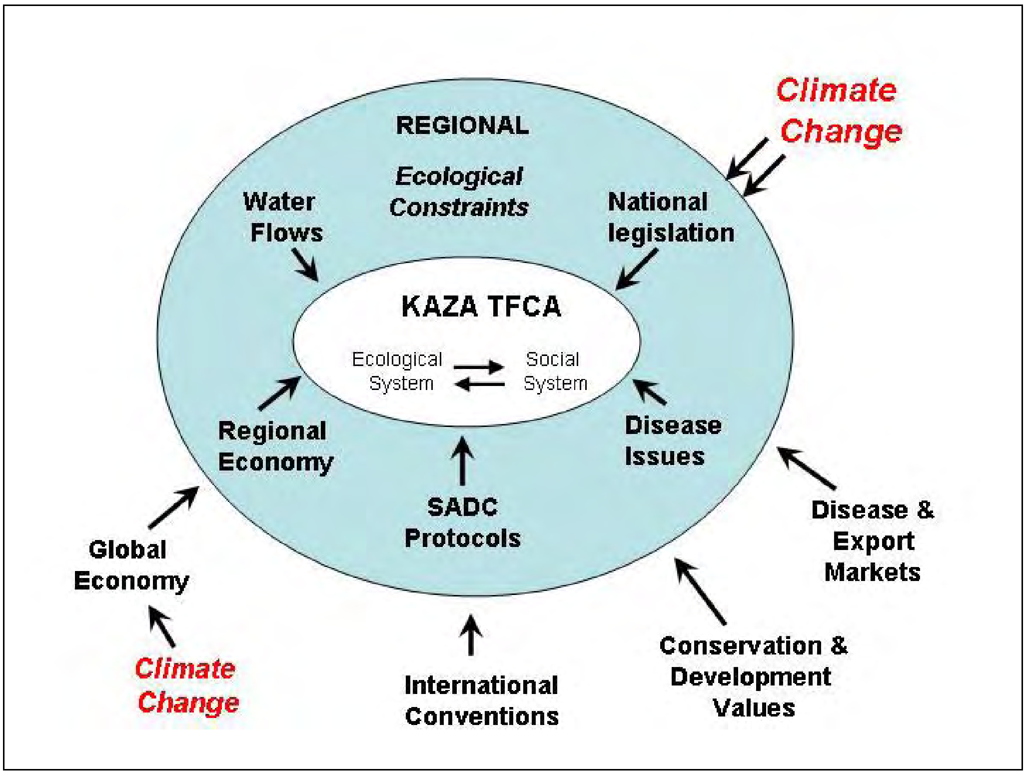

Fig. 3.1 A conceptual diagram of the major large-scale, external drivers influencing the conservation and development of the KAZA TFCA

3.1 Ecological constraints and opportunities for wildlife based land use

There are several important ecological constraints to the development of southern Africa[1] that are generally ignored in the development discourse relating to the region, but they have an important bearing on the role of conservation and TFCAs as a form of land use in the region. In summary the key features of the region (Cumming 1999) are as follows:

1. The region is predominantly arid or semi arid with uncertain rainfall. It is characterized by high spatial variability within seasons, high variability between years, recurrent but unpredictable drought over the last few decades, and increasing temperature which exacerbates the problems relating to aridity.
2. The soils are mostly derived from an ancient basement complex and are mostly infertile – a characteristic particularly applicable to the KAZA area. The soils in high rainfall areas are leached and low in nutrients (which results in unpalatable plants) while the soils in arid areas are richer but plant growth is constrained by low moisture levels.
3. Range animal production is limited by rainfall in arid areas and by nutrients in moist areas. Furthermore, livestock numbers in the region are approaching, or have reached, a ceiling. There are now more humans than there are livestock units in the region as a whole and production levels per animal and per person are about $1/20^{th}$ of those realized in Europe, for example.
4. Per capita production of staple foods and animal products has declined by more than 25% since 1980. Sustainably arable land covers only about 7% of southern Africa and irrigable land < 1%. Currently about 5-6% is cultivated and 0.28% is irrigated. Much non-arable land is cultivated. Given these data we have to question the extent to which continuing cultivation in marginal lands is sustainable. The high level of nutrient mining in sub-Saharan Africa (Drechsel et al 2001) adds further weight to these concerns.

The relevance of these features of southern Africa to the development of TFCAs and marginal lands is that wildlife based tourism can provide viable alternative development paths and opportunities. Particular attention needs to be given to decoupling the generation of wealth from a direct dependence on primary production. Because the major earnings from wildlife based land uses do not depend on the production of meat and fibre, but on services surrounding wildlife and wild places, they are less dependent on rainfall and forage production than is agriculture.

3.2 Water and wetlands

Despite the predominance of arid land in southern Africa an outstanding feature of the KAZA area is its extensive wetlands that support a rich flora and fauna and that provide an essential component to the livelihoods of a very high proportion of the people living within the TFCA. They also support a growing and internationally attractive tourism industry. These wetlands are, however, fed from high rainfall catchments lying outside the boundaries of the TFCA. Runoff from precipitation within KAZA is low as a result of the mostly extremely flat terrain and porous nature of the sands and sandy soils that predominate in the area. The status and

[1] In this report 'southern Africa' covers Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, South Africa, Zambia and Zimbabwe.

long term sustainability of KAZA's wetlands will therefore depend greatly on land use and the management of water yields and offtake in the upper catchments of the Okavango and Zambezi basins.

The KAZA TFCA sits astride two large river basins, one being the Zambezi and the other the Okavango Basin. The only other endoreic basin in southern Africa is the smaller Etosha Basin which lies to the west of the Okavango basin.

The Zambezi River basin has eight riparian states and the Okavango has four, if Zimbabwe, with the Nata River that flows into Lake Makgadikgadi, is included. Angola, Botswana and Namibia have established a river basin commission (OKACOM – Permanent Okavango River Basin Water Commission) to coordinate water resource management and examine riparian conflicts. By contrast the Zambezi Basin has only a single water authority, namely, the Zambezi River Authority formed by Zambia and Zimbabwe. The development of a wider commission through ZACPLAN (originally Zambezi basin action plan) has so far been ineffective (Nakayama 1999, Shela 2000). With the expected increase in demand for water and declining precipitation in the region of the upper catchments of these two basins, the development and implementation of effective *integrated river basin management* is becoming increasingly urgent.

The need to develop effective water management and conflict resolution strategies between riparian states is highlighted by the endoreic drainage basin of the Okavango. The Okavango system has two largely arid states that 'produce' very little water and a single state, Angola, which provides about three-quarters of the flow into the Caprivi and the Okavango delta (Ashton 2003, **Table 3.1**). The upper Zambezi wetlands are supplied primarily from Angola and Zambia but the system has not attracted the same attention as the Okavango and I have not found comparable data on water flows and use for the upper Zambezi, i.e. the catchments above the Victoria Falls.

Current water use in the Okavango basin by a full range of users (**Table 3.2**) is low and was estimated to be ~ 24 $Mm^3.yr^{-1}$ in 2000 by Ashton and Neal (2003), i.e. less than 1% of the average water flow. However, water extraction can be expected to increase dramatically (**Table 3.3**) with the resumption of agricultural development in the Angolan headwaters of the Cuando and Cuito Rivers. Ashton and Neal (2003) estimated that extraction would increase to about 300 $Mm^3.yr^{-1}$ by 2020 with the full range of expected developments in Angola and further extraction by Namibia. The figure is still low at < 3% of current estimated water flows.

However, these figures and projections do not include the potential effects of climate change on basin dynamics in terms of runoff, river flows and water use demands. Anderssen et al (2006), using the Pitman hydrological model, predicted that no more than 5% of river flow at low months would be extracted for domestic and livestock use, as well as informal and all planned formal irrigation schemes. The Anderssen et al (2006) models set the maximum effect of irrigation at a reduction of 17% of the minimum monthly flow, or 8% of the annual flow. The situation would change markedly during wet years if all of the potential hydro-power schemes were developed, while global climate change models used in their simulations indicated a reduction in flow as high as 26%. They note that the effect on minimum flow (i.e. during the driest months) is proportionally higher than on annual flows.

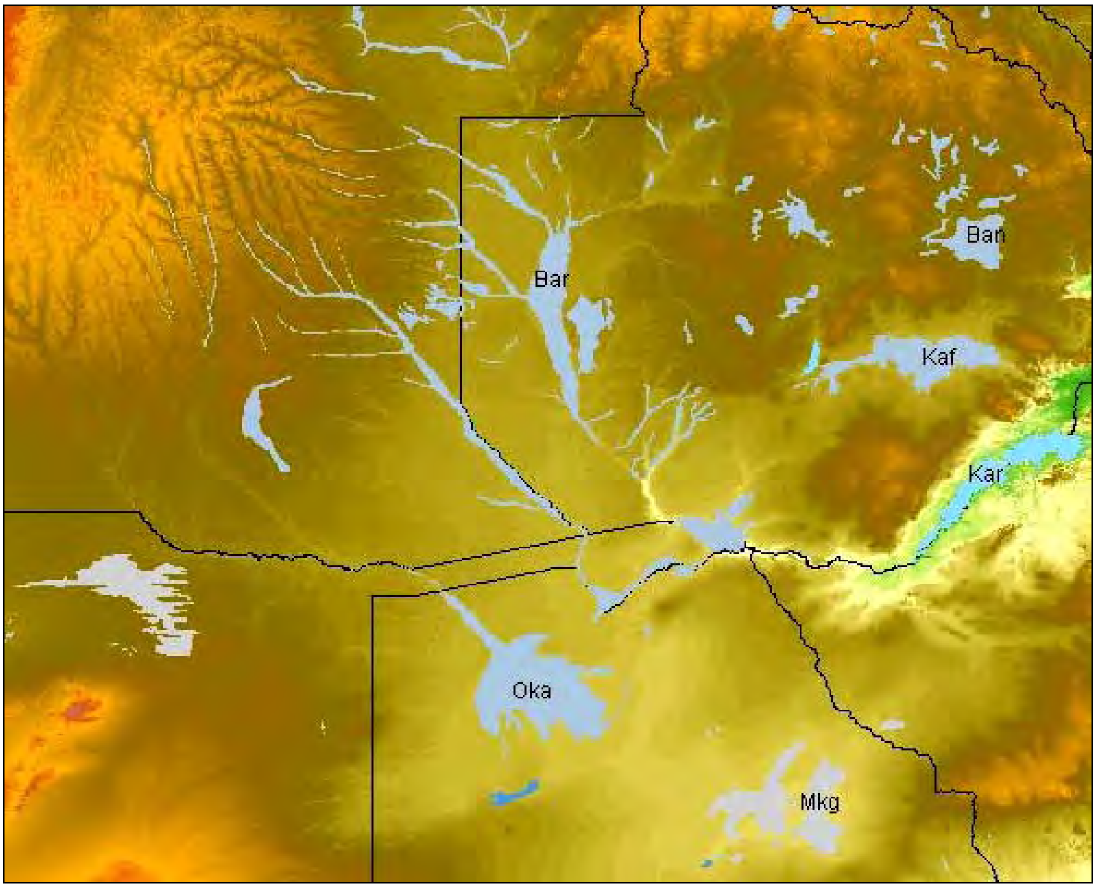

Fig. 3.2 A digital elevation model of the KAZA region showing national boundaries and the major wetlands in the region. (Ban – Bangweulu, Bar – Barotse Flood Plain, Kar – Lake Kariba, Mkg – Makgadikgadi Pan, Oka – Okavango Delta)

Table 3.1. Catchment areas, mean annual rainfall and the contribution of water flows and direct rainfall to the Okavango Delta. (Compiled from Ashton 2003)

Country	**Country Catchment Area** (km^2)	**Mean Rainfall** ($m.yr^{-1}$)	**Annual contribution to Delta flows**		**Inputs to Total Delta Water Balance** (%)
			Mm^3	**%**	
Angola	151,200	873	9,572	94.45	71.76
Botswana:					
- Rivers only	58,350	480	265	2.62	1.99
- Direct rainfall onto Delta only	15,844	486	3,205	-	24.03
Namibia	123,560	427	297	2.93	2.22
Totals – Basin only	333,110	639	10,134	100	-
Basin + Delta	348,954	632	13,340	-	100.00

Table 3.2 Estimated water demands by different sectors in Angola, Botswana and Namibia (Source: Ashton 2003)

Water use Sector	Angola	Botswana	Namibia	Total	%
Rural subsistence use	5.65	1.48	1.27	8.40	36.0
Urban domestic use	7.44	0.70	0.81	8.95	38.4
Stock watering	0.25	0.27	0.15	0.67	2.9
Industrial activities	0.00	0.25	0.06	0.31	1.3
Agricultural activities	0.50	1.22	2.83	4.55	19.5
Tourism	0.00	0.42	0.10	0.43	1.8
Totals	13.84	4..34	5.22	23.31	100

Table 3.3 Projected growth in consumptive water demand in the Okavango basin under two scenarios: A, existing patterns of demand prevail with no new developments, and B, existing demand patterns plus new developments in water transfer and irrigation. (Source: Ashton 2003)

Basin Country	Total Consumptive Demand ($Mm^3.yr^{-1}$)		
	2000	2010	2020
A. *.Existing demand with no new developments*			
Angola	13.84	17.35	21.75
Botswana	4.11	3.98	4.32
Namibia	5.21	6.13	7.21
Basin Total	23.17	27.47	33.284
B. *Existing demand patterns plus potential new transfers and irrigation*			
Angola	13.84	67.35	121.750
Botswana	4.11	28.98	54.32
Namibia	5.21	66.13	127.21
Basin Total	23.17	162.47	303.28

The potential reductions in river flows within the Okavango basin suggested by the above studies are long term and reflect likely average conditions. It is important to bear in mind that while there is considerable uncertainty surrounding the predicted changes there is a high level of agreement that climatic *variability* and the frequency of extreme conditions is likely to increase. The peaks and troughs of the roughly eighteen year cycle of wet and dry periods and the prolonged dry years of the 1990s are thus likely to be exacerbated.

Ashton and Neal (2003) developed a useful conceptual diagram summarizing the many factors influencing decision-making in relation to water in the Okavango Basin and the delta (See **Fig. 3.3)**

The likely impacts of changes in river flows and increasing aridity are taken up again in Section 7, Ecosystem Services.

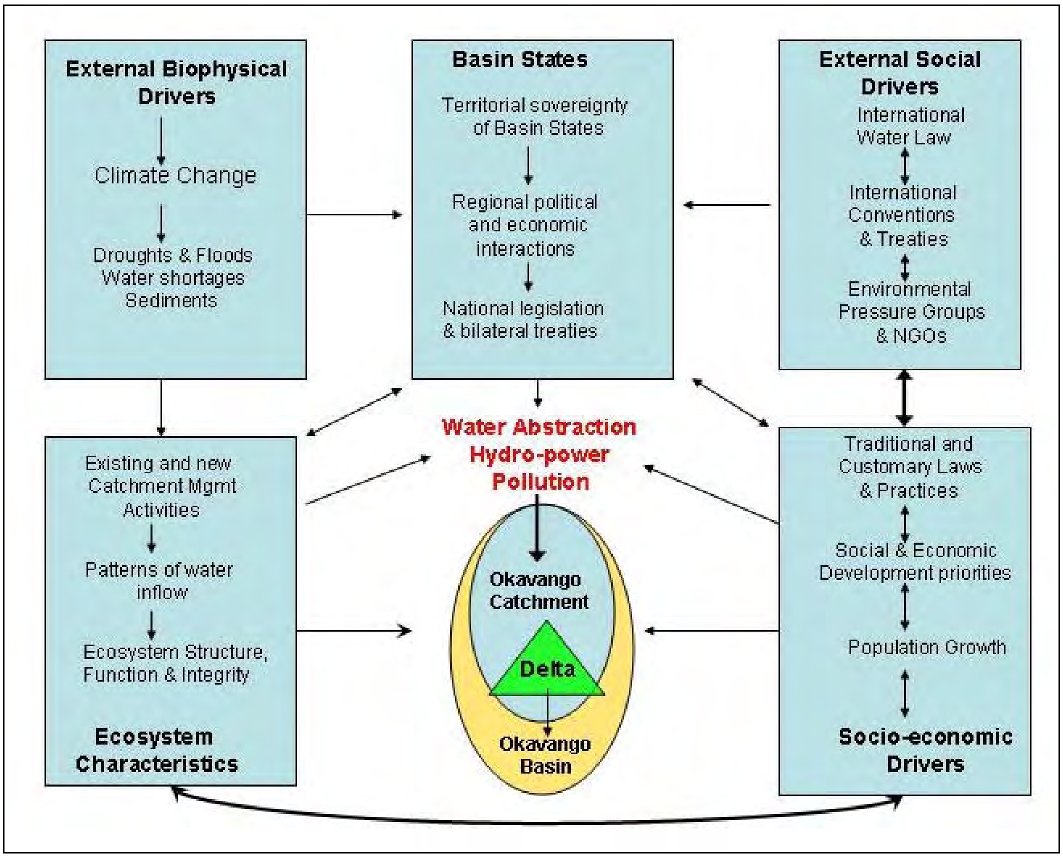

Fig. 3.3 Conceptual diagram of a range of drivers impacting on the Okavango basin and its conservation and management. (Adapted from Ashton and Neal 2003)

3.3 International and regional conventions, protocols and agreements

There are several international and regional conventions and protocols that influence natural resource management policy and practice in the region and that relate to the KAZA TFCA. The more directly relevant international conventions to which KAZA member states are signatories (**Table 3.4**) are those that deal directly with the conservation of biodiversity, trade in endangered species, conservation of wetlands and the management of water resources. Regional protocols of importance include the SADC protocols on wildlife conservation and law enforcement, forestry, fisheries, and shared water courses.

In addition to the formal international conventions and protocols a wide range of civil society and non-governmental organisations contribute to and influence development and conservation in KAZA and the five countries of the TFCA.

Table 3.4 Conventions and protocols to which member states of the KAZA TFCA initiative are signatories. (S – signed, R – ratified, A – acceded)

Convention/Protocol	Country				
	An	Bw	Na	Zm	Zw
CBD - Convention on Biological Diversity 1992	R	R	R	R	R
RAMSAR – Ramsar Convention on Wetlands of International Importance 1971	-	R	R	R	-
UNCCD – UN Convention to Combat Desertification 1994	R	R	R	R	R
CITES – Convention on Trade in Endangered Species	-	A	A	A	A
WHC – World Heritage Convention 1972	R	A	A	R	R
Convention on the Law of the Non-Navigational Uses of International Watercourses	R	R	R	-	-
UN Framework Convention on Climate Change	R	R	R	R	R
UNCED WCED (World Commission on Environment and Development).					
SADC Protocols: Wildlife Conservation and Law Enforcement, Fisheries, Forestry, Shared Water Courses, Development of Tourism	S	S	S	S	S
OKACOM – Okavango River Basin Commission	S	S	S	-	-
Zambezi River Authority	-	-	-	S	S
ZAMCOM - Zambezi Water Course Commission 2004	S	S	S	-	S

3.4 Tourism and global and national economies

Tourism is considered to be one of the world's fastest growing economic sectors but it is vulnerable to uncertainties in global financial markets, the price of oil and travel, and to political instability. It is also vulnerable to changes in tastes and fashions, marketing and infrastructure. Over the last few years there have been consistent expectations of 5% per annum growth in the tourism sector in southern Africa. While this has applied to some countries such as South Africa, Botswana and Zambia, it has not applied to Zimbabwe where tourism over the past eight years has shown a marked decline. The civil war in Angola also affected tourism in the Caprivi and, of course, within Angola.

Current and future trends and prospects for the growth of global and regional tourism are clearly an important factor in the development of the KAZA TFCA because much of its development has been predicated on revenue generated from tourism. The central attraction of KAZA is its wetlands but unfortunately these are the features most vulnerable to climate change. As a result there will be a need to diversify both the range of tourism products within KAZA, and their spatial distribution, in order to ameliorate the impacts of projected declines in rainfall and wetlands in the KAZA area. This issue is pursued further in Section 10 on Resilience and Adaptability.

3.5 National conservation legislation

The laws, policies and values relating to conservation and natural resource management in the five countries involved in the KAZA TFCA make provision for the protection and conservation of the fauna and flora of each state, for the establishment of protected areas, and the promulgation of regulations governing the use of, and trade in, wild plants and animals. However, while legislative intentions may be appropriate the trends in landuse and large wild mammal populations suggest that existing policies and regulations, and the resources made available to wildlife conservation agencies, are inadequate and that conservation is not succeeding, other than perhaps in Namibia (Cumming 2004). In Namibia most large mammalian herbivore species are either increasing or stable; in the remaining countries between 26% and 64% of large mammal species are declining (Cumming 1999, 2004). The extremely low operating budgets (e.g. < US$10 per km^2 in Zambia and Zimbabwe) for conservation agencies make it impossible to meet their mandates nationally let alone in ambitious developments such as the KAZA TFCA.

Some of the national provisions on trade in wild species and their products are constrained by international conventions such as CITES. This constraint is most apparent, and has the greatest effect, in relation to the trade in elephant products.

Differences in policy and legislation between the states are probably greatest in relation to the management, use and benefits that may be derived from wildlife by those living on land outside protected areas; i.e. by those who bear the costs of conserving wildlife but realize little of its benefits. I flag this as one of the major issues requiring attention in the context of building adaptive capacity in the face of climate change and sustaining the future development of the KAZA TFCA. The issue is taken up more fully in Section 7: Conservation beyond state protected areas.

3.6 Animal Disease Management Policies and Practice.

A wide range of complex interactions involving the intersection of domestic animals, wildlife and human diseases can cascade down to affect the development of large transfrontier conservation areas (Cumming 2004a , Cumming 2007, Cumming et al 2007, Osofsky et al 2008) (**Fig 3.4**). Disease control strategies for livestock have had major impacts on landuse and conservation in southern Africa and in the five KAZA countries during the last century. The livestock sector has been heavily subsidized in the provision of support services and in marketing and pricing structures. For those countries that have had access to export markets to Europe (Botswana, Namibia and Zimbabwe) there have been further subsidies in terms of market prices for beef and aid in the provision of veterinary and other services to the beef industry. These perverse incentives at national and international levels have resulted in land uses being distorted in favour of beef production (Arntzen, 1998, Barnes, et al 1992, 2001). By the same token wildlife has been viewed as the primary reservoir of several, if not most, of the important livestock diseases, with the result that, until recently, the view that “one cannot farm in a zoo” prevailed. Only in recent years has wildlife been seen as a legitimate form of landuse.

The earlier belief that livestock production and particularly export markets were threatened by the presence of wildlife resulted in long term game elimination programmes, particularly in relation to the elimination of tsetse fly. For example, game elimination programmes started in the Sebungwe region in Zimbabwe as early as 1919 and continued through to the 1970s (Child and Riney 1987, personal observations) when they were replaced by insecticide spraying programmes and later by the use of odour baited traps or “targets” (Vale et al 1988). The tsetse fly (*Glossina morsitans centralis*) is distributed over a large area in western Zambia, including all of the Kafue NP, and spreads into the Luiana Reserve, the Linyanti in the Caprivi and until recently into the Okavango Delta (**Fig. 3.5**).

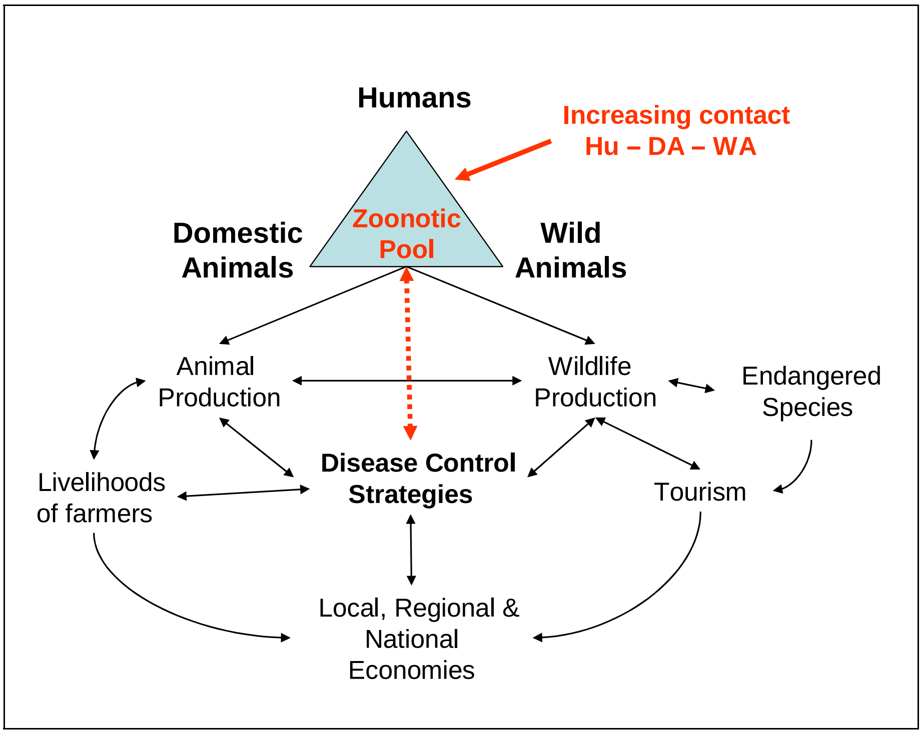

Fig. 3.4 Conceptual diagram of the linkages between wildlife, livestock and human diseases, and the potential implications of disease control strategies for livelihoods and conservation. (From Cumming et al 2007)

In Botswana, large swathes of the country were partitioned by game fences (**Fig. 3.5**) to control Foot and Mouth Disease (FMD) and protect beef export markets. The fences interrupted large mammal migration routes and contributed to major declines in migratory species such as wildebeest, zebra and hartebeest. Namibia maintains a cordon fence that runs from the eastern boundary with Botswana to the coast. Game fences have also isolated the Hwange-Matetsi complex and from the mid 1960s an approximately 15 km wide fenced, selective game elimination corridor surrounded the Sebungwe area. Patterns of fencing, established to control diseases in livestock populations that are not associated in any direct way with the KAZA TFCA, will likely continue to impact on KAZA in the future and will almost certainly have implications for corridors, adaptive strategies in the face of climate change and in establishing linkages between the centre and outlying components of the TFCA.

The recent interest and developments in commodity based trade that could allow the export of appropriately prepared animal products (e.g. de-boned beef from within FMD zones) holds some hope for opening higher valued markets to peasant farmers (Thomson 2008) and for the development of multispecies production systems that involve both wildlife and livestock. There is also an encouraging paradigm shift taking place towards a “One Health” approach that includes considerations of ecosystem health and eschews the narrow single sector and single disease management approach that has prevailed (e.g. Wilcox and Colwell 2005, Osofsky et al 2008).

Nevertheless, there remain a range of animal diseases that affect both domestic and wild animals in the KAZA region (**Table 3.4**) and which also include zoonoses of importance to humans, such as bovine tuberculosis, rift valley fever, trypanosomiasis, rabies, echinococcosis, and cystercercosis. Contagious bovine pleuropneumonia, an introduced disease that is now endemic in Angola, is also particularly important (**Fig.3.5**) (e.g. Mangani, 2007, Musisi et al 2007, Windsor and Wood 1998).

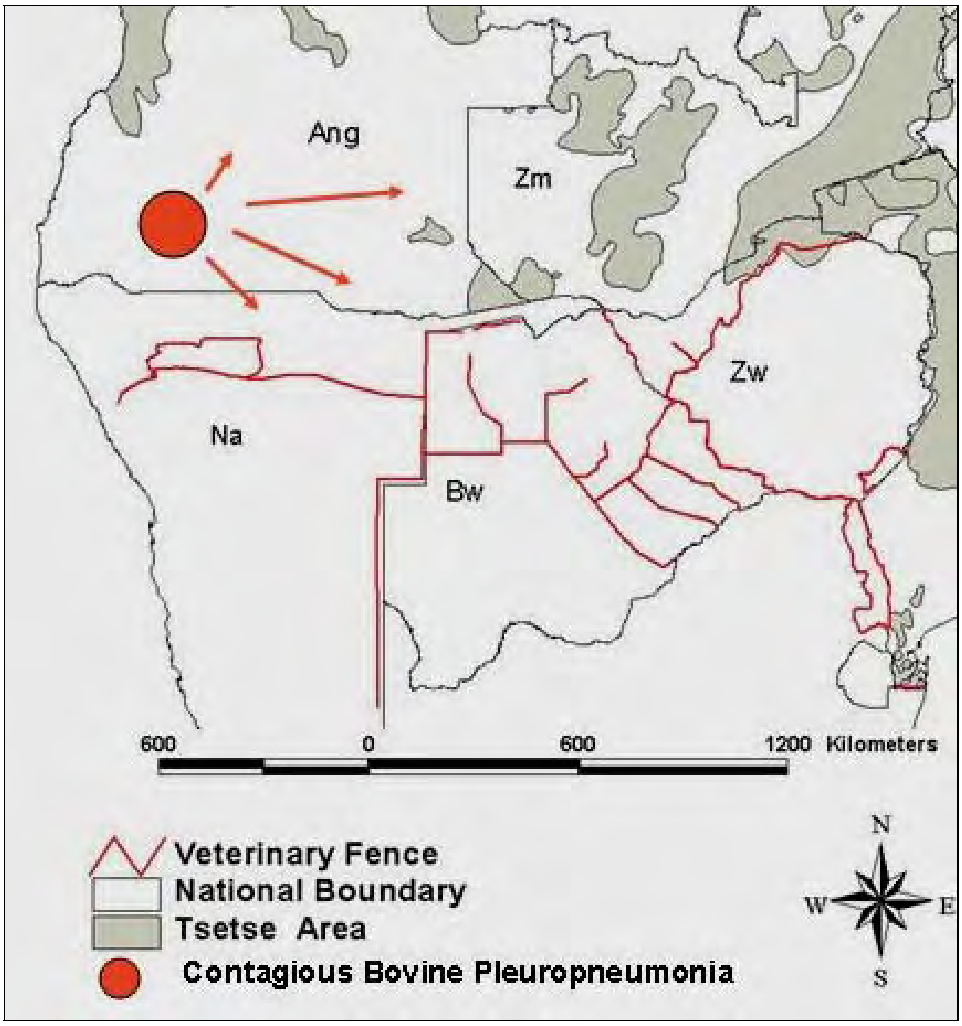

Fig. 3.5 Distribution of tsetse fly, a center of contagious bovine pleuropneumonia infection in Angola, and distribution of major game fences in the region.

Table 3.5 Animal diseases of concern in the KAZA TFCA. The origin of diseases is indicated as either indigenous (indig.) or introduced (alien).

Mode of Transmission	Disease	Origin	Wildlife	Domestic Animal	Human	Comments
Contagious	Rinderpest	Alien	+	+	-	Last Outbreak in 1896
	Bovine pleuropneumonia	Alien		+		Introduced
	Foot and Mouth Disease	Alien	+	+	-	Carried by buffalo through the KAZA region
	Malignant catarrhal fever	Indig.	+	+	-	Wildebeest the primary host
	Brucellosis	Alien	+	+	+	
	Bovine tuberculosis	Alien	+	+	+	
	Anthrax	Indig.	+	+	+	
	Rabies	Indig	+	+	+	European street virus introduced to SA in 1892
	Canine distemper	Alien	+	+	-	
	Toxoplasmosis	Indig.	+	+	+	
	Sarcoptic mange	Indig.	+	+	+	
Vector borne	Trypanosomiasis	Indig	+	+	-	Cases of human sleeping sickness in Caprivi and middle Zambezi Valley
	African Swine fever	Indig.	+	+	-	
	East Coast Fever (Theileriosis)	Alien	+	+	-	
	Heartwater (Cowdriosis)	Indig.	+	+	-	
Endoparasite	Echinococcosis	Indig	+	+	+	
	Cystercercosis	Indig.	+	+	+	

An important emerging issue is the extent to which climate change will alter the patterns and distribution of human and animal diseases across the sub-region and influence zoonotic diseases and the emergence of new diseases. The interactions between climate change, patterns of land and resource use and diseases are likely to be complex and are potentially major drivers in the development and sustainability of the KAZA TFCA. As the Pre-feasibility Study for the KAZA TFCA noted, the approach being adopted in the *AHEAD*-GLTFCA programme (e.g. Cumming 2004, Cumming et al 2007) is also relevant to the KAZA TFCA.

4

INTERMEDIATE SCALE:
COMPONENTS AND DRIVERS WITHIN KAZA

4.1 Gradients of Biodiversity

The distribution of species richness within the broad area encompassing KAZA TFCA is particularly important in relation to impending climate and land use / land cover change. A key question is whether KAZA is large enough to continue to provide refugia for the present range of species within its boundaries. In the likely event that it will not be able to do so it is important that the TFCA is structured and managed in ways that will maintain links beyond its boundaries. Such a strategy will be particularly important for wetland dependent species. Some guidance as to the direction of where those links should lie is provided by, (a) the patterns of wetland distribution and their palaeontological linkages outlined in **Fig. 9.2,** and (b) the gradients in diversity across the TFCA region (e.g. **Fig. 4.1**). There is a close relationship between the distribution of species richness of trees and mammals in southern Africa (Andrews and O'Brien 2000) and this holds true for the KAZA area (**Fig. 4.2**).

Important in the context of regional linkages is the existence of gradients in species richness across the region from low levels of diversity of trees and mammals in the south-west with increasing diversity to the north-east and east (**Fig. 4.2**). These gradients indicate that, in the face of increasing aridity, it will be important to maintain conservation corridors and links to those parts of the sub-region that are likely to experience less drastic changes in temperature and precipitation – these areas lie to the north east and the east of KAZA. Diversity gradients coincide with the long-standing links to wetland areas in the north-east drawn out by Cotterill's (2006) work.

The Kalahari sand sheet that covers some 2.5 million km^2 and stretches from the Northern Cape to the Congo, a distance of nearly 3,000 km, with a rainfall gradient ranging from 45 to 1,800 $mm.yr^{-1}$, provides an ideal transect and gradient in which to examine soil-moisture-plant relationships. Results from the Kalahari Transect study undertaken by Scholes et al (1997) and the International Geosphere-Biosphere Programme (IGBP) provide a basis on which to predict the sorts of changes that are likely to occur within the KAZA area in response to a northward, or northeastwards shift in rainfall isohyets under climate change. The likely changes in vegetation structure are most clearly illustrated by the changes found along the rainfall gradient of the Kalahari transect between Upington in the northern Cape and Mongu in the Western Province of Zambia and illustrated in **Fig. 4.3**

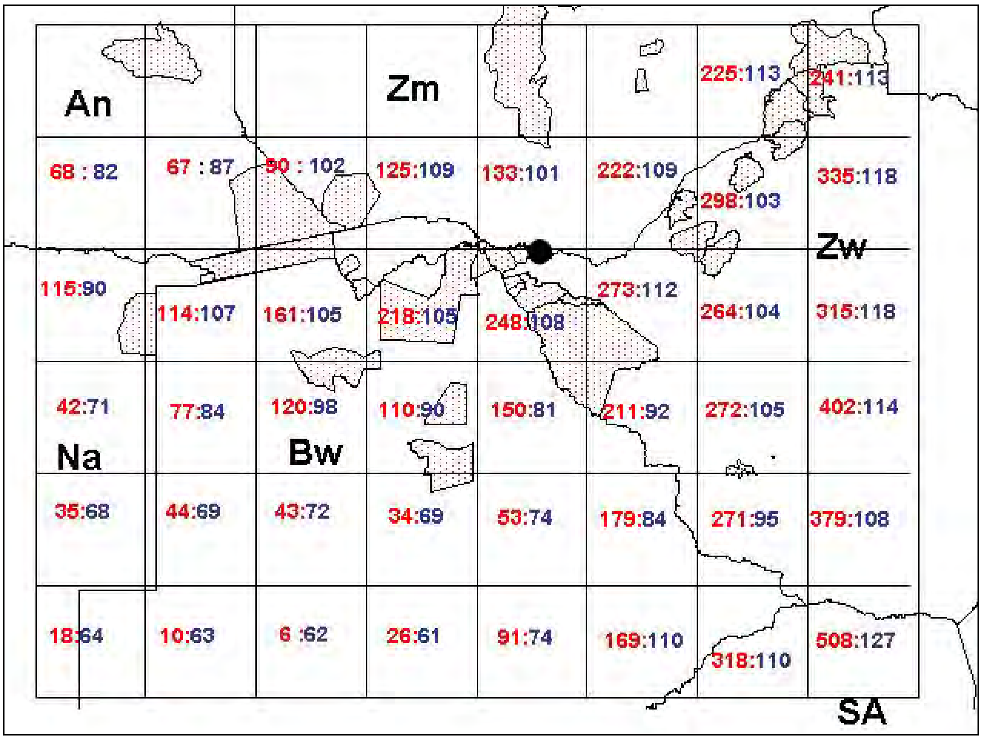

Fig. 4.1 Distribution of species diversity of trees and mammals across the TFCA region. Each ~ 25,000 km^2 grid square shows the occurrence of the number of tree species (red figures) and the number of mammal species in that square. The grid overlies national boundaries and the boundaries of several protected areas. The parts of the countries covered are indicated by their abbreviations, namely, An, Angola; Bw, Botswana; SA, South Africa; Zm, Zambia; Zw, Zimbabwe. ● indicates the position of the Victoria Falls. (Data on numbers of species per grid square derived from O'Brien 1993 and Andrews and O'Brien 2000)

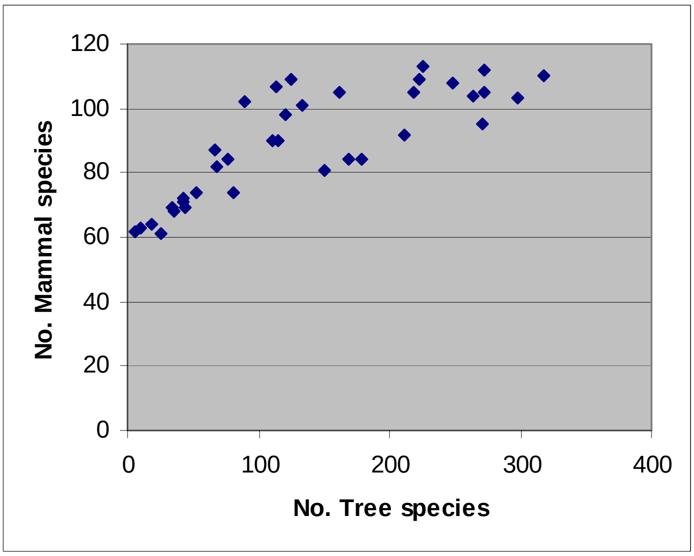

Fig. 4.2 Relationship between the number of tree species and the number of mammal species in the general KAZA TFCA area as reflected in the number of species occurring in equal area grid squares of ~ 25,000 km^2. (Data from **Fig. 4.1**)

Porporato et al (2003) found that the soil moisture gradient between 300mm and 950mm along the Kalahari transect was mainly due to storm frequency rather than storm depth, which serves to highlight the importance of rainfall frequency and interval to rainfed crop production.

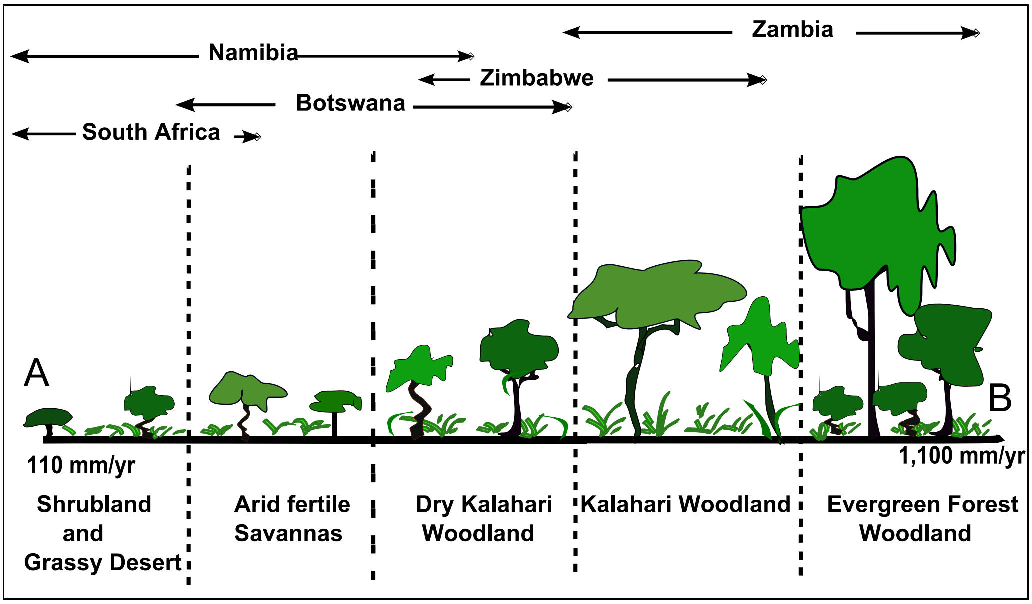

Fig. 4.3 Vegetation gradient along the Kalahari Transect (Redrawn from Scholes et al 1997)

The key point here is that rainfall, and to some extent soil nutrients, are the driving variables in terms of productivity and biodiversity gradients across the region – a factor that has major implications in the face of climate change.

4.2 Conservation area clusters and the KAZA TFCA mosaic

Transfrontier conservation areas are usually associated with contiguous national parks that share an international boundary, e.g. the Great Limpopo Transfrontier National Park. In the KAZA TFCA this situation may obtain if the Luiana Partial Reserve in south east Angola is gazetted as a national park to provide a common international boundary with Sioma-Ngwezi National Park in Zambia and Babwata National Park in Namibia. Apart from this opportunity there are presently no internationally shared boundaries between protected areas of the partner countries within the KAZA TFCA. The fragmented, or mosaic nature, of land tenure and land use within the KAZA TFCA creates a range of challenges in terms of connectivity for conservation and tourism, disease control strategies, security, and for containing conflict between differing land uses.

The different categories of conservation areas within the KAZA TFCA are covered in the next Section (Section 6). The state designated areas are as follows: National parks (NP), Game Reserves (GR), Partial Reserves (PR), Safari Areas (SA), Game Management Areas (GMA), Wildlife Management Areas (WMA), Forest Reserves (FR) and Recreational Parks (RP).

At a large scale there are six clusters of protected areas within the TFCA (**Fig. 3.4**). From east to west these are:

1) Khaudom NP and Nyae-Nyae Conservancy (and possibly Tsunkwe Conservancy),
2) Chobe National Park with Moremi Game Reserve, the Caprivi, Okavango Delta, and the Luiana area in Angola,
3) Nxai Pan and Makgadikgadi,
4) Kafue National Park and its surrounding GMAs,
5) Hwange NP and associated safari areas, forest reserves, CAMPFIRE areas and a conservancy on commercial farming land.
6) Lake Kariba Recreational Park, Matusadona and Chizarira National Parks, and the safari areas, forest reserves and CAMPFIRE areas to the south of Lake Kariba in the Sebungwe region.

Outliers include the hunting areas (Mucusso, Luengue, Mavinga and Luiana Coutadas) to the north and west of the Luiana Provisional Reserve, the Mavinga Partial Reserve, the northern extent of the Western Game Management Area in Zambia, i.e. the area to the north of the Southern Lueti River, and the Luiwa Plains NP (**Fig. 4.4**).

Fig. 4.4 Clusters of conservation areas in the KAZA TFCA with three central clusters (red outline) and five 'outliers' (green outline) and arrows indicating linkages/corridors that remain to be established

Of the six clusters, the greatest connectivity, both within the clusters and between them, occurs in the Kafue NP area, the Hwange NP – Matetsi SA and the area centered on Chobe NP. The core of the TFCA is probably the cluster centered on the Chobe NP with a possible extension through to the Zambezi NP and the Victoria Falls. The core cluster covers an area of about 40,000 km^2 and includes five national parks (Chobe, Babwata, Mamili, Mudumu, Sioma-Ngwezi), Moremi Game Reserve, the Okavango Delta, the Luiana Partial Reserve, and several forest reserves. The only dense rural settlements within the core area are confined to the Chobe Enclave and parts of the eastern Caprivi. The increasing number of community conservancies being established in Caprivi further serves to strengthen and consolidate this core component of the TFCA. The area also includes what are arguably the most important wetlands within the TFCA, namely, the Okavango Delta, the Linyanti swamps, and the Zambezi-Chobe wetlands in eastern Caprivi.

The largest contiguous area nominally assigned to wildlife conservation is the Kafue NP and its surrounding GMAs. This area now covers 67,120 km^2. However, large mammal populations are seriously depleted in the GMAs and also in parts of the Kafue NP (Martin 2008). Important wetlands in this complex include the Busango swamps and floodplain in the north of the area and the flood plains associated with the Kafue River above the Iteshe-teshi dam and the Kafue Flats to the east of the park. The GMAs have been designated as areas in which the sustainable use of wildlife resources is intended to be a primary landuse. This has not transpired and a once rich wildlife resource has been greatly depleted through over-hunting and illegal harvesting. As Martin (2008a) has shown in some detail, the key issue is that the meagre returns to villagers from wildlife are such as to act as a disincentive rather than an incentive to retain and manage wildlife on their land. The situation could readily be reversed through the introduction of appropriate policies that allow realistic returns to be retained by villagers rather than government agencies – a topic that is examined in more detail in Section 7.

The second large area of contiguous conservation areas within the TFCA is the Hwange-Matetsi-Victoria Falls complex which is made up almost entirely of unsettled state land protected areas comprising four national parks (15,547 km^2), two safari areas (3,430 km^2) and four forest reserves (3,010 km^2), resulting in an a area of state protected land of 21,987 km^2. Parts of the Tsholotsho Communal Area that lie adjacent to southern boundary of Hwange NP could also be included, as could the Gwayi Conservancy to the east of Hwange NP, which would bring the total wildlife area to about 25,000 km^2.

It is instructive to examine the changes in land use that have occurred in this area of north-western Zimbabwe over the last century. During the early 1900s the eastern parts of the area were thinly settled by Matabele people to the south and Tonga in the north. The arid western areas were inhabited at very low densities by San hunter-gatherers. By the 1920s large areas had been designated for agriculture which was largely unsuccessful. In 1928 the Hwange Game Reserve was proclaimed and the Zambezi National Park (initially Victoria Falls Game Reserve) was also established in 1928. The Matetsi area to the north of Hwange remained a commercial cattle farming area until 1972, when it was expropriated and turned into a safari area. At that time many of the ranches had already turned to safari hunting as a more profitable form of land use (Johnstone 1975). The Ngamo Forest Reserve was established as early as 1925 while the remaining four more northerly forest reserves adjacent to Hwange National Park and the Matetsi Safari Area were established during the 1960s. In addition to harvesting indigenous hardwoods, these forest areas were run as safari hunting concessions. Commercial farms under free hold title in the Matetsi and Gwayi farming areas also switched to wildlife as a land use. The northern-western part of the Tsholotsho Communal Land was likewise leased as a safari concession under the CAMPFIRE programme.

The key feature of these changes over nearly a century is that the Kalahari sands and shallow basalt soils of the area combined with low and uncertain rainfall were just not viable for rainfed cropping or livestock production with the result that as policy changes allowed, landowners and occupiers (including the state) shifted to wildlife-based land uses.

A promising recent development is the move on the part of the Zimbabwe Parks and Wildlife Authority towards an adaptive co-management approach that aims to involve the full range of stakeholders and landowners involved in the wildlife industry in northwestern Zimbabwe (Cumming 2006). The results of a scenario planning workshop are instructive (**Fig. 4.5**) and provide a potential exploratory model for the TFCA. It was generally agreed by participants in the workshop that the 'lose-lose' scenario depicted the state of affairs in northwestern Matabeleland in 2006. Implementation of the ideas and plans developed at that workshop has since been constrained by a lack of resources.

The north-western Zimbabwe example of evolving land uses across differing tenure regimes and the intended shift towards an adaptive co-management regime for a large landscape encompassing a full range of tenure regimes and stakeholders has clear implications for the KAZA TFCA. It is particularly relevant to establishing corridors between the disparate state protected areas in the region and to dealing with the looming elephant problem.

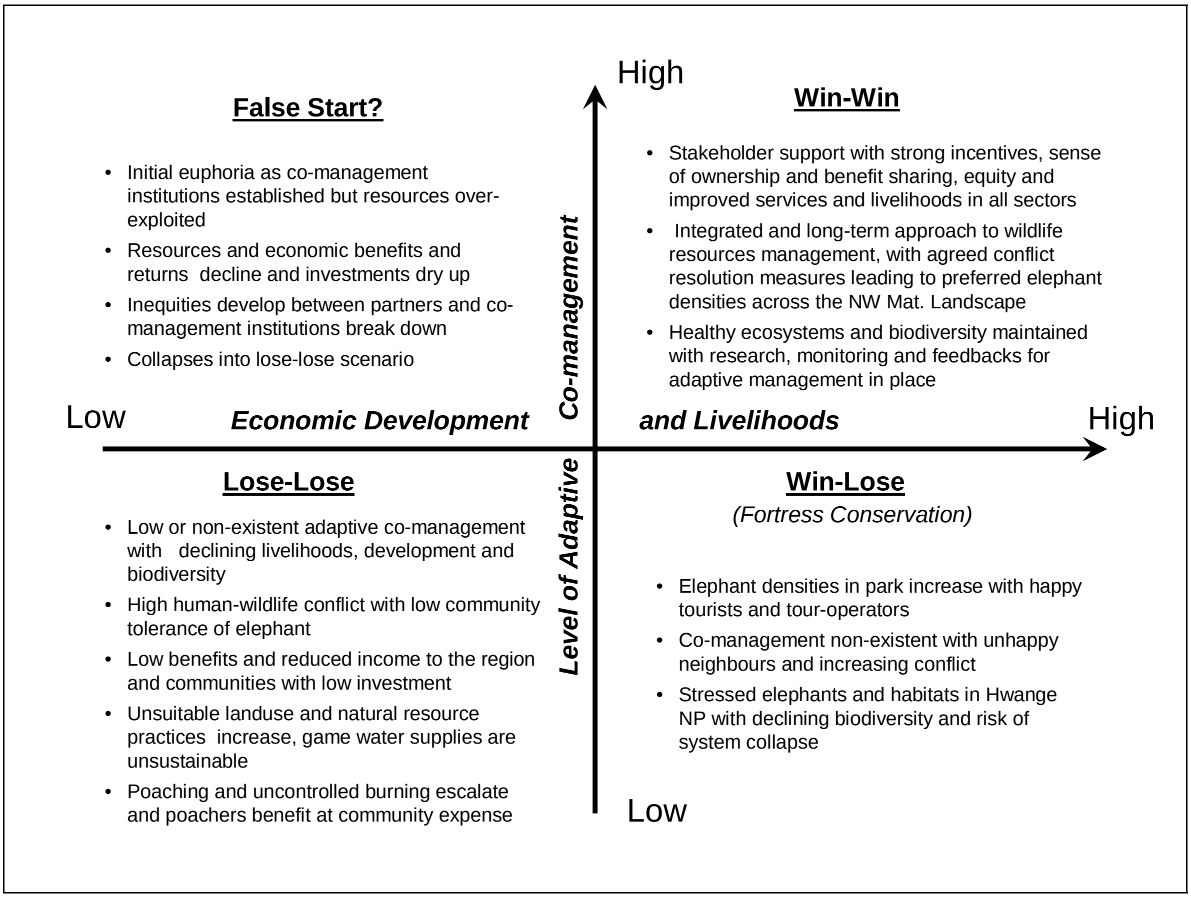

Fig. 4.5 Narrative summary of the alternative scenarios for Hwange NP and NW Matebeleland. (From Cumming 2006)

Shifts to wildlife-based land uses outside of protected areas are occurring in the Caprivi and, as Barnes et al (2001) noted in their study of returns to different land uses in Ngamiland, there is likely to be an increasing shift towards wildlife based tourism in northern Botswana.

It is tempting to conclude that these trends will continue well into the future or at least that existing areas under wildlife conservation will be sustained. There are, however, serious policy and legal constraints working against the trend continuing, particularly in the community occupied lands in Botswana, Zambia and Zimbabwe and I examine these in Section 7.

4.3 Human population growth and drivers of land use change

The growth of human populations in formerly sparsely inhabited areas is an ongoing phenomenon in Africa and despite increasing urbanization is likely to continue for the foreseeable future. Rural population growth invariably results in increasing land transformation whether for livestock or crop production and it is clearly a matter that will need to be included in the longer term planning of the development of the KAZA TFCA. Apart from growth of existing settlements there is the potential for an influx of people with the generation of increasing wealth (a honey-pot effect) and in Angola there is the likely return of refugees and the potential from migration from elsewhere within Angola to the presently lightly settled areas of the south east and within the KAZA TFCA.

Annual human population growth in the centre of the KAZA TFCA in the Caprivi between 1921 and 1996, based on graphs in Mendelsohn and Roberts (1997), averaged 3.6 %. Growth in the number of households between 1943 and 1996 in four selected areas in eastern Caprivi varied between 2.9 and 3.4 %, while in Mukwe, in the west on the Kavango River, the growth rate in the number of households during the same period was 6.2 %. Within Babwata NP there has been a marked influx of people as benefits from wildlife have increased for those who have long inhabited the area (Julie Taylor, personal communication, 2008). Turpie et al (1999) used a population growth rate of 2.8 % per annum for the Barotse Flood Plain.

The eastern outlier to the TFCA in the form of Lake Kariba and the Sebungwe[1] provides a good example of the rapid and unexpected changes in land use that can occur when areas are cleared of tsetse fly and infrastructure in the form of roads is developed (in this case initially to control tsetse fly). The Sebungwe is still shown in many maps as being primarily a wildlife area but this is far from a true reflection of the reality on the ground. The primary protected areas in the Sebungwe (Chizarira and Matusadona NPs, Chirisa and Chete Safari Areas) are, however, increasingly becoming isolated ecological islands and the landuse changes and influx of subsistence farmers (**Fig. 4.7** and **Table 4.1**) that occurred, particularly during the 1980s reflect a policy failure in respect of returning the full value of wildlife benefits to the autochthonous inhabitants of the Sebungwe region.

In 1980 the Sebungwe region still retained large areas of wild land and was rich in wildlife resources that supported a number of hunting concessions. The CAMPFIRE programme was conceived in the early 1980s (Martin 1984) but was not officially implemented until 1989. In the intervening period returns from wildlife safaris in the Sebungwe were collected by

[1] Sebungwe is the name of the former district that covered the region lying south of Lake Kariba. It includes much of the present day districts of Binga, Gokwe and Kariba.

government and after lengthy delays retuned, in part, to the three Rural District Councils involved.

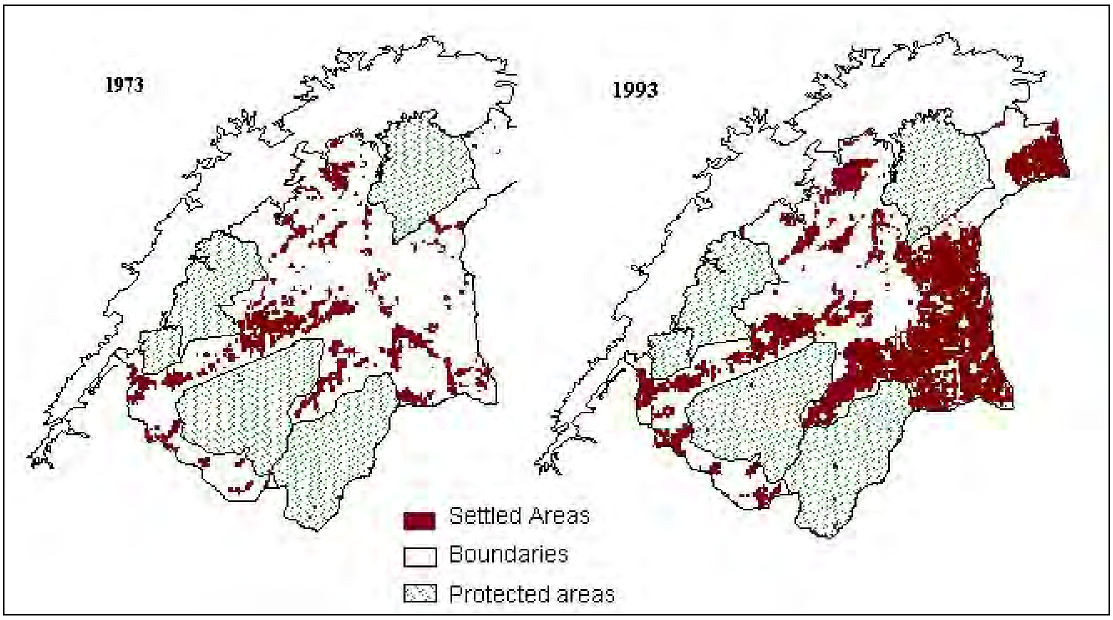

Fig. 4.6 Changes in the Sebungwe region of Zimbabwe in the area settled between 1973 and 1993. Lake Kariba lies to the north of the area. (Source: Cumming and Lynam 1987)

The District Councils passed very little back to the communities in whose areas the hunting had taken place with the result that wildlife and wild land held little value to them. The end result was rapid land transformation and the loss of a valuable resource that, given appropriate policies, would have provided better returns to communities and households than livestock (Murindagomo 1997). Although no post 1993 aerial photography is available for the Sebungwe it is clear, from several personal visits to the area since the mid-1990s, that the earlier trends of increasing human populations and land clearance have continued. By way of contrast, private landholders, leaseholders and state forest reserves in the northwest of the country were, in terms of wildlife legislation, able to realize the full benefits from wildlife and conserved and managed it accordingly.

Thus the interaction of legal and policy changes, human population growth, disease control and infrastructure can have unexpected results in terms of land transformation and these types of complex interactions are likely to come to the fore with marked shifts in climate within the KAZA region.

Table 4.1 Changes in human population density between 1973 and 1993 in three districts where a large part of the district falls within the Sebungwe. (Data from Cumming and Lynam 1997)

District	Human Population density (people.km^{-2}) 1982	Human Population density (people.km^{-2}) 1993	Percentage change
Binga	6.11	11.3	+ 84.9%
Gokwe	18.15	29.7	+ 63.6%
Kariba	2.7	7.6	+ 182.0%

5

LOCAL SCALE:

BIODIVERSITY AND THE CONSERVATION AREA NETWORK

Landuse change in the region is being driven by expanding human populations, of which a high proportion are marginalized rural people that depend directly on natural resources. In the context of KAZA a promising potential and sustainable route out of the poverty trap is for disadvantaged communities to realize the full benefits of biodiversity on their land. The realization of this goal will, however, depend to a large extent on the presence of intact and attractive wild landscapes and large charismatic species of mammals, as well as rare species and a range of other taxa that will attract tourists. These considerations raise three complementary questions:

1. What are the endemic, near endemic and limited distribution species within KAZA, where are they and what are the threats to their survival?
2. Which globally or regionally threatened species occur in KAZA that require special conservation attention and action?
3. Which are the key species in terms of generating revenue and income for the TFCA and its inhabitants? This may include charismatic mammals and birds, habitats and landscapes, timber resources, medicinal plants and certain ecosystem services.

Answers to these questions are needed to guide the setting of local scale conservation priorities and an overview of species diversity in the KAZA TFCA area is provided in this section followed by an examination and ranking of the individual conservation areas within the KAZA TFCA.

So far as I am aware, no Key Biodiversity Areas (KBAs) (Eking et al 2004, Langhammer et al 2007, Knight et al 2007a) have been identified the KAZA TFCA area although several protected areas that include black rhinoceros (*Diceros bicornis*) and the wild dog (*Lycaon picus*) would qualify, as would areas containing very limited distribution endemic herpetofauna (e.g. Sioma-Ngwezi NP) and endemic plants species such as occur in the Batoka Gorge. In addition, no Alliance for Zero Extinction (ACE) sites have been identified in the KAZA TFCA. The formal identification of KBAs (e.g. Langhammer et al 2007) requires, *inter alia*, conservation assessments at national levels, gap analyses and the full participation of local stakeholders in the process – clearly beyond the scope of a desk study. As a result a different approach to ranking protected areas was adopted here (Section 5.2.3). The approach is based on earlier work on identifying conservation priorities in the region (e.g. Cumming and Jackson 1984, Cumming 1984 and 1999, Bell and Martin 1984) and deals, in part, with the questions posed above.

5.1 Biodiversity in the KAZA TFCA

5.1.1 Species numbers

Species lists for plants, mammals, birds, reptiles, amphibians, fishes, and butterflies were produced in the 4-Corners study of biodiversity (Timberlake and Childes 2004) The number of species within each major taxon and the overall number of species for the 4-Corners area (**Table 5.1**) probably represent a reasonable approximation of the overall number of species occurring in the KAZA TFCA (with the exception of Angola which has been poorly collected). Additional areas that are now included in the KAZA TFCA but which were not in the 4-Corners area, such as the Sebungwe in Zimbabwe, would undoubtedly extend the species lists.

It draws heavily on the study and compilation on biodiversity in the 4-Corners area (i.e. the KAZA region less Lake Kariba and the Sebungwe region of Zimbabwe) by the Biodiversity Foundation for Africa (Timberlake and Childes 2004). I have not attempted to add species from Kariba or the Sebungwe that might have been omitted from the studies included in the 4-Corners study.

Table 5.1 The numbers of species recorded in the 4-Corners area
(Source: Timberlake and Childes 2004)

Taxon	Overall	Angola	Botswana	Namibia	Zambia	Zimbabwe
Plants	2,645	-	1442	635	1,662	1,334
Mammals	197	91	149	118	162	150
Birds	601	211	502	462	542	504
Herpetofauna	178	106	135	122	135	133
Fishes*	109	-	-	-	-	-
Butterflies	295	140	237	160	268	274

* Because the major rivers form country boundaries within KAZA assigning fish species to countries is inappropriate and for this reason only a total figure for KAZA is given.

5.1.2 Endemic and threatened species

1. Plants

As noted by Timberlake (2004) "*The four-corners area is the meeting place of the Zambezian and Kalahari floras and is a transition zone for both flora and vegetation. It is not an area of endemism. It is also heavily dissected by wetlands and floodplains which act as dispersal corridors and encourage the wide distribution of species. As the area has been environmentally unstable for the last million or so years it is unlikely to support many species that are only found in that area*." Despite not being considered a centre of plant endemism there are nevertheless fifteen species that are presently considered endemic to the area.

a) *Endemic species*. There are 15 endemic/near endemic plants in the KAZA TFCA area (Timberlake 2004). They comprise one species of sedge, four grass species, one lily, and nine dicotyledonous species, of which five are small trees or shrubs, three are herbs and one is a succulent. For most, if not all of the species, the major threat to their survival is likely to be loss of suitable habitat. Four of these endemic species are confined to the rocky basalt gorges below the Victoria Falls. These species are *Aristida brainii*, *Danthoniopsis petiolata*, *Euphorbia fortissima*,and *Jamesbrittenia zambeziaca*.

b) *Threatened species*. The SABONET (Southern African Botanical Diversity Network) project catalogued nationally, but not necessarily regionally, threatened plant species (Golding 2002). Of the 18 species of nationally threatened plant species that occur within the KAZA area, none are listed in the IUCN Red Data List as being globally threatened (Timberlake 2004). Some of the species are also widely distributed and occur elsewhere in Africa. For example, the orchid *Eulophia latilabris* although endangered in Botswana and Zimbabwe occurs in Angola and Uganda.

Timberlake (2004) identified eight sites of conservation concern for plants within the 4-Corners area that carried high plant diversity, or included species of restricted distribution. The selection was biased towards areas for which satellite imagery was available. Of the eight areas identified, five straddle international borders (**Fig. 5.1)**

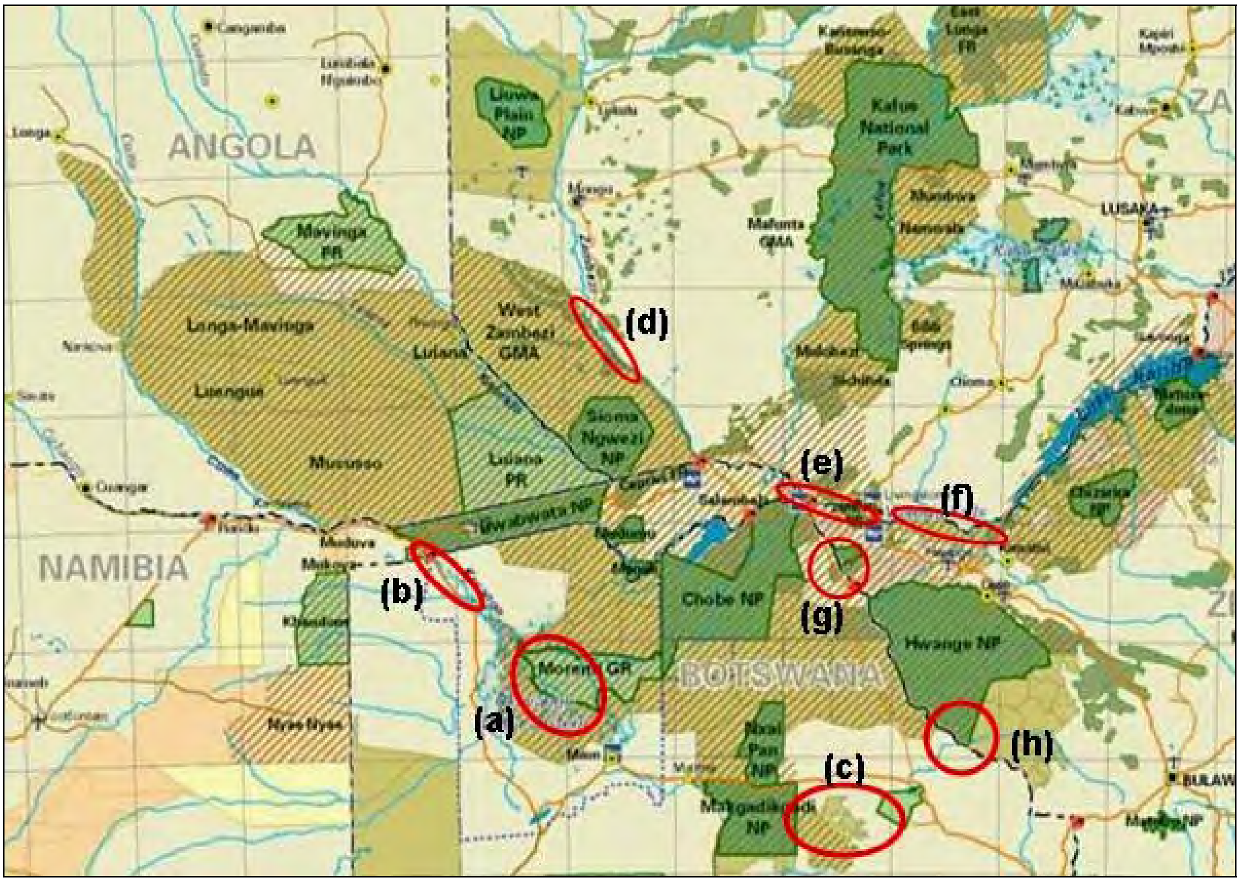

Fig. 5.1 Areas of concern for the conservation of plants in the 4-Corners area (Source: Timberlake 2004). (a) Okavango Swamps, (b) Kavango/Okavango river fringes, (c) Makgadikgadi Pans and Nata River Delta, (d) Zambezi riparian woodland (below Senanga), (e) Zambezi riparian woodland (between Kazungula and Victoria Falls), (f) Victoria Falls and Batoka Gorge, (g) Kazuma Pan, (h) Southern Hwange dunes and Nata mudflats. (Base map from Transfrontier Conservation Consortium 2006a).

2. Mammals.

There is one species of endemic/near endemic mammal in the KAZA TFCA, namely, Woosnam's desert mouse (*Zolotomys woosnami*) the distribution of which is centered on Babwata NP in the Caprivi. Cotterill (2004) listed 31 species of conservation concern in the 4-Corners area of which six species are listed in the IUCN Red Data List as vulnerable (lion, cheetah, spotted-necked otter, honey badger, Kafue lechwe and Anchiete's pipistrelle bat), and two are listed as critically endangered (black rhinoceros and African wild dog).

Of the larger mammals Cotterill (2004) considered the following species to be vulnerable within the 4-Corners area, although they are not listed as such in the IUCN Red Data List: leopard, hippopotamus, sitatunga, Penric's waterbuck, red lechwe, puku, roan antelope, tsessebe, klipspringer, oribi and pangolin.

The wetland dependent species (sitatunga, lechwe, puku, reedbuck and waterbuck) may be particularly vulnerable because wetlands are also areas in which humans and livestock concentrate and compete with wild herbivores (Martin 2004).

Key mammal species for KAZA may be defined as those that are (a) globally endangered and threatened, (b) the additional large mammal species that are considered vulnerable within KAZA, and (c) species that are economically important (**See Box 5.1**)

Box 5.1 Key large mammal species in KAZA

Globally Endangered species:

Black rhinoceros, African wild dog

Globally Vulnerable species:

Lion, cheetah, spotted necked otter, honey badger, Kafue lechwe

Species vulnerable in Kaza:

leopard, hippopotamus, sitatunga, Penric's waterbuck, red lechwe, puku, roan antelope, tsessebe, klipspringer, oribi and pangolin

Additional economically important species

Elephant*, sable, buffalo, crocodile

* IUCN Red Data Lists include elephant as an endangered species, however, KAZA has the largest elephant population in the world at >250, 000 animals

3. Birds

Bird Life International recognizes 12 Important Bird Areas (IBAs) within the KAZA area (Fishpool and Evans 2001, **Table 5.2**).

Mundy (2004) recorded 17 globally threatened and near threatened bird species that occur in the 4-Corners area. Of these the blue crane is a vagrant, three species are palaearctic migrants (lesser kestrel, pallid harrier and blackwinged pratincole), and one, the Africa skimmer, is an Afrotropical migrant. The globally vulnerable species that are resident within KAZA are the salty egret, lappet faced vulture, cape griffon, wattled crane, and black cheeked lovebird. The near threatened resident species are the shoebill stork, lesser flamingo, taita falcon, Stanley's bustard, and Chaplin's barbet.

The only KAZA endemic bird species is the black cheeked lovebird.

Mundy (2004) provided a list of 12 bird species that were of concern to at least three of the countries participating in the KAZA TFCA (**Table 5.3**)

Table 5.2 Important Bird Areas (IBAs) in the KAZA TFCA area (Data from Fishpool and Evans 2001) (The number of species occurring at a site out of the number of species whose distributions are largely limited to that biome are indicated where appropriate, e.g. 12 species of 17 Zambezian biome species occur in BW001. The numbers BW001, NA002, etc., are the Birdlife International identifying numbers for IBAs).

Important Bird Area	Area (km2)	Key bird species
Botswana		
Chobe National Park and Moremi Game Reserve (BW001)	10,680	Marabou stork (*Leptoptilis crumeniferus*), Woolynecked stork (*Ciconia episcopus*), Lesser moorhen (*Gallinula angulata*) Zambesian biome – 12 of 17 species, Kalahari-Highveld biome – 4 of 6 species
Linyanti Swamp (BW0002)	200	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*), Blackwinged pratincole (*Glareola nordmanni*), Rufousbellied Heron (*Ardeola rufiventris*), African openbilled stork (*Anastomus lamelligerus*), African spoonbill (*Platella alba*)
Okavango Delta (BW003)	18,000	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*), Blackwinged pratincole (*Glareola nordmanni*), Lesser kestrel (*Falco nuamanni*), Corncrake (*Crex crex*)
Lake Ngami (BW0004)	250	Lesser kestrel (*Falco nuamanni*), Blackwinged pratincole (*Glareola nordmanni*), Breeding site for African spoonbill, Eastern white pelican and ducks, > 20,000 water birds at times
Makgadikgadi Pans (BW005)	12,000	Wattled crane (*Grus curunculatus*), Lesser flamingo (*Phoenicopterus minor*), Blackwinged pratincole (*Glareola nordmanni*),
Namibia		
Eastern Caprivi Wetlands (NA002)	4,680	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*) Blackwinged pratincole (*Glareola nordmanni)*
Mahango Game Reserve and Kavango River (NA003)	245	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*)
Bushmanland (Tsumkwe) Pan System (NA006)	1,200	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*), Blackwinged pratincole (*Glareola nordmanni*), Lesser flamingo (*Phoenicopterus minor*), Pallid Harrier (*Circus macrourus*), Great snipe (G*allinego media*)
Zambia		
Liuwa Plain National Park (ZM005)	3,660	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*) breeds, Blackwinged pratincole (*Glareola nordmanni*) breeds, Lesser kestrel (*Falco nuamanni*), ?? plover (*Charadrishybridu*) breeds, Caspian plover (*Charadris asiaticus*)
Barotse Flood Plain (ZM006)	6,000	As for Liuwa Plain + several additional species breeding, e.g. African spoonbill, African open billed stork
Sioma Ngwezi National Park (ZM007)	5,276	15 of the 56 Zambezian biome species that occur in ZM recorded
Machile (ZM008)	3,000	Lesser kestrel (*Falco nuamanni*), Wattled crane (*Grus curunculatus*), Black-cheeked lovebird (*Agapornis nigrigenus*), 9 of 56 Zambezian biome species recorded
Mosi-oa-Tunya NP & Batoka Gorge (ZM009)	100	Taita falcon (*Falco fasciinucha*), Black-cheeked lovebird (*Agapornis nigrigenus*), Rock pratincole (*Glareola nuchalis*) 8 of 56 Zambezian biome species recorded
Kafue National Park (ZM0012)	22,400	Slaty egret (*Egretta viaciegula*), Wattled crane (*Grus curunculatus*), Pallid Harrier (*Circus macrourus*), Lesser kestrel (*Falco nuamanni*), Corncrake (*Crex crex*), Great snipe (G*allinego media*), Chaplin's barbet (*Lybius chaplini)*
Zimbabwe		
Hwange National Park (ZW009)	14, 460	12 of the 23 Zambezian biome species recorded and 3 of the 6 Kalahari Highveld species from Zw recorded
Chizarira National Park (ZW0010)	1,910	Taita falcon (*Falco fasciinucha*) 13 of 23 Zambesian biome species recorded
Batoka Gorge (ZW0011)	120	Taita falcon (*Falco fasciinucha*)

Table 5.3 Bird species of conservation concern to at least three countries in the KAZA TFCA area. (After Mundy 2004) (Angola does not appear to have developed a list)

Species	Bw	Na	Zm	Zw
Great crested grebe	✓	✓	✓	
White pelican	✓	✓		✓
Pin-backed pelican	✓	✓		✓
White backed night heron	✓	✓		✓
Bittern	✓	✓	✓	
Greater flamingo	✓	✓		✓
Hooded vulture	✓	✓		✓
White backed vulture	✓	✓		✓
Bateleur eagle	✓	✓	✓	✓
Crowned crane	✓	✓		✓
Rock Pratincole	✓	✓		✓
Ground hornbill	✓	✓		✓
Yellow-billed oxpeckers		✓	✓	✓

4. Herpetofauna

Broadley (2004) provided an annotated list of 178 species of turtles, snakes, lizards and frogs for the 4-Corners area. The area carries five strict endemics, namely, two lizards, one amphisbaenian and two frogs (Broadley 2004 and **Table 5.3**). Near-endemics include a terrapin, a semi-aquatic snake and two frogs (**Table 5.3**). Of the nine endemics and near endemic species, six are wetland species.

Table 5.4 Endemic and near-endemic species of herpetofauna in the KAZA TFCA area and their distribution (Data from Broadley 2004)

Species	Distribution
Endemics	
Tsodilo thick-toed gecko – *Pachydactylus tsodiliensis*	Tsodilo Hills (Bw)
Makgadikgadi spiny agama – *Agama makarikaria*	Northern edge of Makgadikgadi Pans (Bw)
Long-tailed pestle-tailed Worm-lizard – *Dolophia longicauda* (Amphisbaenia)	Caprivi and Hwange District confined to Baikiaea woodlands (Na and Zw)
Matetsi reed frog - *Hyperolius rhodesiensis*	Matetsi River (Zw)
Kafue reed frog – *Hyperolius pyrhiodictyon*	Kafue flats (Zm)
Near-endemics	
Terrapin – *Pelosios bechuanicus*	Upper Zambezi River, Zambezi River above Victoria Falls, Caprivi and the Okavango Delta
Semi-aquatic snake – *Crotaphopeltis barotseensis*	Selinda spillway, Okavango Delta, Kolobo on Barotse Flood Plain – eats frogs (Bw, Na, Zm)
Kafue round-snouted worm lizard – *Zygaspis kafuensis* (Amphisbaenia)	Kafue flats on the eastern boundary of Kafue National Park (Zm)
Mapacha Grass Frog – *Ptychadena mapacha*	East Caprivi, Ojmatako River (likely in Ang. Zm & Zw)
Aposematic reed Frog – *Hyperolius aposematicus*	From Lealu on Upper Zambezi to Victoria Falls and Lake Liambezi (Zm, Na)

5. Fishes

The total number of indigenous fish species recorded from the 4-Corners area is 109 (Bills and Marshall 2004). They occur in four major river systems, the Okavango with 82 species, upper Zambezi (i.e. above the Victoria Falls) with 71 species, Kafue with 62 species, and the middle Zambezi (i.e. below the Victoria Falls) with 45 species. Apart from a still undescribed killifish in the Caprivi there are no fish species endemic to the KAZA area and none are listed on the IUCN Red Data List. Bills and Marshall (2004) list four rare species that warrant attention. These are *Neolebias lozii* know only from the Barotse flood plain, *Nothobranchius kafuensis* from the Kafue flats, *Nothobranchius* sp. found only in two pans in the Caprivi, and *Chiloglanis emarginatus* from a tributary of the Gwayi River in Zimbabwe and outside the KAZA TFCA area.

The introduction of exotic species is a matter of considerable concern, particularly the introduction of the Nile tilapia *Oreochromus nilotica* which is apparently displacing the middle Zambezi endemic *Oreochromus mortimeri* (Bills and Marshall 2004).

The major threats to fish fauna of the TFCA are the abstraction of water, the building of dams, over-fishing, and the introduction of exotic species often from aquaculture development projects. For example, no less than 25 species (exotics and indigenous species) from elsewhere in Zambia have been introduced to the lower end of the Kafue flats (Bills and Marshall 2004, from van den Audenaerde 1994).

6. Invertebrates

Apart from butterflies, dragonflies, and aquatic molluscs very little is known about invertebrate diversity in the KAZA TFCA Area. Gardiner (2004) listed 295 species of butterfly for the 4-Corners area with a single endemic, *Erkssonia alaponoxa*, from Kataba that is restricted to *Brachystegia* woodlands on Kalahari sands. A second near endemic, *Acraea anemosa* f. *alboradiata,* is restricted to the riparian fringe on the Zambezi between the Victoria Falls and Katimo Mulilo. Other forms of the species occur further afield in East Africa. There are several butterfly species that are restricted to wetlands and these would disappear were the wetlands to dry out. The Victoria Falls area, and the rainforest in particular, is characterized by unusually high butterfly diversity within the TFCA area (Gardiner 2004).

Two species of butterfly produce large numbers of edible caterpillars, generally known as "mopane worms". One species, *Imbrazia belina* feeds on the leaves *Colophospermum mopane* trees and shrubs in the southern parts of the KAZA TFCA, while the other, *Cirina forda*, feeds on *Burkea africana*. Pupae of the moth *Gonometa rufobrunnea* produce a high quality silk and sporadically occur in very high numbers in mopane woodland and scrub areas in the southern parts of the KAZA area in Botswana and Zimbabwe. These species are now commercially exploited.

Ramberg et al (2006), in their review of the biodiversity of the Okavango Delta, note that during the 1960s and 1970s Pinhey collected 92 species of dragonflies and damselflies in the Delta and that more recently Kipping added two further species bring the total to 94. However, of the 92 species found by Pinhey in the 1970s only 70 were found by Kipping 25 years later and of the missing species 12 had been found by Pinhey in three or more localities

(Ramberg et al 2006). Ramberg et al (2006) suggest that two factors may have been responsible for the apparent loss of species, one being the extended dry period during the 1980s and 1990s and the other being the blanket spraying with deltamethrin during 2001-2002 to control tsetse fly.

Dangerfield (2004) drew attention to the generally high diversity of soil invertebrates and the extent to which they have been neglected. He emphasized the important role that termites play as ecosystem engineers in the system through the large mounds they build. Recent studies of large termitaria in the Chizarira National Park (Humphrey 2008, Joseph 2008) highlight their importance in enhancing plant species diversity and their role as refugia large trees and hole nesting birds in an area where elephants have converted woodland to shrubland.

The freshwater invertebrate fauna of the region has been similarly neglected. Marshall (2004) reviewed the available literature and reported 28 species of aquatic molluscs from 12 families. Of particular interest is the rich invertebrate fauna in ephemeral pans in areas such areas as Hwange NP and the extreme effects that introduced catfish (*Clarias* sp.) can have on invertebrates populations and species diversity in these pans.

5.2 The Conservation Area Network within KAZA TFCA

There are more than 70 protected areas within the KAZA TFCA that range in size from 22,000 km^2 (Kafue National Park) to 19 km^2 (Victoria Falls National Park). These protected areas cover a range of types and purposes from strict national parks under state control to multiple use areas under community management (See following section). Small sacred groves that undoubtedly occur within the region have not been included in this review. The matrix, that area within which protected areas are embedded, covers 100,000 km^2 and is almost entirely land under traditional communal tenure or is state land. Small areas of land in Zimbabwe (in the Hwange- Matetsi area) that were formerly under freehold title were transferred, through a change in the constitution, to state land or leasehold land in 2006.

5.2.1 Categories of protected areas

A wide range of protected areas occurs within the TFCA and there is some measure of confusion or mismatch in attempts so far to find a common classification across the five nations involved. This is particularly apparent in mapping and map legends. The following classification follows national designations of the various forms of conservation area and each is defined. The numbers and areas covered by the different categories of conservation area within KAZA in each of the countries are summarized in **Table 5.5** below.

1. **National Parks** in all countries are areas that do not have people, other than staff, settled within their borders[1]. Fauna and flora are protected and resource extraction is not legally practiced. Development other than by the park authorities is not allowed, i.e. hotels and similar permanent structures constructed and owned by the private sector are generally not permitted within the park. This practice has been followed in Botswana, Namibia,

[1] Two exceptions are the Kalahari National Park in central Botswana and the Babwata National Park in western Caprivi in Namibia, both of which have resident San or Kwe people living within their boundaries.

Zambia and Zimbabwe – the policy in Angola in this regard is not clear. Generally, national parks in the KAZA TFCA equate to Category II of the IUCN classification. Although completely undeveloped areas within some of the larger parks could be considered wilderness areas and thus be classified as strictly protected areas, i.e. IUCN Category I. Most national parks have “park plans” and some measure of zonation. Use is confined to game viewing, photographic tourism, wilderness trails, etc, and is non-consumptive apart from fishing in some areas.

2. **Safari Areas** (Zimbabwe). As in national parks these fully protected areas are not settled but sport hunting is permitted under set quotas and mostly through professionally guided hunts. They were initially established as controlled hunting for sport hunting. Infrastructure development is minimal with dirt roads and temporary rustic camps although the Matetsi SA, a former farming area, has permanent brick houses. These areas are not equivalent to the Game Management Areas, Wildlife Management Areas, or Coutadas, of Zambia, Botswana and Angola, respectively, in which people are settled.

3. **Game Reserves** (Botswana) and **Partial Reserves** (Angola). The Moremi Game Reserve in Botswana is presently the only game reserve within the KAZA TFCA and has a special status as it is within tribal land and was initially set aside by the Chief of the area. There are two “Partial Reserves” in South East Angola and their legal status is defined as “An area where it is forbidden to hunt, kill or capture animals, or to collect plants, other than for authorized scientific or management purposes” (Jones 2008), which places them in a similar category to national parks.

4. **Recreational Parks**. This is a category peculiar to Zimbabwe in which recreational pursuits such as boating, yachting, fishing and the construction of recreational centres is permitted. The only recreational park within KAZA is Lake Kariba.

5. **State Forest Reserves** occur within KAZA in each country except Angola. They are under state control where indigenous forests and woodlands are managed for the production of timber usually through leases to commercial logging companies. In Botswana and Zimbabwe controlled sport hunting also takes place in state forests.

6. **Game Management Areas** (GMAs – Zambia). Wildlife designated land under communal tenure, usually acting as buffer zones to national parks. Wildlife is controlled and managed by the state with community involvement and benefits through the ADMADE programme.

7. **Wildlife Management Areas** (WMAs – Botswana). These are areas in which wildlife utilisation is intended to be the major landuse. People live within these areas and grow crops, gather wild foods and hunt under quotas or permits. Overlying the boundaries of WMAs are the country’s hunting blocks which may be designated for specific uses such as photographic tourism, community leases, private sector leases etc. (see further details below).

8. **Coutadas** (Angola). This category is not mentioned by Jones (2008) in his review of conservation legislation for the KAZA TFCA and the status of the five “coutadas” in south east Angola is not clear. In Mozambique coutadas are effectively controlled hunting areas in which people are settled and in which hunting rights are leased to safari companies. This is the sense in which the five Angolan coutadas are regarded in this report.

9. **Community Conservancies** (Namibia). Conservancies "are the legal instruments through which rural communities gain rights to use, manage and benefit from wildlife" (NACSO 2004). Communities develop management institutions that cover geographically defined areas and can include natural resources besides wildlife, such as rangelands and water. The important point is that full benefits from the utilization of wildlife and from tourism can be returned to communities. The result has been a marked improvement of large mammal populations within community conservancies (Weaver and Skyer 2005).

10. **CAMPFIRE Areas** (Zimbabwe). In terms of Zimbabwe's wildlife legislation the land owner or occupier is the Appropriate Authority for wildlife which confers on them the right and responsibility to manage, use and benefit from wildlife on their land. In the case of Communal Lands the minister can confer Appropriate Authority on the District Council but not to wards or resource management units at lower administrative levels. This has resulted in participating communities deriving less than the full benefits from wildlife and in a steady erosion of wildlife populations within most districts involved in the programme. The mapping of entire districts or even of wards, in Zimbabwe, as wildlife conservation areas is therefore inappropriate.

11. **Community Forest Reserves** (Zambia). Several community forestry reserves probably occur in the area to the south of the Kafue NP but no information has been found on them.

5.2.2 Inventory and characterization of protected areas in KAZA TFCA

A full listing and brief characterization of each protected area is provided in **Appendix 1**. For each area I have attempted to provide the following information: area in square kilometers, date designated or date established, broad landscape and habitat (vegetation) features of the area, key large mammal and bird species of conservation and economic interest, endemic species, noteworthy ecological processes or services, and key issues relating to the conservation status of the area. For several areas no data were located within the time available. Descriptions and reliable inventories of biological resources for a large number of the conservation areas within KAZA were not available in the published literature or even from sources within countries. The IUCN and WCMC database on protected areas was particularly weak and even a well established national Park such as Chobe had little more available in the database than a map showing its location. A key resource was the IUCN/UNEP (1987) Directory of Afrotropical Protected Areas. The inventory in **Appendix 1** provided a partial basis for scoring particular protected areas using the ranking system described in the following section.

Table 5.5 The numbers and areas of different categories of conservation area in the KAZA TFCA.

Type of conservation Area	Country										Totals			% of Total KAZA TFCA Area**
	Angola		Botswana		Namibia		Zambia		Zimbabwe					
	No	Area	No	Area	No	Area	No	Area	No	Area	No	Area	%	
National Park	-	-	3	9,210	4	10,884	6	31,402	6	18,827	17	70,324	22.8	17.6
Game Reserve	-	-	1	1,8000	-	-	-	-			1	1,800	0.6	0.5
Safari Area	-	-	-	-	-	-	-	-	4	6,224	4	6,224	2.0	1.5
Recreational park	-	-	-	-	-	-	-	-	1	2,830	1	2,830	0.9	0.7
State Forest Reserve	-	-	5	6,190	1	1,200			8	7,005	14	14,395	4.7	3.6
Partial Reserve	2	14,350	-	-	-	-	-	-	-	-	2	14,350	4.7	3.6
Game Management Area	-	-	-	-	-	-	10	82,790	-	-	10	82,790	26.9	20.7
Wildlife Management Area	-	-	4	47,492	-	-	-	-	-	-	4	47,492	15.4	11.9
Community Conservancy	-	-	-	-	10	4,055	-	-	-	-	10	4,055	1.3	1.0
Campfire Wildlife Area	-	-	-	-	-	-	-	-	7	2,100	7	2,100	0.7	0.5
Hunting Block (Community)*	-	-	15		-	-	-	-	-	-	-	-	0	
Hunting Block (Commercial)*	-	-	11		-	-	-	-	-	-	-	-	0	
Coutadas	4	61,700	-	-	-	-	-	-	-	-	4	61,700	20.0	14.4
Totals	**6**	**76,050**	**39**	**64,692**	**15**	**16,140**	**14**	**114,192**	**26**	**36,986**	**100**	**308,070**	**100**	**76.0**

* The areas for these hunting blocks in Botswana are included in the areas of the Wildlife Management Areas and areas are therefore not tabled.
** Total area taken as 400,000 km^2.

5.2.3 Ranking and prioritizing protected areas

Ideally, a formal conservation assessment of the entire KAZA TFCA needs to be carried out using the full range of data on species distributions, habitats, risks assessments and so on (e.g. Margules and Pressey 2000, Freitag et al, 1997, Kremen et al 2008). However, such an analysis requires several months of work by a team of scientists and ideally should involve the full participation of governments, resource managers, stakeholders and scientists working within KAZA. The work carried out in South Africa for the fynbos, valley bushveld and Cederburg provides an excellent set of models (Cowling et al 1999, Cowling et al 2003, Knight et al 2006a, 2006b). Desirable as this approach is, it is clearly beyond the scope of a short term desk study.

For the KAZA TFCA large gaps in information are apparent and the data from the different countries concerned are at differing scales, resolution, quality and times. This all suggests that **a priority** for KAZA is a full ecological survey and data synthesis using a standard format and methodology across the entire area of the TFCA, e.g. using ¼ -degree grid squares to plot historical and current species distributions for as many taxa as possible.

Published data in this format are available for the distribution of mammals in Botswana (Smithers 1971) and Zimbabwe (Wilson 1975), for birds in Botswana (1 degree grid squares) and Zimbabwe (Zimbabwe Bird Atlas database for ¼ degree grid squares), for amphibians in parts of Angola, and for Botswana, Namibia, Zambia and Zimbabwe (Poynton and Broadley, 1985a, 1985b, 1987, 1988, 1991). O'Brien (1993) and Andrews and O'Brien (2000) compiled data for trees and mammals in southern Africa (south of the Kunene-Zambezi Rivers) using equal area blocks of 20,000 and 25,000 km^2 respectively.

In the absence of data and resources to carry out a formal analytical assessment of conservation priorities the **biological value** for each conservation area within KAZA was assessed and scored using the following sets of criteria:

1. Size of area
2. Large scale habitat diversity
3. Types of wetland
4. Endemic and threatened plants
5. Endemic and threatened vertebrates
6. Key ecosystem processes

The **conservation effectiveness (conservation status)** of each area was assessed and scored using the following seven criteria:

6. Legal status (official legal security of the area)
7. Historical and traditional status
8. Resources available for protection and conservation action
9. Level of development and implementation of protected area plans
10. Research and monitoring

The treats posed by population growth and land and development pressures were assess and scored on the basis of the following two criteria.

3. Land pressures
4. Land capability (potential development pressures)

The ranking criteria outlined and used here are based on several assumptions about their use in assigning priorities to particular areas within KAZA TFCA. The more important of these are:

a) Conservation effort and resources should be invested in those areas of highest diversity as reflected by diversity of major vegetation or community types, the presence of endemic and endangered species, and the presence of charismatic species of mammals and birds that are also of economic importance to the area.

b) The conservation of wetlands is particularly important to the KAZA TFCA because they are both a major draw-card for tourists and because nowhere else in the region are wetlands so well represented within a large conservation area.

c) In addition to the biological value of an area there is a need to gauge its suitability for the investment of resources and funds. Areas of low biological value that are poorly protected and likely to be threatened by local resource claims are clearly less attractive as sites for investment in conservation than those of higher biological or conservation value that have the potential to be effectively protected in the long term. Given the scarcity of prime agricultural land and high levels of poverty in southern Africa the reality is that such land will face increasing pressures for agricultural development.

Finally, it is important to note for many areas little current information was available on both their biological value and conservation effectiveness and the scores assigned to them are therefore open to correction and revision. Ideally the criteria adopted and the scoring system and scores used should be developed through a consensus of stakeholders in a workshop setting (e.g. Cumming and Jackson 1984, Bell and Martin 1984). As result the criteria, scores and ranking presented here are essentially a "straw dog" to provoke discussion and critical examination of conservation priorities across the TFCA and to stimulate the implementation of a full conservation assessment using current methods.

The set of criteria and scores used were as follows:

1. Biological and conservation values

1. Size of area

1 – Less than 100 km^2
2 – 100 – 1,000 km^2
3 – 1,000 – 5,000 km^2
4 – 5,000 – 10,000 km^2
5 – >10,000 km^2

2. Habitat Diversity (Numbers in parenthesis refer to White's (1983) vegetation types)

1 – Mopane (28)
2 – Wet miombo (25)
3 – Dry miombo (26)
4 – Transitional woodland (35a)
5 – *Baikiaea* woodland (22a)
6 – *Brachystegia bakerana* (47)
7 – Grassland on Kalahari sand (60)
8 – Herbaceous swamp (75)
9 – Edaphic grassland (64)
10 – Halophytic grassland (76)
11 – *Crytosepalum* forest (6)

3. Wetlands (applicable only to dryland habitats 1-5 above)

0 – No wetlands
1 – Ephemeral wet season pans / dambos or vleis (no rivers)
2 – Seasonal river(s) with permanent pools
3 – Perennial rivers with well developed riparian fringe

4. Endemic and threatened plant species

0 – No endemic or threatened species
1 – One or more threatened species
2 – At least one endemic species
3 – Two or more endemics
4 – Key population of a critically endangered species

5. Endemic and threatened vertebrate species

0 – No endemic or threatened species
1 – One or more threatened species
2 – At least one endemic species
3 – Two or more endemic species
4 – Key population of a critically endangered species

6. Ecosystem processes

0 – no unusual process / not a key resource area for large mammals or birds
1 – Supports large mammal migration / important bird area
2 – Key corridor or potential corridor area
3 – Important protected watershed

2. Conservation effectiveness and threats

1. Legal status (official security of the area)

0 – No legally protected status
1 – Private or community designation as protected area
2 – Local authority regulations
3 – Ministerial authority (i.e. Minister responsible can change status)
4 – Subject to change of status only by Act of Parliament

2. Historical and traditional status

0 – Not presently settled and not settled in recent times
1 – Previously settled and still regarded as home by those displaced
2 – Not settled, no deep rooted cultural claims evident
3 – Not settled, with traditional support for conservation status of the area
4 – Traditionally a sacred and protected area

3. Resources for protection and conservation action

0 – No employed staff, infrastructure or equipment – paper park
1 – Staffed and equipped on a minimal basis
2 – Moderately staffed and equipped but below capacity required for effective protection
3 – Under effective community / private protection
4 – Full complement of trained and equipped staff

4. Development and planning

0 – Undeveloped, no access or base station, no plan
1 – Limited seasonal access, rudimentary plans
2 – All-weather access with some implementation of protected area plan
3 – Infrastructure developed but area plans not fully implemented
4 – Full infrastructure development and implementation of area plans

5. Research and monitoring

0 – No research or monitoring input
1 – Preliminary ecological surveys
2 – Continuing ecological survey and basic monitoring
3 – Resident research unit
4 – Well developed research and monitoring programme

3. Population and landuse threats

1. Land pressures

4 – Rapidly expanding rural population on boundary and density > 10 people/km^2
3 – Expanding rural population, 5-10 people/km^2
2 – Slowly expanding population, 1- 5 people/km^2
1 – Sparse, stable or declining rural population, < 2 people/km^2
0 – Land unsuitable fore settlement – no foreseeable land pressure

2. Land capability (Development pressures)

4 – Prime agricultural land with irrigation potential or mineral-rich mining deposits
3 – More than 10% of area suitable for productive dry land cropping
2 – Limited cropping potential (<10%), limited grazing, supports low population (<10/km2)
1 – Unsuitable for dry land cropping or livestock production (e.g. tsetse, low nutrient status)
0 – Unsuitable for habitation and livestock grazing (e.g. swamps, desert, no water)

5.2.4 Explanatory notes on ranking criteria

The thinking and logic behind each of the sets of criteria is outlined here.

1. Conservation Value

1. *Size of protected area*. In general the larger the area the greater the species and habitat diversity is likely to be and hence larger areas are ranked higher than smaller areas. Edge effects are reduced in larger areas although this depends in part upon their shape; this factor has not been taken into account here. An index of edge to area could be computed for each park polygon using appropriate GIS tools. The central areas of even very large parks can be influenced by activities outside their boundaries. This has recently been exemplified by the reduction in the number of lions and pride sizes in the centre of Hwange National Park as a result of safari hunting in the peripheral forest and safari areas.

2. *Habitat diversity*. White's (1983) vegetation map of Africa was used as a basis for ranking the eleven major vegetation types that occur within the KAZA TFCA area. More detailed vegetation maps are available (e.g. Wild and Barbosa's (1967) *Flora Zambeziaca* map which covers all but the Caprivi and south east Angola) but there is as yet no integrated vegetation mapping that covers the entire KAZA region. Habitats were ranked on a scale of 1-11 according to the area they covered within the wider region, with higher scores being

assigned to those covering smaller areas and those with wetlands. If more than one vegetation type occurred within a protected area the scores were added and divided by 2 to avoid undue weighting in the overall score due to habitat type and diversity. Nevertheless the scoring system *is* heavily weighted to broad scale habitat diversity as the most appropriate surrogate for biodiversity given our current state of knowledge of the KAZA TFCA.

It is also important to note that there is some measure of co-variance between area and habitat ranking scores since, at the scales used, larger conservation areas will generally also contain more than one habitat type.

3. *Wetlands - presence and type*. Major wetlands are scored under habitat diversity (with high scores being accorded to wetland vegetation types). An additional score is added here for dryland areas (habitat types 1-5 that doe not include major wetlands) that may contain ephemeral wetlands and rivers with riparian fringes that would not be mapped at the scale used for vegetation types. The scores range from 0 for areas with no wetlands to 3 for areas with perennial rivers and marked riparian fringes. The latter are important, for example, as corridors for many bird species and for butterflies. Some areas without rivers but rich in ephemeral pans are included and assigned a score of 1.

4 & 5. *Endemic and threatened species* of plants and vertebrates The scoring is similar for plants and vertebrates and ranking is on the basis of the presence of threatened species using the IUCN red data listings and species that are endemic, or near-endemic, to the KAZA TFCA (See section 5.1.2). The highest rank is assigned to areas holding key populations of critically endangered species. In our present state of knowledge this may only apply to the wild dog, *Lycaon pictus* and the black rhinoceros *Diceros bicornis*.

6. *Ecosystem processes*. In the context of the KAZA TFCA it is important to maintain existing migratory phenomena and to establish corridors that may sustain migrations and dispersal between major protected areas. Although threatened species are covered under criteria 4 & 5 above, areas that sustain a key population of a threatened species are catered for here, as are areas that may protect an important watershed such as the Kafue NP.

2. Conservation effectiveness (conservation status)

The ranking criteria and scores are based on five features that contribute to, or are necessary for, effective protection and conservation of an area. Two very important criteria are missing, annual operational budgets and the number of field staff. These have not been included because the data are not readily available.

1. *Legal status (official security of the area)*. The ranking scores suggested here reflect increasing legal security of the protected area on the assumption that it is easier, for example, for the status of a private property or community reserve to be changed than it is for the status of a protected area to be changed. Usually a change in the status of a national park requires parliamentary approval.

2. *Historical and traditional status*. As has become clear from the land claims in respect of national parks in South Africa, historical and cultural attitudes regarding land occupied by a protected area can be very important to determining its long term future and sustainability. The highest score is assigned to areas that would have the greatest support of local inhabitants.

3. *Resources available for protection and conservation action*. The resources available to protect and manage a protected area are clearly important and the ranking here assists in identifying shortfalls in the protection of areas that may be of high conservation value but are not being adequately protected. For many areas data were not available and the scores assigned were suppositions on my part – these are indicated in red font.

4. *Development and planning*. Again, access, infrastructure and planning are important components of effective protection, resource management and conservation. The scores range from no development to a well developed and managed park. None of the protected areas within the KAZA TFCA fall into this latter category.

5. *Research and monitoring*. For conservation to be effective it needs to be based on up-to-date and reliable information on the status and trends of the habitats, plants and animals being conserved. The effort being invested in research and monitoring provides a useful index to the state of conservation in an area. The investment or lack of it in research is also a useful indicator of national commitment to the core business of conservation.

3. Population and landuse threats

1. *Land pressures*. Population pressures and the growing needs of resource poor rural populations provide an index of the potential threats likely to be faced by a protected area.

2. *Land capability (development pressures)*. The criteria and ranking here is based on the assumption that a protected area on prime agricultural land is more likely to face pressures from governments and farmers than is land of low agricultural potential. That is, prime agricultural land faces a greater conservation threat than land of limited agricultural potential.

Several additional threats could be considered such as poaching, the construction of dams and highways, civil unrest, political support for conservation, etc. but the scoring of these would require input from people within each country in order to reach any sort of consensus on some of the more potentially contentious issues.

5.2.5 Results and Discussion

The scores for each area and the rankings resulting from the additive score of biological value and conservation status are shown in **Tables 5.6 and 5.7** and plotted in **Fig. 5.2.** The scores for threats are also shown but were not used in the ranking. Those conservation areas falling in the top ten are all national parks, apart from the Moremi Game Reserve and the Western GMA. They are also, for the most part, clustered in the central area of the TFCA. The high rank of the Western GMA suggests that this area may merit much closer attention in terms of its biodiversity, wetlands, and potential to form an important corridor area. The high ranking of the Makgadikgadi Pan NP (#12 Table 5.7) also suggests that this park, and its linkages to the rest of the TFCA (see Section 8 on wildlife corridors), merit greater attention.

Many of the small community conservancies in the Caprivi have a higher than expected ranking and this is a result of their importance as potential corridor areas, the wetland habitats falling within them and the high scores assigned to areas where there was strong community support for conservation. Their overall value may thus have been somewhat inflated.

Conservation effectiveness of areas throughout the TFCA is weak, with the highest score being that for Hwange National Park returning a score of 14 out of maximum possible score of 20. As discussed in Section 7 below, the low level of funding and resources in all of the protected areas in the KAZA TFCA is a matter of considerable concern.

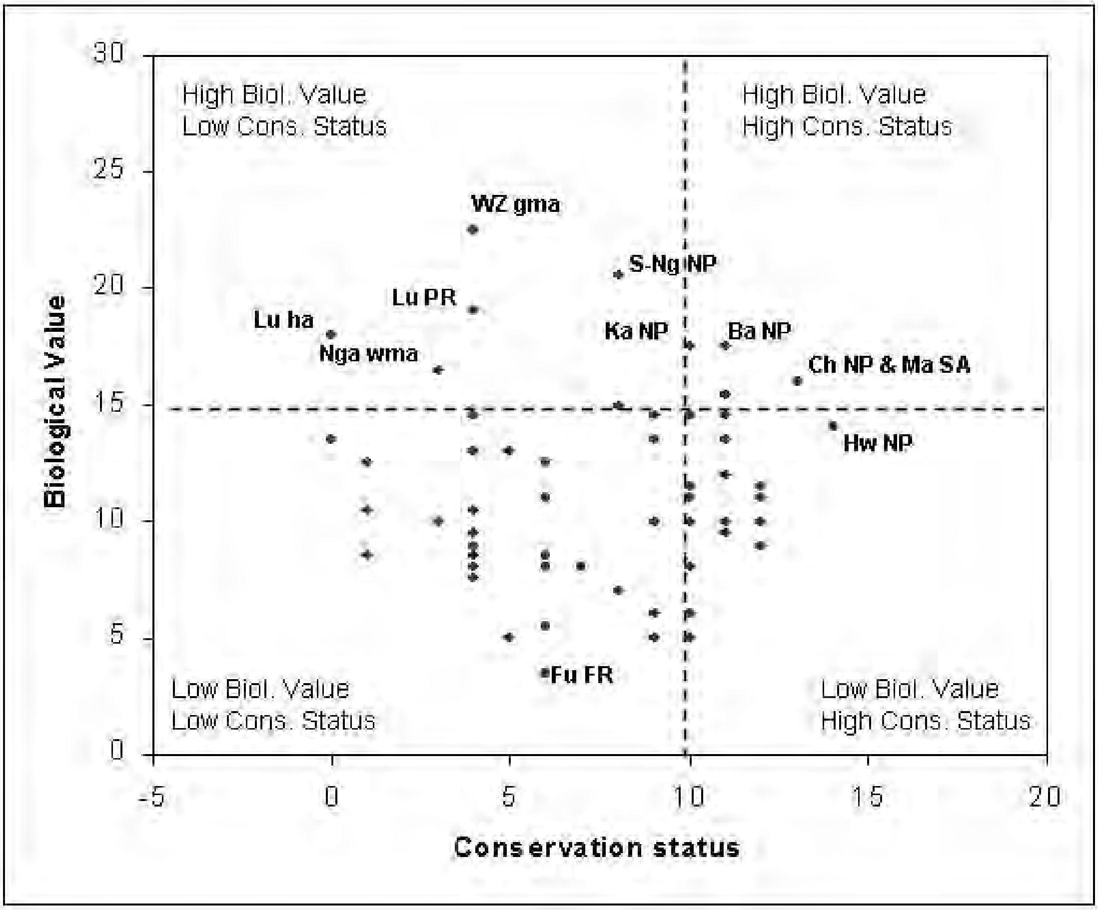

Fig. 5.2 Plot of biological value and conservation status scores from Table 5.7. The plots fall into four quadrants four with scores above or below the 50% scores on each axis. An indicative conservation strategy is to invest in improving the conservation status of those areas of high biological value, i.e. those areas with a biological value score above a score of 15 or more. (Ba NP – Babwata NP; Ch NP & Ma SA – Chobe NP and Matetsi SA; Fu FR – Fuller FR; Ka NP – Kafue NP; LU ha – Luiana HA; Lu PR – Luiana PR; Nga wma – Ngamiland WMA; S-NG NP – Sioma-Ngwezi NP; WZ gma – West Zambezi GMA.)

At the lower end of the rankings are a set of Forest Reserves and Game Management Areas. The forest reserves in the Sebungwe are poorly protected and managed and have been impacted by people and livestock. Chizarira National Park and Chirisa Safari Area both have high potential but have been heavily impacted by elephants and fire and are presently poorly protected.

While this exercise has provided a plausible ranking of conservation areas within the KAZA TFCA and should provide a useful starting point for discussing priority areas, its limitations need to be recognized. It also highlights the urgent need for greatly improved, up to date information on the distribution and status of biodiversity in the TFCA, as well as the need for improved and accessible information on the effectiveness of conservation activities in the protected areas of the KAZA TFCA. The almost complete absence of effective monitoring of protected area performance and lack of transparency[1] is not limited to the KAZA TFCA (e.g. Cumming 2004b) and remains a cause for concern throughout the region.

The possibility of including additional factors such as ecosystem services and the status of key resources (as characterized in Appendix 1) was examined. A logical difficulty arises in 'valuing' ecosystem services, such as provisioning services of food and fibre, in areas where people cannot legally use them, which is the case in fully protected areas. Most regulating services (e.g. flood mitigation, silt trapping, disease regulation) were either captured under the scores for wetlands or were unknown. Carbon sequestration likewise could not sensibly be scored for particular conservation areas consistently across the region without appropriate land cover information. Cultural services (landscapes, vistas, recreational amenity values and spiritual aesthetic values) could have been scored but require the input of people who have experience of the areas in question.

Threats from human population growth and land pressure were initially included within the scores on conservation status, but because they can be scored as being additive (the more threatened an area the more important it is) or subtractive (the more threatened an area the lower its investment value, and often its conservation status) they were scored as a separate category (**Tables 5.6 and 5.7**).

[1] Conservation agencies in the region tend to be remarkably reluctant to release, or make available, data on their budgets and levels of operation.

Table 5.6 List of conservation areas within the KAZA TFCA with the national category, area (km2) and scores assigned under each criterion. Under 'Category', 'National' shows the conservation abbreviations, e.g. NP = National Park, and 'Areas' indicates the sub total in area for that category of conservation area. Area km^2 = area of the particular conservation area. (See section 5.2.3 above for criteria and scores used).
NP = National Park, GR = Game Reserve, PR = Partial Reserve, SA = Safari Area, GMA = Game Management Area, WMA = Wildlife Management Area
FR = Forest Reserve, HA = Hunting Area (Coutada), CC = Community Conservancy, ECC = Emerging Community Conservancy. Red font = estimates

Country/PA		Area		Biological Value (a)							Conservation status (b)						Threat (c)			Total Score	
	National Category	Area Km2 (sub-total)	Km2	1	2	3	4	5	6	Score	1	2	3	4	5	Score	1	2	Score	(a+b-c)	(a+b+c)
Angola																					
Luiana	PR		8,400	4	11	0	1	1	2	19	3	1	0	0	0	4	2	2	4	19	27
Mavinga	PR	14,350	5,950	4	5.5	0	0	1	2	12.5	1	0	0	0	0	1	2	2	4	9.5	17.5
Longa-Mavinga	HA		10,000	4	5.5	0	0	1	0	10.5	1	0	0	0	0	1	2	2	4	7.5	15.5
Mucusso	HA		25,000	5	2.5	0	0	1	0	8.5	1	0	0	0	0	1	2	2	4	5.5	13.5
Luengue	HA		16,700	5	5.5	0	0	1	2	13.5	1	0	0	0	0	1	2	2	4	10.5	18.5
Luiana	HA	61,700	10,000	4	11	0	0	1	2	18	1	0	0	0	0	1	2	2	4	15	23
National sub-total		**76,050**																			
Botswana																					
Chobe NP	NP		9,980	3	9	0	1	2	1	16	4	2	2	2	3	13	2	2	4	25	33
Nxai Pan	NP		2,590	3	2	1	1	2	1	10	4	2	2	1	2	11	3	2	5	16	26
Makgadikgadi	NP	16,710	4,140	3	7.5	0	1	2	1	14.5	4	2	2	1	2	11	3	0	3	22.5	28.5
Moremi	GR		1,800	3	4.5	0	1	2	1	11.5	2	2	3	3	2	12	2	2	4	19.5	27.5
Chobe FR	FR		2,400	3	3	0	1	2	2	11	4	2	1	1	2	10	2	1	3	18	24
Kazuma	FR		1,280	3	2.5	1	1	2	2	11.5	4	2	1	1	2	10	3	1	4	17.5	25.5
Kasane	FR		1,200	3	2.5	1	1	2	2	11.5	4	2	1	1	2	10	2	3	5	16.5	26.5
Sibuyu	FR		1,010	3	3	1	1	2	0	10	4	2	1	1	2	10	3	1	4	16	24
Maikaelolo	FR	6,190	300	2	2	1	1	2	0	8	4	2	1	1	2	10	3	1	4	14	22
Ngamiland (N of fence)	WMA		21,937	4	6.5	1	1	2	2	16.5	1	0	0	0	2	3	2	2	4	15.5	23.5
Ngamiland (S of fence)	WMA		3,870																		0
Chobe WMA	WMA		2,430	3	3	1	1	2	0	10	1	0	0	0	2	3	2	2	4	9	17
OkavangoDelta				4	5	0	1	2	1	13	1	0	0	0	4	5	2	2	4	14	22
Makgadikgadi	WMA		8,275																		
Central GMA (Nata)	WMA	47,492	10,980																		
National sub-total		**70,392**																			

Country/PA	National Category	Area: Area Km2 (sub-total)	Km2	Biological Value (a): 1	2	3	4	5	6	Score	Conservation status (b): 1	2	3	4	5	Score	Threat (c): 1	2	Score	Total Score: (a+b-c)	(a+b+c)
Namibia																					
Bwabwata	NP		5,715	4	7.5	0	1	3	2	17.5	4	1	3	2	1	11	2	1	3	25.5	31.5
Mudumu	NP		1,010	3	7.5	0	1	2	2	15.5	4	1	3	2	1	11	3	3	6	20.5	32.5
Mamili	NP		319	2	7.5	0	1	3	2	15.5	4	1	3	2	1	11	3	3	6	20.5	32.5
Khaudom	NP	10,885	3,841	3	2	1	0	2	0	8	4	1	2	2	1	10	2	1	3	15	21
Caprivi Forest	FR		1,200	2	2.5	1	0	1	2	8.5	1	1	1	2	1	6	3	2	5	9.5	19.5
Kwandu	CC		190	2	2.5	0	2	1	2	9.5	1	3	3	2	2	11	4	2	6	14.5	26.5
Mayuni	CC		151	2	6.5	0	2	1	2	13.5	1	3	3	2	2	11	4	2	6	18.5	30.5
Mashi (+extension)	CC		330	2	6.5	0	2	1	2	13.5	1	3	3	2	2	11	4	2	6	18.5	30.5
Balyerwa	ECC		250	2	7.5	0	2	1	2	14.5	0	3	3	1	2	9	4	2	6	17.5	29.5
Wuparo	CC		148	2	7.5	0	2	1	2	14.5	1	3	3	2	2	11	4	2	6	19.5	31.5
Malengalenga	ECC		250	2	6.5	0	2	1	2	13.5	0	3	3	1	2	9	4	2	6	16.5	28.5
Salambala	CC		930	2	3	0	2	3	2	12	1	3	3	2	2	11	3	2	5	18	28
Impalila	CC		250	2	7.5	0	2	1	2	14.5	1	3	3	1	2	10	4	2	6	18.5	30.5
Bamumu	ECC		250	2	3	0	2	1	2	10	0	3	3	1	2	9	4	2	6	13	25
Lusese	ECC		250	2	3	0	2	1	2	10	1	3	3	1	2	10	4	2	6	14	26
Nakabolewa	ECC		250	2	3	0	2	1	2	10	1	3	3	1	2	10	4	2	6	14	26
Masida	ECC		380	2	3	1	1	1	2	10	1	3	3	1	2	10	4	2	6	14	26
Butabaja/Kapani	ECC	4,055	400	2	3	1	1	1	2	10	1	3	3	1	2	10	4	2	6	14	26
	National sub-total	**14,940**																			
Zambia																					
Kafue	NP		22,400	5	5.5	3	0	1	3	17.5	4	2	2	1	1	10	3	1	4	23.5	31.5
Sioma-Ngwezi	NP		5,276	4	6.5	3	2	3	2	20.5	4	2	1	1	0	8	3	1	4	24.5	32.5
Liuwa Plain	NP		3,660	3	8	0	2	1	1	15	4	2	1	1	0	8	3	1	4	19	27
Mosi-oa-Tunya	NP	31,402	66	1	1	2	1	0	0	5	4	2	2	1	1	10	3	3	6	9	21
Mulobezi	GMA		3,420	3	1.5	2	0	0	1	7.5	1	0	1	1	1	4	3	2	5	6.5	16.5
Sichifula	GMA		3,600	3	4	2	0	0	0	9	1	0	1	1	1	4	3	2	5	8	18
Bilili Springs	GMA		3,080	3	8	2	0	0	0	13	1	0	1	1	1	4	3	2	5	12	22
Namwala	GMA		3,600	3	7.5	0	0	0	0	10.5	1	0	1	1	1	4	3	2	5	9.5	19.5
Mumbwa	GMA		3,370	3	3	2	0	0	0	8	1	0	1	1	1	4	3	2	5	7	17
Lunga-Luswishwi	GMA		13,340	5	5.5	0	0	0	0	10.5	1	0	1	1	1	4	3	2	5	9.5	19.5
Machiya-Fungulwe	GGMA		1,530	3	5.5	0	0	0	0	8.5	1	0	1	1	1	4	3	2	5	7.5	17.5

Country/PA	**National Category**	**Area**		**Biological Value (a)**							**Conservation status (b)**						**Threat (c)**			**Total Score**	
		Area Km2 (sub-total)	**Km2**	**1**	**2**	**3**	**4**	**5**	**6**	**Score**	**1**	**2**	**3**	**4**	**5**	**Score**	**1**	**2**	**Score**	**(a+b-c)**	**(a+b+c)**
Zambia (cont.)																					
Kasonso-Busanga	GMA		7,780	4	5.5	0	0	0	0	9.5	1	0	1	1	1	4	3	2	5	8.5	18.5
Mufunta	GMA		5,000	4	6.5	3	1	0	0	14.5	1	0	1	1	1	4	3	2	5	13.5	23.5
West Zambezi (part)	GMA	82,790	38,070	5	11	0	2	3	2	22.5	1	0	1	1	1	4	3	3	6	20.5	32.5
Forest Areas ??																					
National sub-total		**114,192**																			
Zimbabwe																					
Hwange	NP		14,651	5	3	1	0	2	3	14	4	2	2	3	3	14	1	1	2	26	30
Zambezi	NP		564	2	3	3	2	3	0	13	4	2	2	3	1	12	1	1	2	23	27
Victoria Falls	NP		19	1	2	3	3	1	3	13	4	2	2	3	1	12	4	2	6	19	31
Kazuma Pan	NP		313	2	3	1	0	1	0	7	4	2	1	1	0	8	1	2	3	12	18
Chizarira	NP		1,910	3	2	0	0	1	0	6	4	2	1	1	1	9	4	1	5	10	20
Matusadona	NP	18,827	1,370	3	2	3	0	1	0	9	4	2	2	3	1	12	2	1	3	18	24
Matetsi Safari Area	SA		2,920	3	3	2	3	3	2	16	3	2	2	3	3	13	1	1	2	27	31
Deka	SA		510	2	1	0	1	1	0	5	3	2	2	2	0	9	1	1	2	12	16
Chirisa	SA		1,713	3	2	0	0	1	0	6	3	2	1	3	1	10	4	2	6	10	22
Chete	SA	6,224	1,081	3	1	3	0	1	0	8	3	2	1	1	0	7	0	0	0	15	15
Lake Kariba	RP		2,830	3	1	3	0	0	2	9	3	2	2	2	3	12	3	0	3	18	24
Sijarira	FR		256	2	1	3	0	0	2	8	3	2	1	0	0	6	3	1	4	10	18
Kavira	FR		282	2	1	3	0	0	2	8	3	2	1	0	0	6	3	1	4	10	18
Mzola	FR		627	2	3	0	0	0	0	5	3	2	0	0	0	5	4	2	6	4	16
Ngamo	FR		1,029	3	2.5	1	2	1	3	12.5	3	2	1	0	0	6	3	2	5	13.5	23.5
Sikumi	FR		1,173	3	4	0	0	1	3	11	3	2	1	0	0	6	3	2	5	12	22
Fuller	FR		233	1	2.5	0	0	0	0	3.5	3	2	1	0	0	6	4	2	6	3.5	15.5
Kazuma	FR		240	1	2.5	1	0	1	0	5.5	3	2	1	0	0	6	3	2	5	6.5	16.5
Panda Masuie	FR	7,005	335	1	2.5	0	0	0	0	3.5	3	2	1	0	0	6	4	2	6	3.5	15.5
National sub-total		**32,056**																			
Overall Total Area (km2)			**310,604**																		

Table 5.7 Rank order of conservation areas based on sum of the scores for biological and conservation value and conservation effectiveness. (See Table 6.2 for scores for each criterion used. Every tenth area is more boldly underlined)

No.	Conservation Area	State	Conservation Effectiveness	Biological & Conservation Value	Total
1	Chobe NP	Bw	13	16.0	29.0
2	Matetsi Safari Area	Zw	13	16.0	29.0
3	Bwabwata NP	Na	11	17.5	28.5
4	Sioma-Ngwezi NP	Zm	8	20.5	28.5
5	Hwange NP	Zw	14	14.0	28.0
6	Kafue NP	Zm	10	17.5	27.5
7	Mudumu NP	Na	11	15.5	26.5
8	Mamili NP	Na	11	15.5	26.5
9	West Zambezi (part) GMA	Zm	4	22.5	26.5
10	Makgadikgadi NP	Bw	11	14.5	25.5
11	Wuparo CC	Na	11	14.5	25.5
12	Zambezi NP	Zw	12	13.0	25.0
13	Victoria Falls NP	Zw	12	13.0	25.0
14	Mayuni CC	Na	11	13.5	24.5
15	Mashi CC	Na	11	13.5	24.5
16	Impalila CC	Na	10	14.5	24.5
17	Moremi GR	Bw	12	11.5	23.5
18	Balyerwa CC	Na	9	14.5	23.5
19	Luiana PR	An	4	19.0	23.0
20	Salambala CC	Na	11	12.0	23.0
21	Liuwa Plain NP	Zm	8	15.0	23.0
22	Malengalenga CC	Na	9	13.5	22.5
23	Kazuma FR	Bw	10	11.5	21.5
24	Kasane FR	Bw	10	11.5	21.5
25	Nxai Pan NP	Bw	11	10.0	21.0
26	Chobe FR	Bw	10	11.0	21.0
27	Matusadona NP	Zw	12	9.0	21.0
28	Lake Kariba RP	Zw/Zm	12	9.0	21.0
29	Kwandu CC	Na	11	9.5	20.5
30	Sibuyu FR	Bw	10	10.0	20.0
31	Lusese CC	Na	10	10.0	20.0
32	Nakabolewa CC	Na	10	10.0	20.0
33	Ngamiland WMA	Bw	3	16.5	19.5
34	Bamumu CC	Na	9	10.0	19.0
35	Mafunta GMA	Zm	4	14.5	18.5
36	Ngamo FR	Zw	6	12.5	18.5
37	Luiana HA	An	0	18.0	18.0
38	Maikaelolo FR	Bw	10	8.0	18.0
39	Okavango Delta	Bw	5	13.0	18.0
40	Khaudom NP	Na	10	8.0	18.0
41	Bilili Springs GMA	Zm	4	13.0	17.0
42	Sikumi FR	Zw	6	11.0	17.0
43	Chirisa SA	Zw	10	6.0	16.0
44	Mosi-oa-Tunya NP	Zm	10	5.0	15.0
45	Kazuma Pan NP	Zw	8	7.0	15.0
46	Chizarira NP	Zw	9	6.0	15.0
47	Chete SA	Zw	7	8.0	15.0

48	Caprivi Forest FR	Na	6	8.5	14.5
49	Namwala GMA	Zm	4	10.5	14.5
50	Lunga-Luswishwi GMA	Zm	4	10.5	14.5
51	Deka SA	Zw	9	5.0	14.0
52	Sijarira FR	Zw	6	8.0	14.0
53	Kavira FR	Zw	6	8.0	14.0
54	Mavinga HA	An	1	12.5	13.5
55	Luengue HA	An	0	13.5	13.5
56	Kasonso-Busanga GMA	Zm	4	9.5	13.5
57	Chobe WMA	Bw	3	10.0	13.0
58	Sichifula GMA	Zm	4	9.0	13.0
59	Machiya-Fungulwe GMA	Zm	4	8.5	12.5
60	Mumbwa GMA	Zm	4	8.0	12.0
61	Longa-Mavinga	An	1	10.5	11.5
62	Mulobezi GMA	Zm	4	7.5	11.5
63	Kazuma FR	Zw	6	5.5	11.5
64	Mzola FR	Zw	5	5.0	10.0
65	Mukosso HA	An	1	8.5	9.5
66	Fuller FR	Zw	6	3.5	9.5
67	Panda Masuie FR	Zw	6	3.5	9.5

6.

ECOSYSTEM SERVICES

Gretchen Daily (1997) in a landmark book on the subject described ecosystem services as "the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfill human life." The Millennium Ecosystem Assessment (MA) (2005a) was primarily concerned with making the link between ecosystem services and human wellbeing explicit. The classification system developed by the MA characterized ecosystem services as supporting services, regulating services, provisioning services and cultural services. This classification served their purpose within a conceptual framework that linked ecosystem services to human well being through direct and indirect drivers of ecosystem change (**Fig. 6.1**).

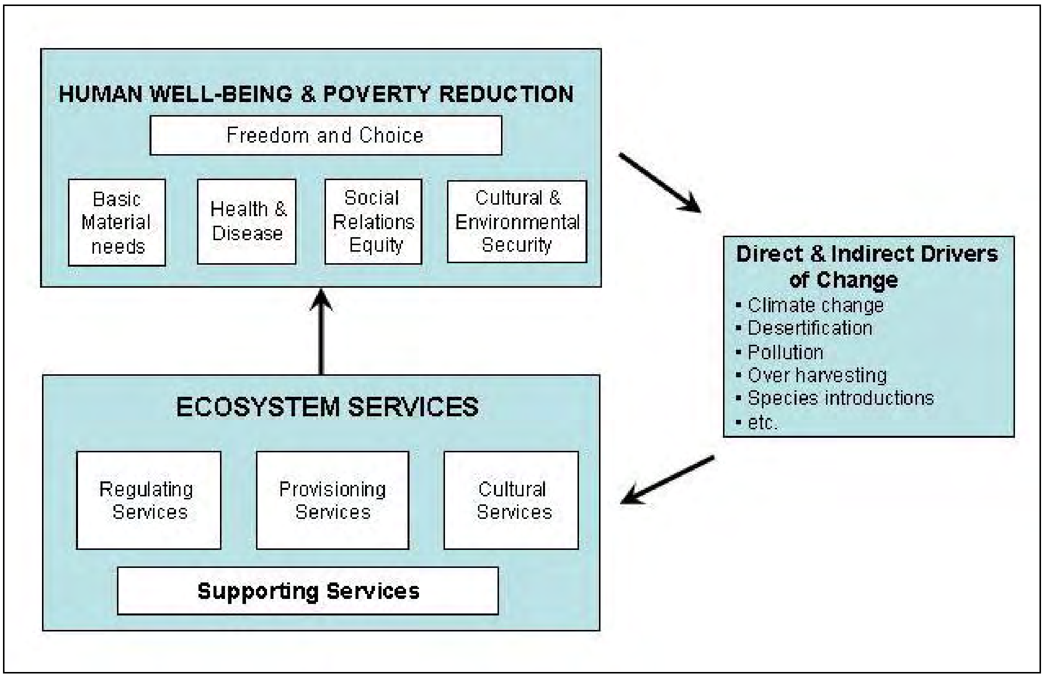

Fig. 6.1 Links between ecosystem services, human well-being, and direct and indirect drivers, based on MA conceptual framework. (Redrawn from Scholes and Biggs 2004)

Describing and commenting on ecosystem services is reasonably straightforward but assigning values to them and ranking them and conservation areas in relation to their contribution to ecosystem services raises several theoretical and practical problems. The valuation of goods, whether manufactured or harvested from ecosystems, is based on market prices and the values of bundles of goods can be aggregated to produce indices of value such as the cost of living index and GDP. The economic valuation of services has long been the subject of controversy and remains problematic in the valuation of ecosystem services (e.g. Boyd and Banzhaf 2006, 2007). Part of the problem centers around precisely how ecosystem *services* are defined and valued, what the objectives of the valuation exercise are, and whose values should prevail (e.g. Farber et al 2002). The result is that the definition and classification of ecosystem services is currently under scrutiny and debate (e.g. Boyd and Banzhaf 2006, Wallace 2007, 2008, Costanza 2008, Fisher and Turner 2008) and the adequacy of the MA goods and services framework is being questioned. This is mainly on the grounds that it confuses means and ends and the valuation of 'cultural services' is problematic (Wallace 2007). Terms such as "ecosystem function" are also problematic and there remain major shortcomings and gaps in the theory and data needed to link ecological diversity to ecosystem dynamics and, in turn, to ecosystem services and human wellbeing (Carpenter et al 2006).

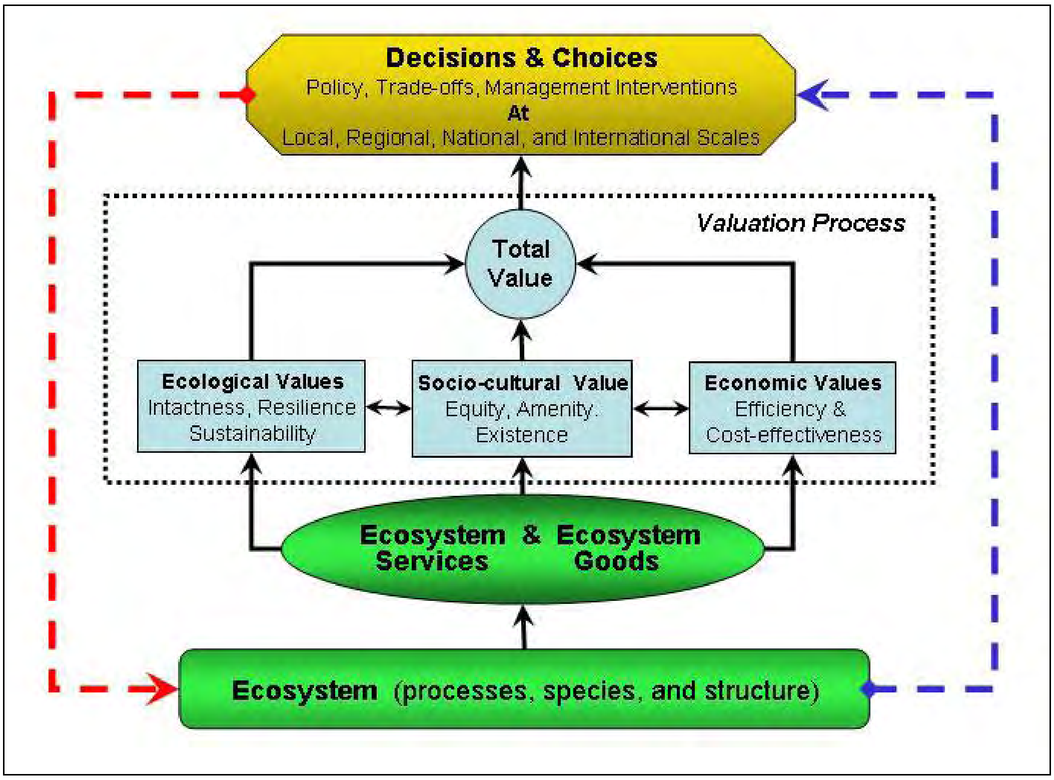

Fig. 6.2 A framework outlining the assessment and valuation of ecosystems, and ecosystem goods and services, with dashed lines indicating major feedback loops. (Adapted from de Groot et al 2002)

Which ecosystem services are key ecosystem services for the KAZA TFCA and how their values should be ranked, will depend not only on the values of those using or benefiting from the services but also on the values of a wide range of stakeholders from local to international levels (**Fig. 6.2**). For example, while the presence of large numbers of elephants may be important to a foreign tourist and the tourism industry the same experience (or ecosystem service provided by the presence of elephants) may not be valued by a local farmer who is more likely to see the presence of elephants as a threat to his crops and livelihood, or even his life. To the peasant farmer who may derive no benefits from elephants they will rank as a disservice. Clearly, which ecosystem services are important within the context of KAZA (**Fig. 6.3**) will differ depending on the stakeholders involved. The perception of their value will also be scale dependent. For example, water and wetlands are arguably the most important resources in the KAZA TFCA and differing services can be identified and valued at regional (effects on climate), national (irrigation and food security, flood control) and local scales (fisheries and household use). Similarly the value of ecosystem services provided by large wilderness areas needs critical evaluation, both from the perspective of how these values may link to the conservation of biodiversity, and from the perspectives of human wellbeing, and maintaining the resilience and adaptive capacity of the KAZA TFCA and the wider region.

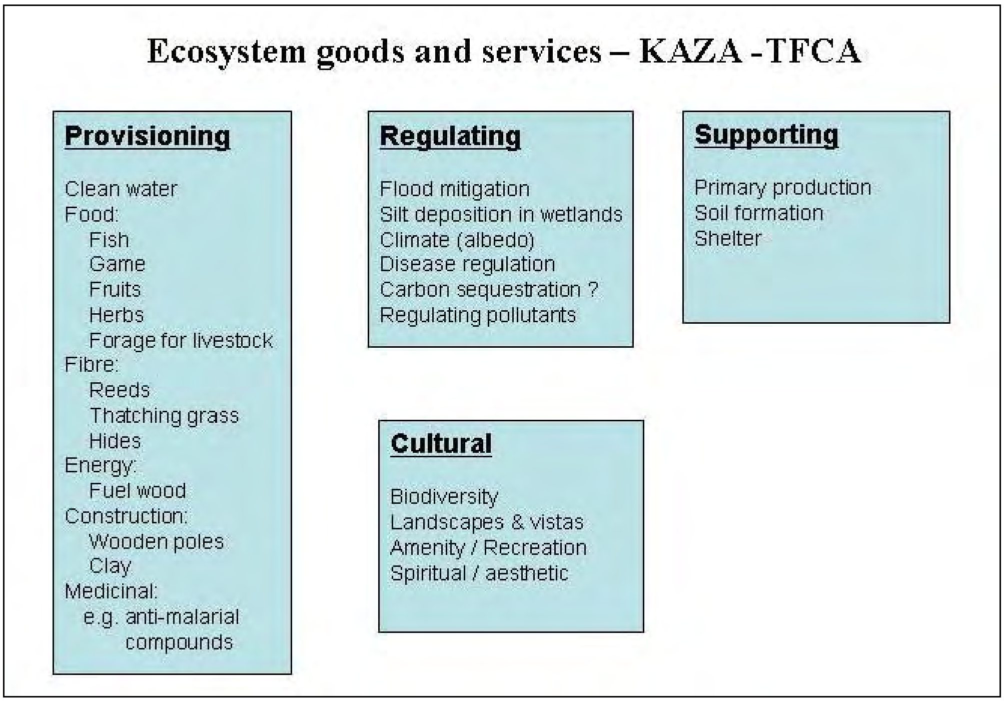

Fig. 6.3 A range of ecosystem goods and services of importance in the KAZA TFCA (arranged in the MA framework). The provisioning services would be those of most direct concern to rural subsistence farmers within KAZA while those concerning amenity value and recreation (biodiversity, wilderness, presence of wildlife) would be of greatest interest to tourists and the tourism industry)

Substantial work has been carried out on valuing wetlands of the Zambezi Basin (Turpie et al 1999) and the Okavango Delta (Turpie et al 2006). Economic returns from alternative land uses in Ngamiland in Botswana have been examined by Barnes et al (2001), and Barnes (1998) conducted a major study of the direct use values of Botswana’s wildlife sector. A firm basis for valuing and ranking the range of protected areas within KAZA on the basis of their ecosystem services is not feasible given the current gaps and state of knowledge on the topic. However, in very general terms the biological value scores assigned to conservation areas in the previous section (**Tables 5.6 and 5.7**) captured some aspects of ecosystem services in the scores assigned to eleven different vegetation types. In these, wetlands scored higher, for example, than mopane woodlands. An additional set of scores was assigned for the presence of different categories of wetland and for specific ecosystem processes such as corridors and existing migrations.

The economic valuation studies by Barnes (1998), Barnes et al (2001) and Turpie et al (1999, 2006) reveal the value of wetlands and wildlife in the KAZA region and the extent to which the goods and services these provide are generally undervalued by policy instruments and incentive structures, and consequently by the communities using them.

In their economic analysis of primary land uses in Ngamiland, Barnes et al (2001) considered that crop production, the small scale use of non-timber forest products and wildlife, and game farming were of low economic potential. They conducted a detailed analysis of various livestock and wildlife models and concluded, *inter alia*, that capital intensive livestock ranching was inefficient in Ngamiland and that the expansion of Botswana's Foot and Mouth Disease (FMD) free zone into Ngamiland was unlikely to be economically efficient. Their findings confirmed that: "*…. economically efficient allocation of land in Ngamiland will revolve around the expansion of two main forms of land use: (1) small- to large-scale traditional livestock production, and (2) wildlife based tourism development. Both traditional livestock and wildlife-based tourism have real comparative advantage and as generators of livelihood, they tend to be complementary. There are indications that livestock values will drop in the long term and that livestock may lose its comparative advantage. Wildlife values, on the other hand are likely to increase in the long term, increasing the comparative advantage of wildlife-based land uses.*"

Barnes et al (2001) also note that small-scale livestock production, although providing significant household income, tends to be economically inefficient due to significant subsidies and open access grazing which results in low herd productivity. The effects of declining rainfall as a result of climate change on primary production and extensive livestock grazing systems are also likely to favour wildlife-based land uses. Wildlife-based tourism in the Okavango delta was found to be extremely efficient economically and the landuse of choice where suitable conditions involving wildlife and wetlands occurred.

In their study of the economic value of Zambezi basin wetlands Turpie et al (1999) examined four wetland areas of which one, the eastern Caprivi wetlands, fall within the KAZA TFCA, and another, the Barotse flood plain and wetlands, is immediately adjacent to the presently demarcated KAZA area. The other wetlands they examined were the Shire River and the Zambezi delta. The authors examined regional capacity to conduct evaluations of ecosystem goods and services, which was very low. They outlined the methods they used in some detail and noted that not all of the methods that had been developed for valuing ecosystem services were suitable for use in developing countries. A summary of their results for household returns from a range of ecosystem goods is provided in **Table 6.1**.

The peak stocking rates reported by Turpie et al (1999) are about twice the levels expected under dry land conditions and reflect advantages conferred by high moisture and partial transhumance on the numbers of livestock that households can carry given access to seasonally flooded grasslands. Interestingly, of the total net financial returns to households from livestock, crops and harvested natural resources, the latter amounted to between 40 and 50% of the total (**Table 6.1**)

Wooden poles for housing, fuel wood, and other non-timber forest products harvested from neighbouring woodlands, were not included in the Zambezi wetlands study. Neither was a distinction drawn between the value of grazing that livestock derived from wetlands and the adjacent dry lands. There is clearly a need for comparable data from dry lands in order to assess the comparative advantage of wetland resources for the dominant production systems of livestock and crops in these areas. Because the values of wetlands to households or communities living in or adjacent to wetlands will differ from one wetland to the next and, because the data are not available, it is not yet possible to rank the various wetlands in the KAZA TFCA. And given the lack of comparable dry land studies of the value of ecosystem goods and services it is also not yet possible, except possibly in the broadest and somewhat unsatisfactory terms, to rank conservation areas in terms of their contribution to ecosystem services within the KAZA TFCA.

Table 6.1 Value of a range of ecosystem goods derived from, or depending largely on, the eastern Caprivi wetlands and the Barotse flood plain. (Summarised from Turpie et al 1999)

Item and (units)	Caprivi Wetlands	Barotse Flood Plain
Study area (km^2)	3,040	6.600
Wetland area (km^2)	5,500	2,200
Rural population density ($people.km^{-2}$)	9.9	33.9
Peak cattle density ($cattle.km^{-2}$)	39.3	79.1
Area under subsistence crops (km^2)	276	237
Livestock:		
Annual net financial returns per household	422	120
***Crops**:*		
Annual net financial returns per household	208	84
***Harvest of natural resources per household*:**		
Fish (kg)	278	382
Other wild animals (kg)	36.7	-
Palm leaves (bundles)	8.4	0.2
Reeds and papyrus (bundles)	36.9	16.7
Grass (bundles)	33.8	13.7
Food plants (kg)	32.1	-
Annual net financial returns (US$) per household from:		
Fish	224	174
Other wild animals	48	0.4
Palm leaves	3	0.3
Reeds and papyrus	87	11
Grass bundles	28	8
Food plants	11	-
Total net financial returns (US$) per household from harvested natural resources	401	194
% of net financial returns to households from agriculture vs. harvested natural resources	61% : 39%	51% : 49%

In a recent comprehensive study of wildlife management options for Madumu North Complex in the Caprivi, Martin (2007) found that the net return to land from safari hunting was approximately US$ 5 per ha. Martin (2007) further examined the likely returns from species in relation to their metabolic mass (a comparative measure of the energy consumption and thus of resource use between species) and found that the most valuable species, in terms of value per unit of resource use, was not elephant but sitatunga. In terms of returns to a standard hunting quota the returns from buffalo were about six times higher than those from elephant (Martin 2007, Table 13) when balanced against resource use. In other words elephants consumed relatively far more for their value to a hunting safari than did buffalo.

Although Turpie et al (1999 and 2006) do discuss the policy implications of their work this is directed at a national level to place greater value on wetlands. The examples of values and valuations of ecosystem goods and services dealt with above are not clearly or explicitly linked to livelihood strategies and decision making at local levels. The cross-scale connection needs to be made because it is the subsistence farmers that make the day to day decisions on resource use. The "sustainable livelihoods framework" (Ashley and Carney 1999) provides a useful alternative framework that can embed ecosystem goods and services within the wider framework of capitals that need to be examined when considering sustainable livelihoods, namely, natural, social, human, financial, physical, and human capitals. The development of these capitals depends greatly on ecosystem goods and services and their sustainability. The livelihoods framework is also readily linked to institutional and policy issues and to biodiversity outcomes as indicated in **Fig. 7.4.**

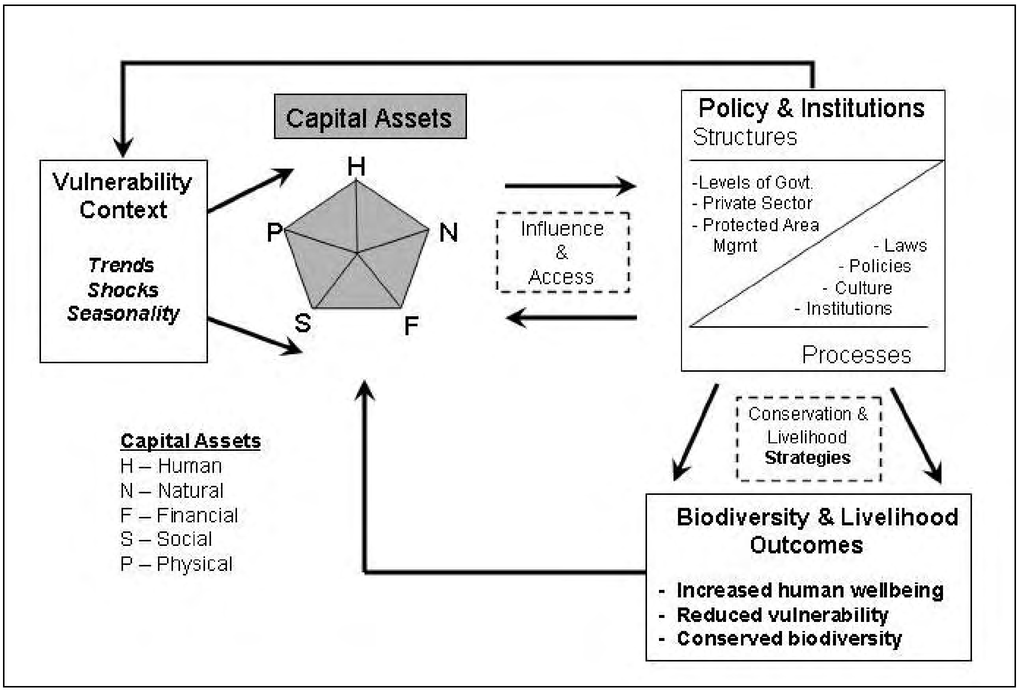

Fig. 6.4 Sustainable livelihoods framework with an emphasis on policy and institutions and protected area management for improved livelihoods of neighbouring communities. (Adapted from Campbell and Luckert 2002)

The current state of knowledge of ecosystem services in the KAZA TFCA, and indeed in partner countries, does not appear to be sufficiently well developed to allow an effective evaluation and ranking of the protected areas within KAZA on the basis of their contribution to ecosystem services to the TFCA and its people. Similar considerations apply to the question of the contribution that wildlife corridors may make to the provision of ecosystem services and to the long term sustainability of the KAZA TFCA.

7

STATE PROTECTED AREAS AND CONSERVATION IN THE SURROUNDING MATRIX.

7.1 Conservation in a mosaic of protected and non-protected areas

The present configuration of the KAZA TFCA consists of six, possibly seven, separate large-scale clusters of conservation areas, each comprising one or more protected areas embedded in a matrix of land under communal tenure.

National parks form only 17.6% of the overall area (**Table 5.5**). Two of these national parks are larger than 10,000 km^2, three are between 5,000 and 10,000 km2, and the remaining parks are less than 5,000 km^2 in extent. If the two Partial Reserves in Angola are included as national parks (as in **Fig. 7.1**) then the number of parks between five and ten thousand km^2 is increased to five and the overall area to 25% of the KAZA TFCA.

The total area of the KAZA TFCA covered by state protected areas in which human settlement is not permitted (National Parks, Safari Areas, Forest Reserves and Game Reserves) amounts to 89,858 km^2, or 22.5% of the TFCA.

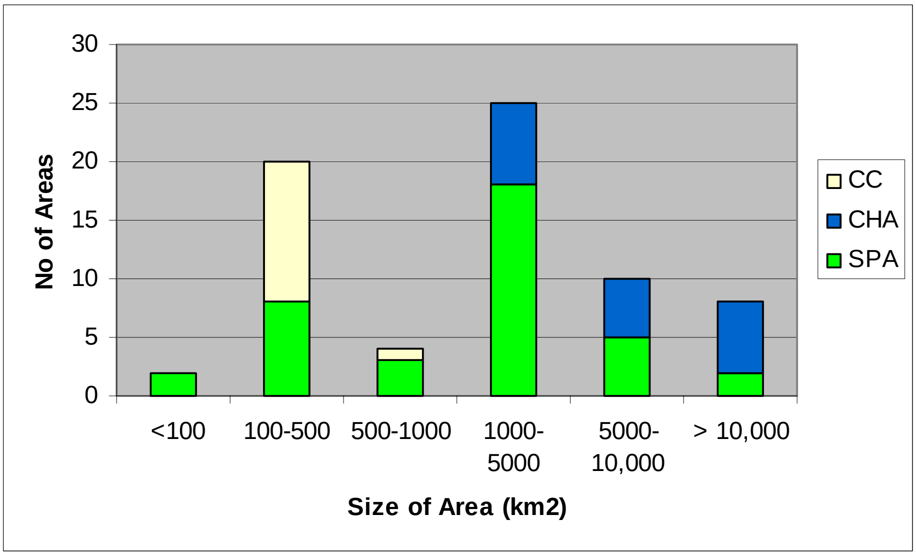

Fig. 7.1 The number of conservation areas in the KAZA TFCA within different size classes ranging from areas of less than 100 km^2 to areas of greater than 10,000 km^2 in extent. (SPA = State protected area, CHA = Controlled hunting areas, CC = Community conservancies)

Nearly half of the KAZA TFCA (48%, **Table 6.1**) is covered by designated controlled hunting areas (GMAs, WMAs and Coutadas) in which there are people living under traditional systems of communal tenure. The community conservancies in Namibia and the CAMPFIRE area in Zimbabwe (a further 6,300 km^2 or 1.6%) would also fall within this category. Land presently not designated under any form of conservation within the TFCA (i.e. land in addition to that listed in Table 6.1) covers about 92,000 km^2 or nearly 23% of the total area. This is a rough estimate and clearly depends on precisely where the boundaries of the TFCA will eventually fall.

The purpose of drawing attention to these figures is to emphasize that the greater proportion of the KAZA TFCA is made up of land under traditional communal tenure. Each of the countries, except Angola, has developed community based natural resource management (CBNRM) programmes that aim to provide benefits to local communities by conserving natural resources and large mammals in particular. Wildlife populations in Namibia have shown a remarkable recovery in community conservancies (Weaver and Skyer 2005). However, in Botswana, Zambia and Zimbabwe there has been a steady attrition of large mammal populations over the last 20 to 30 years (East 1998, Cumming 1999, 2004b). CBNRM in these countries is clearly not providing communities with sufficient benefits to encourage investment in conservation and to allow for the recovery and growth of wildlife populations.

Not only is conservation in the matrix of controlled hunting areas and communal farming lands presently insecure, but the state protected areas within KAZA are also in a parlous state. Budgets for all protected areas in the region are too low for them to fully protect the wildlife resources within them, even at moderate levels of poaching threat. Budgets are also too low to provide the administrative framework and infrastructure needed to operate at profitable levels that could provide for adequate investment in their core business of conservation (Cumming, 2004b, Martin 2008a, 2008b, **Table 7.1**). As a general rule of thumb a budget of at least US $200 per km^2 is required to effectively protect a national park (Cumming et al 1990). On the basis of studies on staffing and operating costs for state protected areas in South Africa, Namibia and Mozambique, Martin (2008a, 2008b) derived the following relationship for estimating the required budget to effectively manage parks in southern Africa.

Total Cost = US$ A . (Illegal Hunting Challenge) . (Annual Scout Salary) .√(Area)

Where: A is a constant which has the value 4 for savanna parks or 2 for desert parks; ***Illegal Hunting Challenge*** is a constant taking the values of 1 – Low, 2 – Moderate, 3 – High, 4 – Severe; the ***Annual Scout Salary*** is expressed in US$; the ***Area*** of the park is expressed in square kilometers.

Table 7.1 Required operational budgets compared with existing budgets (US $/km^2) in five selected major national parks within the KAZA TFCA.

Protected Area	Required	Existing	Deficit	% Deficit
Hwange NP	120	<10	110	92%
Kafue NP	170	55	115	67.6
Chobe NP	194	74	120	61.8
Moremi GR	285	68	217	76.1
Nxai Pan NP / Makgadikgadi NP	226	37	189	83.6

Note: Data for Kafue, Chobe, Moremi and Nxai Pan/Makgadikgadi derived from Martin 2008a, 2008b. The calculation for Hwange NP is based on a game scout salary of USD $1200 per annum instead of the existing inadequate salary of < $350 per annum.

When resources to manage protected areas are inadequate several problems arise, including an inability to fully protect valuable species such as black rhino and a lack of capacity to deal with human-wildlife conflict. Much of the KAZA TFCA is highly fragmented with regard to the juxtaposition of protected areas and intervening land with human settlement. Press reports over the last year, for example, indicate high levels of conflict between people and elephants in the Caprivi, even to the extent of the authorities suggesting that residents observe a dusk to dawn curfew in places. Again, a key question is, "What returns to households are required to offset the costs of living with wildlife?" If these returns are great enough and communities are empowered to manage the wildlife on their land it is likely that a high proportion of human-wildlife conflict issues would evaporate.

A classic example is that of the Masoka community in north eastern Zimbabwe where the ward of 371 km^2 is wedged between the Chewore and Doma Safari Areas in north-eastern Zimbabwe. In the early 1990s the community chose to constrain their settlement and crops within an electrified game-fenced area of 18 km^2 and to retain the rest of their ward as a hunting concession. The number of households has since grown six-fold but they still remain within the fenced enclosure and a small extension. The revenue from wildlife has been used to build and run a primary school, a secondary school, and purchase and maintain a tractor for ploughing fields in the absence of cattle. The community regards the wildlife as their 'cattle'. Although the area was cleared of tsetse fly for a while in the 1990s they chose the wildlife route and tsetse have since re-invaded the area. A detailed assessment of the Masoka CBNRM experience was recently produced by Taylor and Murphree (2007).

The existing budget allocations for effectively managing state protected areas within the KAZA TFCA are clearly inadequate. State resources required to protect wildlife in the surrounding matrix are even more inadequate and in the long run unattainable (e.g. Martin 2008a). This situation re-enforces the need to review policy relating to the devolution of resource access rights to local communities. However, such institutional devolution needs to be implemented at appropriate scales.

7.2 Social-ecological scale mismatches

The previous section outlined several problems related to conservation of both state protected areas, such as national parks and forest reserves, and conservation in the surrounding matrix of communal lands. While budgets and incentives clearly play an important role in achieving conservation the degree to which there is a match, or mismatch, between social institutions and the natural resources they are intended to manage and conserve (Cumming, et al 2006) is perhaps even more important.

In each partner country national policy and legislation is the dominant institution governing conservation and the use of wildlife use. For many natural resources local traditions and cultural practices governing resource use (i.e. local institutions) may take precedence over, or supersede formal national legislation so that *de jure* and *de facto* institutions governing resource use at the local level may not always coincide or match. The legal status of wildlife is generally considered to be *res nullius*, i.e. it belongs to no one until it is subdued and brought under control, either through being captured or being killed. Colonial states thus assumed ownership of wildlife and assumed (or arrogated to the state) the responsibility to control, manage and protect it. In terms of conservation this arrangement worked to some extent during an initial period when human populations were very low and resources for legal enforcement were available. The negative result was that it disempowered rural people of their rights to use wildlife. Increasingly, however, the command and control paradigm (Holling and Meffe 1996) that centralized state control engendered has failed as a result of the mismatch between state institutions and their ability to manage the resource at local levels. A major factor in the breakdown of centralized control systems is weak feedback loops between the state of the resource and decision makers responsible for wildlife conservation who are far removed from realities on the ground.

In recent years there have been attempts to address these scale mismatches by devolving the responsibility for resource management to more appropriate levels where there is the potential for tighter feedback loops between resources, managers and benefits. During the 1960s and 1970s Namibia, South Africa and Zimbabwe introduced policies and enabling legislation that increasingly gave farmers on freehold land the rights to use and benefit from wildlife on their land. The greatest freedom (i.e. Appropriate Authority) was devolved to commercial farmers in Zimbabwe under the Parks & Wild Life Act of 1975 with the result that wildlife as a landuse made remarkably rapid progress in commercial farming areas (e.g. Cumming 1991) until 1997, after which increasing recentralization of control began to reverse earlier gains (Bond and Cumming 2006). The growth of wildlife ranching and wildlife-based tourism in South Africa and Namibia on private land has also been remarkable over the last three decades, suggesting that the institutional and resource management scales are, in general, reasonably well matched – at least for commercial ranching enterprises.

The development of conservancies on freehold land (e.g. the Savé Valley Conservancy, du Toit 1992) where farmers have joined properties by removing internal fences to create a wildlife preserve over an area of 3,000 km^2, is a good example of the development of co-management arrangements to realise a more appropriate fit between institutions (in this case an agreed constitution to govern the management of the conservancy), land and wildlife resources (larger areas, more flexible access to key seasonal resources by large mammals) and benefits to landowners.

So, what is the appropriate scale for managing wildlife on land under communal tenure? Where have common property regimes worked and under what conditions? In Zimbabwe Appropriate Authority was granted to Rural District Councils with a resulting scale mismatch as evidenced in the Sebungwe (see section 4.3 above). In Zambia there was a partial devolution through the ADMADE (Administrative Management Design for wildlife) programme but that only worked for a while in the Luangwa valley where full authority was devolved to the Luangwa Integrated Rural Development Project (LIRDP) operating under a major injection of foreign aid. In the GMAs surrounding the Kafue National Park wildlife populations are well below carrying capacity and the returns from consumptive and non-consumptive tourism are a fraction of their potential (Martin 2008b). This is almost certainly largely because control and management of monitoring, leases, quotas and revenue returns rests with a national authority based in Lusaka, with the consequent disempowerment of potential local level institutions.

As Metcalfe (2006) points out:

> *"Although Zambian maps present GMAs as protected areas, they are settled customary lands. GMAs act as extensive buffer zones around National Parks with the Zambian Wildlife Authority (ZAWA)* [retaining] *statutory control mainly to set trophy quotas (wildlife populations' permitting), marketing the hunts, collecting the revenue and then sharing it with the communities through Community Resource Boards (CRBs) established by its community conservation programme (GRZ, 1998)**.** The funds raised from GMAs provide a substantial part of ZAWA's revenue base at present."* (Metcalfe 2006, page 10).

The state thus effectively exacts a major tax on the wildlife resources in these communal lands and further:

> *"The tenurial structure in the GMAs is sub-optimal because the unit of management and the unit of control are overlapping and contested"* (Metcalfe 2006, page 11).

Metcalfe's (2006) thesis provides a detailed and insightful analysis of the overlapping social structures and their related social-ecological mismatches in the proposed corridor area between the Kafue NP and the Caprivi and Zimbabwe wildlife areas.

In Botswana the extent of resource management devolution to community based organizations is severely constrained by centralized state and district controls and as Martin (2008a) related in a recent presentation to the Government of Botswana:

"What cattle farmer would accept having to:

1. *Obtain a 15 year lease to use the natural resources on which cattle depend?*
2. *Submit a Land Use and Management Plan to be approved before such a lease will be granted?*
3. *Pay an annual land rental to the Land Authority?*
4. *Pay a "Resource Utilization Royalty" to the Ministry of Agriculture?*
5. *Pay 65% of his income to a National Environmental Fund over whose expenditure he has no control?*
6. *Provide regular reports on the use of the remainder of his income (35%) to a Fund Secretariat?*
7. *Obtain permission from the Land Authority to enter into a 'Joint Venture Partnership' with another person?*
8. *Have a Technical Advisory Committee decide who his joint partners must be?*
9. *Have quotas set for cattle utilization by a remote agency according the 'best scientific principles?*
10. *Participate in monitoring natural resources and collecting socio-economic data?"*

As Martin convincingly argues, no cattle farmer would accept these conditions and he goes on to ask if wildlife managers (whether individuals or communities) can seriously be asked to accept the same impositions.

As a perceptive Zimbabwean district official once remarked to me in relation to wildlife in that country "The problem is that cattle are mine but wildlife is ours" – thus emphasizing the mismatch between tenure and resource access rights in relation to wildlife resources.

7.3 Policies and incentives

The previous two sections provide a basis for identifying at least three major problems confronting conservation in the KAZA TFCA, and indeed in the region, namely:

- Inadequate returns from wildlife to the de facto resource managers, i.e. those living on the land and bearing the costs of living with wildlife in the Communal Lands which cover approximately 70% of the TFCA
- Inadequate investments and/or returns to state protected areas to enable them to meet their conservation mandate or their mandate to provide the means (infrastructure, facilities, access fees, etc.) for their citizens to be able to enjoy nature-related recreational pursuits.
- Mismatches between social and ecological scales, particularly in relation to the institutions governing wildlife resource access rights and the distribution of associated benefits.

An additional concern and constraint facing community based natural resource management and conservation is the sectoral separation of fisheries, forestry and wildlife, which in most of the countries involved are subject to separate parliamentary Acts administered by different departments and, in some cases, differing line ministries. The result is differing resource access rights and controls relating to timber, large mammals and fish, and to non-timber forest products. Metcalfe's (2006) study, although carried out in Zambia, throws considerable light on these difficulties in the region as indicated in the following two paragraphs.

> *"The protected local and national forests are surrounded by communal land and provide valuable wildlife habitat, but no policy integrates land, forest and wildlife tenure or management. Communities depend on their traditional authorities for communal land management issues and on the forest and wildlife authorities for an unequal co-management relationship. Three separate legal, policy and institutional environments pertain and the common property design flaws in this arrangement mean high transaction costs, overlapping jurisdictions, and assure a 'tragedy of the commons' on the ground (Hardin, 1968)." (Metcalfe 2006, page 12).*

> *"Southern Africa's CBNRM programmes are flawed by their dependency on empowerment through a single resource (wildlife) that so far has not leveraged tenure of other resources. The Zambian communities presented here are engaged in an internal negotiation process with their customary authorities that seeks to reorganize communal tenure in terms of their equity and control of private commercial access. Pessimistic assessment about the future of community rights to land and natural resources in the face of bioregional approaches, neo-colonial conservation agencies, centrist governments and avaricious capitalists, is understandable, but in this case the outcome is not a forgone conclusion. Provided*

> *with legal, enterprise and organization support local communities may just be capable of creating upward pressure to secure their rights. This would seem a more promising approach than waiting patiently for rights to be given.* ***Optimistically, transfrontier initiatives may provide a new policy forum to make their 'voices' heard."*** (Metcalfe 2006, page 70 – I have added the emphasis on the last sentence).

A key problem is the excessive taxes imposed on wildlife as a landuse option on land under communal tenure. These taxes provide a strong disincentive to wildlife-based land use and promote the conversion of wild land to agricultural production. Given the fragmented nature of the protected area network in the KAZA TFCA a resolution of these policy and institutional issues must rank as a very high priority.

Possible solutions may lie in the exploration of public-private partnerships that could also be extended to communities in public-private-community partnerships. Potentially workable and financially viable models have been outlined for Kafue and the surrounding GMAs (Martin 2008b), and for Botswana and its WMAs (Martin 2008a). The adaptive co-management framework being considered by Zimbabwe for the Hwange-Matetsi complex, if combined with effective business models, could also provide a way out of the current penurious state.

The subject of resource governance and devolution of resource access rights in relation to wildlife and other natural resources is complex and much debated. However, the important issue in relation to the KAZA TFCA is that unless those living on the land with wildlife derive the full and appropriate benefits from wildlife-based land uses and the ecosystem services their land can provide[1] they will increasingly transform the land to small scale, largely subsistence, agricultural production. The end result would be isolated ecological islands in a sea of transformed agricultural land and a failure of the KAZA TFCA as a conservation and development initiative.

[1] The potential returns from payments to communities for ecosystem services (e.g. water, carbon sequestration, flood mitigation) and the adoption, or development, of appropriate joint ventures in tourism clearly require further exploration.

8.

LINKAGES, WILDLIFE CORRIDORS AND SHORTFALLS

"Most evidence for the use of corridors for movement comes from studies involving relatively few observations of relatively small numbers of individuals of relatively few species" Hobbs (1992)

The need to establish wildlife corridors has become an accepted dogma in the development of transfrontier conservation areas in southern Africa. In the case of the KAZA TFCA the wide separation of major protected areas, or clusters of protected areas (see Section 4.2), has prompted the belief that these need to be connected by wildlife corridors. In this context *wildlife corridors* are features that serve to link isolated habitat patches, or isolated areas, by providing suitable terrain or habitat through which animals can move between patches or areas.[1]

The 'Pre-feasibility Study' (Transfrontier Conservation Consortium 2006a) for the KAZA TFCA made the following recommendation with regard to wildlife corridors:

> "*Identification and consolidation of transfrontier wildlife corridors.* The following potential corridors will receive priority attention in the Feasibility Phase:
>
> - The links between the south of the Kafue National Park and the remainder of the KAZA TFCA, part of which could be one or more wildlife corridors from northern Botswana through East Caprivi, or a link with Sioma Ngwezi National Park or to Zimbabwe.
> - The link between Botswana through West Caprivi to south-eastern Angola. This very important corridor will form a major dispersal route for elephants between Botswana and Angola.
> - The need for a corridor to link the north of Khaudom Game Park to Western Caprivi and south-eastern Angola.
> - The link between the protected areas south of Lake Kariba (Hwange) and the remainder of the KAZA TFCA to the west (Chobe)".

These corridors were, understandably, only broadly indicated by arrows on a map and the purpose of one of them was defined in terms of a dispersal route for elephant between Botswana and Angola. Given the lack of evidence of any transboundary migrations of large mammals occurring in the KAZA area (Cumming 2004a), and the general paucity of evidence that corridors are used by animals (e.g. Beier and Noss 1998), there is a need to examine more closely what purpose wildlife corridors may serve in the TFCA since this may influence their siting and design.

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[1] The term '*biodiversity conservation corridor*' or '*conservation corridor'* has recently been coined to refer to a large landscape which is a " *biologically and strategically defined sub-regional space, selected as a unit for large-scale conservation planning and implementation purposes*" (Sanderson et al 2003). In this sense the entire KAZA TFCA might be regarded as a conservation corridor. UNEP's Biosphere Reserves were an earlier model for conserving biological diversity over large landscapes and recent work in South Africa has focused on large landscapes and 'mega-conservancy networks' (e.g. Knight et al 2006a, 2006b and 2007)

8.1 Corridors for what?

The need for wildlife corridors arises in situations where the intervening habitat has been transformed in such a way that animals are prevented, or at least inhibited, from moving between the isolated areas or patches in question, such as in agriculturally transformed landscapes. These considerations immediately raise questions relating to the extent to which habitat fragmentation has taken place in the KAZA TFCA. To what extent has the landscape been transformed? Are protected areas in the KAZA TFCA isolated by intervening areas of transformed habitat and landscapes? To what extent has such transformation as may have occurred acted as a barrier to animal movement or interrupted past patterns of animal movement? Which species are involved? And so on.

These questions need to be answered in order to decide where, if at all, wildlife corridors may be needed and if so, how they may be created. There is also the need to consider the functions that such corridors may be required to perform and the following may be important in terms of the KAZA TFCA and its sustainability in the face of climate change:

a. Migration corridors that serve to maintain regular seasonal movements of animals between alternative areas or habitats.

b. Dispersal corridors that serve to allow the dispersing component of particular species populations to move to other suitable areas or habitats.

c. Adaptive response corridors that provide for both fauna and flora to shift, or disperse, along ecological gradients in response to changing climatic conditions.

Answers relating to questions about habitat fragmentation, and the functions that wildlife corridors may be required to perform, are spatially and temporally scale dependent and will also be influenced by the body size and natural history of the species concerned. Clearly, corridor requirements for dispersing elephants and corridors for Woosnam's rat to shift its distribution in response to climate change will differ, as will the corridor requirements for predators such as the wild dog.

Habitat fragmentation in the KAZA TFCA

Habitat transformation as a result of agricultural development in the KAZA TFCA is restricted to small pockets and probably covers no more than 5% of its overall area. However its spatial distribution may be such that in some areas it will obstruct the connectivity between the large scale clusters within the TFCA or between specific protected areas. These areas need to be identified and mapped.

In other areas habitat transformation may be the result of elephant impacts on woodlands and this is likely to be particularly marked in riparian fringes in protected areas carrying high densities of elephants. Riparian fringes are in themselves important habitats and corridors for a wide range of species.

Fragmentation is, however, not limited to changes in habitat such as occur under cultivation, overgrazing, bush encroachment, and deforestation by people or elephants. Fragmentation can also be caused by the construction of infrastructure such as roads and fences. It can also be established by over-hunting and disturbance resulting in areas that large mammals, at least, will avoid. Areas without surface water, or with deep rivers, can also act as barriers to animal movement and dispersal.

Areas in which habitat fragmentation of various kinds is likely to be an obstacle to animal movements can be identified at a very broad scale (**Fig. 8.1**) but these need to be explored in greater detail and at appropriate scales. It is worth noting that the effective development of wildlife-based landuse in many of the intervening areas of the matrix would do away with the need to establish formal corridors.

Migrations

Much of the popular literature on TFCAs has focused on creating corridors to re-establish mythical migration routes. As Cumming (2004b) found, there was no evidence of transboundary migrations of large mammals in the 4-Corners area. Regular migrations of wildebeest and zebra occurred in two areas within Botswana, namely, between the Linyanti and Savuti, and in the Makgadikgadi area. A regular wildebeest migration occurs to the north of the TFCA across the Liuwa Plains.

Wildlife dispersal corridors

Much discussion, and some research, has focused on creating corridors for the dispersal of elephants from areas of high density centered on the Chobe NP. The idea that corridors linking major protected areas will result in effective natural regulation of elephant populations and a reduction of elephant impacts on habitats in protected areas has been espoused by van Aarde (e.g. van Aarde and Jackson 2007) and his research group at the University of Pretoria. A critical assessment of this approach was offered by Cumming and Jones (2005) who pointed out that should the elephant population continue to grow at about 5% per annum it would double in 12-15 years and there just was not the land available to absorb the increase. Further, most of the land supposedly available to absorb dispersing elephants was communal land, and inhabitants would not accept high densities of elephants without commensurate returns and benefits. In other words consumptive use of elephants would eventually be necessary and the establishment of source-sinks dynamics would be required to regulate elephant populations in the KAZA TFCA region. To some extent this scenario has already developed in the Sebungwe area of Zimbabwe where the elephant population is being stabilised by illegal offtakes (Dunham 2008) but pressure on habitats within the protected area has not yet been relieved (Cumming, personal observations). There is also the risk that creating dispersal corridors for elephant will merely serve to export the elephant overpopulation problem to new areas.

The potential role of wildlife corridors for the dispersal of other large mammal species has received little if any attention. Cumming (1999, Table 11, page 31) outlined the species likely to benefit from the removal of fences and the establishment of transboundary corridors. Links between the Caprivi, Luiana and Sioma-Ngwezi could potentially benefit nine species, links between Chobe and Hwange NP 14 species, and between Khaudom and the Caprivi 13 species of large herbivores.

Historically, periodic dispersals of wildebeest occurred from the Makgadikgadi area to Hwange NP along the Nata River and associated drainages (Cumming 2004a). This route is presently closed by fences and settlement.

Little is presently known about the dispersal of predators in the KAZA region but wild dog populations are likely to benefit from appropriately aligned linkages that provide a “safe passage” between the large protected areas within KAZA.

Adaptive response corridors

As climate change results in changes in the distribution of plant species and the structure and composition of dominant habitats (See Section 4 and **Fig. 4.3**) the species composition of vertebrate and invertebrate communities will also change. Many species will face local extinctions unless they can shift their distribution or range along appropriate corridors. The current climate change predictions and the distribution of species richness (Sections 2 and 4.1) suggest that it will be important to maintain broad scale linkages along a south-east to north gradient, and possibly also along a west-east gradient.

It is this context that the larger conservation planning initiatives, such as envisaged in biodiversity conservation corridors (Sanderson et al 2003), biosphere reserves and mega-conservancy networks would be particularly appropriate. Working at these scales could provide opportunities to proactively address biodiversity loss threatened by climate change, provide increased flexibility to consider human development needs and ecosystem services, and provide options to strengthen resilience and adaptability in linked social-ecological systems (K. Lawrence, personal communication 2008).

Given that a vast number of species are involved and that their likely responses to climate change are mostly unpredictable the only fail-safe strategy that can be applied under present circumstances is to avoid, as far as possible, foreclosing options on potential linkages along the gradients suggested above.

Maintaining corridors for some specialist species and localized endemics such as plant species confined to Batoka Gorge or to similar widely spaced specific rocky habitats is clearly not possible. Several notable rocky gorges occur in the Sebungwe region of Zimbabwe that could hold some of the Batoka Gorge endemics but targeted plant collections in these areas do not appear to have been made.

Risks associated with corridors

Corridors do not necessarily lead to improved conservation. Greater connectivity between protected areas can facilitate the transfer of invasive species and particularly diseases. Within the KAZA TFCA the movement of tsetse fly from the Sebungwe through to the Hwange-Matetsi would be a particular risk. Tseste fly occurred in the Matetsi area before the rinderpest pandemic of 1896. Similar risks might be incurred in establishing a corridor between the Caprivi and Kafue NP.

Several Palaearctic and Afrotropical bird migrants depend on specific habitats such as wetlands, pans and acacia riparian woodlands. Pans and riparian woodlands are degraded by high densities of elephants which may thus adversely influence populations of migrant species that depend on these habitats.

Other types of corridors such as tourist and trade corridors with their associated infrastructure may exacerbate the transfer of alien invasive species and diseases.

8.2 Wildlife corridor options and priorities

There are nine major potential corridor areas (**Fig. 8.1**) each of which has different characteristics and impediments to the establishment of effective linkages (**Table 8.1**). Human settlement and areas of cultivation are common to all of the potential corridor areas but appropriate changes in policies, and laws and incentives, could, as argued in Section 7 above, greatly improve the suitability of these areas for wildlife. Infrastructure development in the form of major highways does present a problem in that it can inhibit free movement of wildlife, result in mortality of both travellers and wildlife and provide a conduit for invasive species and diseases.

Disease control fences in Namibia, Botswana and Zimbabwe present a particular problem because of entrenched veterinary control practices and strong vested interests in beef export markets. Recent moves to introduce commodity based trade arrangements and agreements may serve to alleviate these issues in some areas. For example, the introduction of commodity based trade in north-western Ngamiland could allow for export trade in beef alongside wildlife-based land uses where FMD may be endemic. The risk of bovine pleuropneumonia in this area would nevertheless remain and may require more effective control, if not eradication, of the disease in core infective areas within Angola (**Fig. 3.5)**. In some areas, such as between Hwange and Chobe National Parks the distribution of dry season surface water presents a problem for the dispersal or movement of water dependent species.

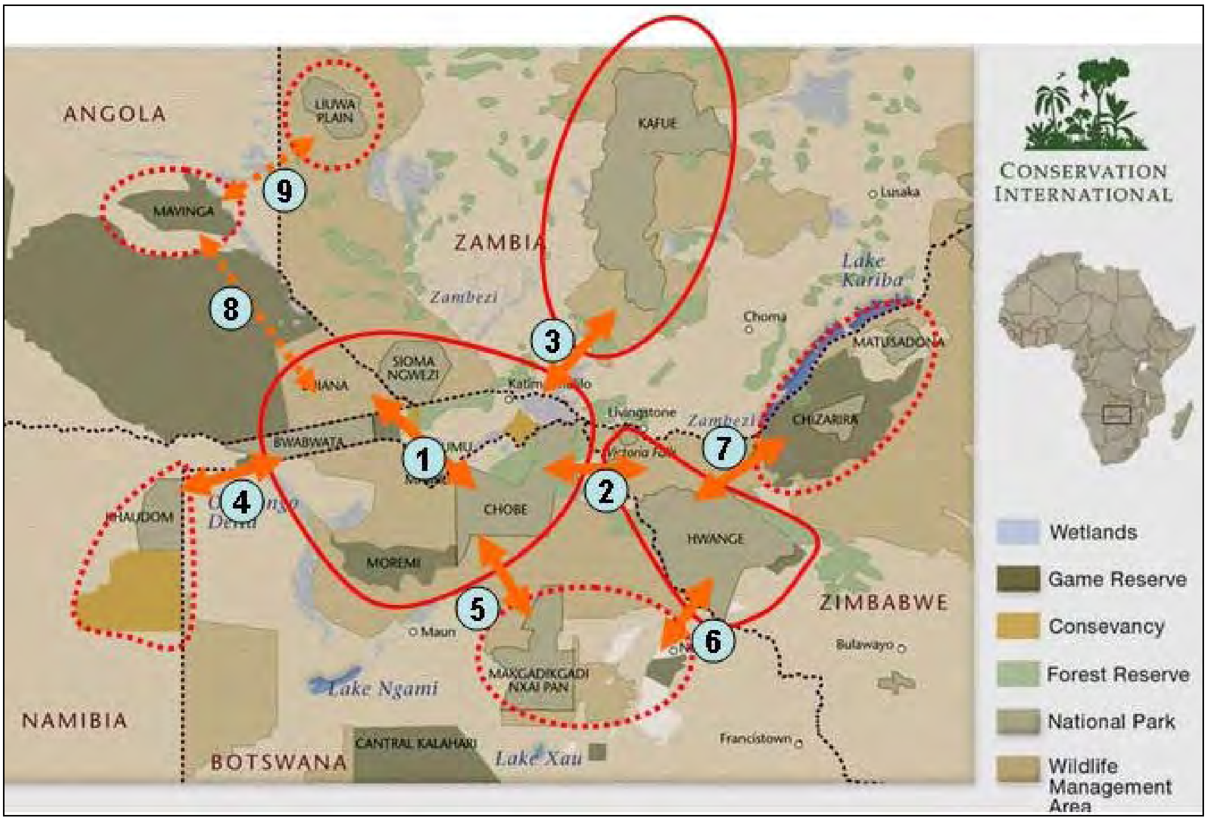

Fig. 8.1 Potential wildlife corridor areas (1- 9) within the KAZA TFCA. (See **Table 8.1** for further details. The numbering can be considered as an order of priority).

Not all barriers to dispersal and movement are due to human influences. In some potential corridors, barriers may be the result of natural changes in vegetation types, in habitat structure (e.g. large expanses of grassland separating dense woodland habitats), or large rivers. Clearly, species responses to habitat changes and heterogeneity will differ and a more detailed appraisal of habitat connectivity, and land cover changes and trends in each of the broad corridors areas in relation to dispersal or movement of specific species is needed.

In terms of action on wildlife corridors the three central corridors (i.e. numbers 1, 2, and 3 in **Fig. 8.1**) stand out as clear priorities. The development of community conservancies in the Mudumu complex and along the Kwando River suggest that key components of the corridor linking Chobe NP and Babwata, Luiana and Sioma-Ngwezi are well advanced. The establishment of a wildlife corridor, or wildlife corridors, between Chobe NP and the Hwange-Matetsi complex appears to have received little attention. Given the short distances involved, and the favourable intervening land uses of forestry and hunting leases, this corridor should be easily established. However, the question of what would prompt species to make use of the corridor needs to be examined.

Table 8.1 Major potential wildlife corridor areas in Kaza TFCA and factors likely to impede animal movement or linkages between protected areas. The location of each potential corridor is shown in Fig. 8.1. (x indicates level of impedance on a scale of 1-3, and a dash indicates that the factor is probably not significant)

Corridor Area	Impediments to wildlife movement / dispersal					
	Settled	Roads	Fences	Landuse	Disease	Water
1. Chobe / Liuana / Sioma-Ngwezi	xx	xx	xx	xx	-	-
2. Chobe / Hwange-Matetsi	xx	x	xx	-	xx	xxx
3. Caprivi / Zambezi / Kafue	xxx	xx	-	xxx	x	-
4. Khaudom / Babwata / Ngamiland	xx	x	xxx	xx	xxx	x
5. Chobe / Nxai Pan / Makgadikgadi	xx	xx	xxx	xx	xxx	x
6. Makgadikgadi / Hwange	xxx	xx	xxx	xx	xxx	xx
7. Hwange-Matetsi / Sebungwe	xxx	xxx	xx	xxx	xxx	-
8. Luiana / Mavinga	x	x	-	-	-	-
9. Mavinga / Liuwa Plain	x	x	-	-	xx?	-

8.3 Shortfalls

The central focus of KAZA TFCA is its wetlands and associated wetland species of fauna and flora. Very little attention appears to have been given to maintaining or establishing connectivity between wetlands. A measure of connectivity, particularly upstream connectivity, may be particularly important during the next 30-50 years if increasing aridity is experienced in the region. In this regard the connections between the Zambezi and the Kafue via the ancient drainage link through Machili (See **Fig. 9.2**) to the Kafue flats could be particularly important. The links from Sioma-Ngwezi through the Western GMA to Liuwa Plain have also been neglected and, given the high ranking of the Western GMA and the importance of maintaining upstream connectivity, this linkage deserves closer investigation.

It is also important to bear in mind that the relationships between high biological diversity and valued ecosystem services are likely to be complex and that they may not be spatially aligned (e.g. Chan et al 2006).

9

RESILIENCE, ADAPTABILITY AND SUSTAINABILITY

"Surprise and structural change are inevitable in systems of people and nature."

"Sustainability is the capacity to create, test, and maintain adaptive capability. Development is the process of creating, testing, and maintaining opportunity. The phrase that combines the two, "sustainable development," thus refers to the goal of fostering adaptive capabilities and creating opportunities."

Holling (2001)

The ability of a population of wild dogs, or a wetland, or a rural community to withstand shocks and surprises depends very largely on its capacity to absorb such disturbances and still retain its identity, i.e. its resilience. Closely allied to the resilience of a system, be it a population, a landscape or a community, is its capacity to adapt in the face of major disturbances or changing circumstances. As was noted in the introduction and elsewhere in this report the KAZA TFCA is a linked social-ecological system operating at many scales and, in more general terms, is essentially a complex adaptive system that is continually changing and adapting. This section briefly introduces concepts of resilience, adaptability and sustainability, examines key drivers and vulnerabilities in the KAZA TFCA and outlines some adaptive strategies that may contribute to the sustainability of the KAZA social-ecological system as a large, biologically rich and intact landscape providing secure livelihoods for those residing in it.

A central issue in the development of the KAZA TFCA is, and increasingly will be, its sustainability in the face of climate change and the question of "sustainability of what and for whom?"

9.1 Change, resilience, adaptability and sustainability

The predominant world view that nature is in a state of balance or equilibrium that can be maintained through appropriate management, or by leaving nature to take its course, is now giving way to a more dynamic view of a world where constant change and flux is recognized and embraced. Increasingly, the non-linear nature of change, and accompanying thresholds, in both slow variables (e.g. carbon accumulation in the atmosphere) and fast variables (e.g. fluctuating patterns of rainfall and cereal production) is being appreciated and studied. And, with changing world views and increasing understanding of the dynamic and largely unpredictable nature of linked social-ecological systems the statement that "the future is no longer what it was" (Allen 1990) is indeed true. As Levin (1999) has stated, "If there is a balance in nature it is to be found only at the broadest scales of space, time and organizational complexity."

In many natural and social systems, for example the growth and decay of a tree or a forest, or a business or corporation, or even a nation state (e.g. Soviet Russia), there are recognizable patterns of growth, consolidation, release or decay, and collapse, followed by rejuvenation or re-organisation. These changes, i.e. adaptive cycles of exploitation, conservation, release, and reorganisation (Holling 2001, **Fig. 1.2**), are occurring at several spatial and temporal scales with numerous cross scale interactions (an example is international trade and pricing agreements which result in cascading effects on subsistence farmers). A nested set of adaptive cycles with cross-scale connections and influences has been referred to as a “panarchy” by Gunderson and Holling (2002).

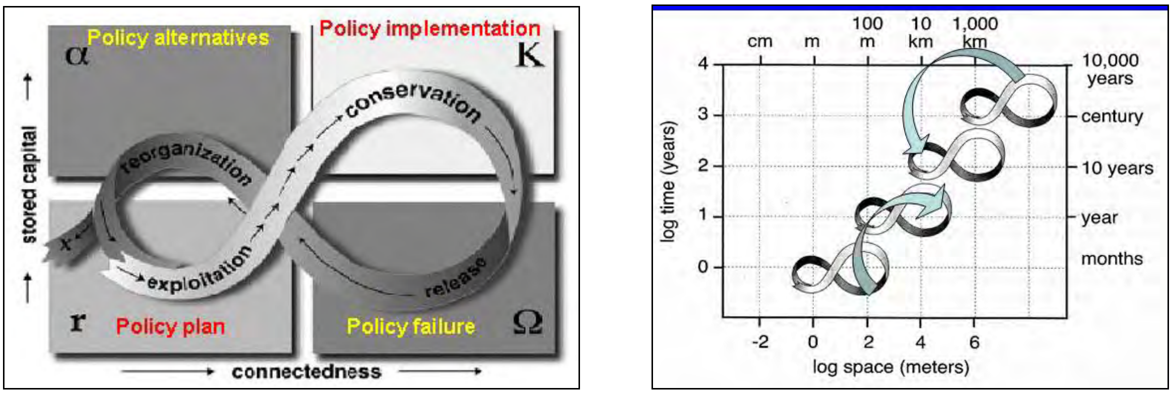

Fig. 9.1 Holling’s adaptive cycle (left) illustrated by using policy development as an example and (right) a series of adaptive cycles at differing spatial and temporal scales, with the potential cross-scale connections shown by large arrows (i.e. a “panarchy”, Gunderson and Holling 2002)

Two definitions of resilience in natural systems appear in the literature. The first uses the engineering definition of resilience which measures the time it takes for a system to return to its equilibrium state following a disturbance. More resilient systems recover more rapidly. This sense of resilience is, for instance, captured in common parlance when referring to a person “bouncing back” after a mishap. Another simple example would be the time its takes for a tuning fork to reach stability after it has been tweaked. The second definition, which is the one used here, is where “*resilience is defined as the capacity of a system to absorb disturbance; to undergo change and still retain essentially the same function, structure and feedbacks. In other words, it’s the capacity to undergo some change without crossing a threshold to a different system regime – a system with a differing identity.”* (Walker and Salt, 2006).

Within this framework adaptability is “*The capacity of actors in a system (people) to manage resilience. This might be to avoid crossing into an undesirable system regime, or to succeed in crossing into a desirable one*.” (Walker and Salt 2006).

In evolutionary terms the wetland ecosystem of southern central Africa, together with its fauna and flora, appears to have been remarkably resilient. The system has, in palaeo-evolutionary terms, experienced major changes in river flows and drainage patterns during the period starting with the break up of Gondwanaland, and the formation of the Indian and Atlantic oceans 160-120 million years ago (Mya), to the Holocene and Recent periods (Cotterill 2006, Moore 2004, Stokes et al 1997, Thomas et al 2000). Cotterill (2006) in a recent study of the evolution of drainage patterns in southern central Africa in relation to the speciation of wetland dependent antelope (particularly *Kobus leche*) provides a comprehensive and authoritative account of the palaeo-dynamics of drainage patterns in the region. A simplified summary of more recent changes is provided in **Fig. 9.2.**

The Kalahari sands form the largest “sand sea” in the World and parts of the area that fall within KAZA have experienced active dune movement as recently as four thousand years ago during periods of extreme aridity (O’Connor and Thomas 1999). Palaeo-climatic and tectonic shifts, and erosion cycles and river capture, have resulted in levels of instability that have been a major determinant of the biodiversity of the KAZA region.

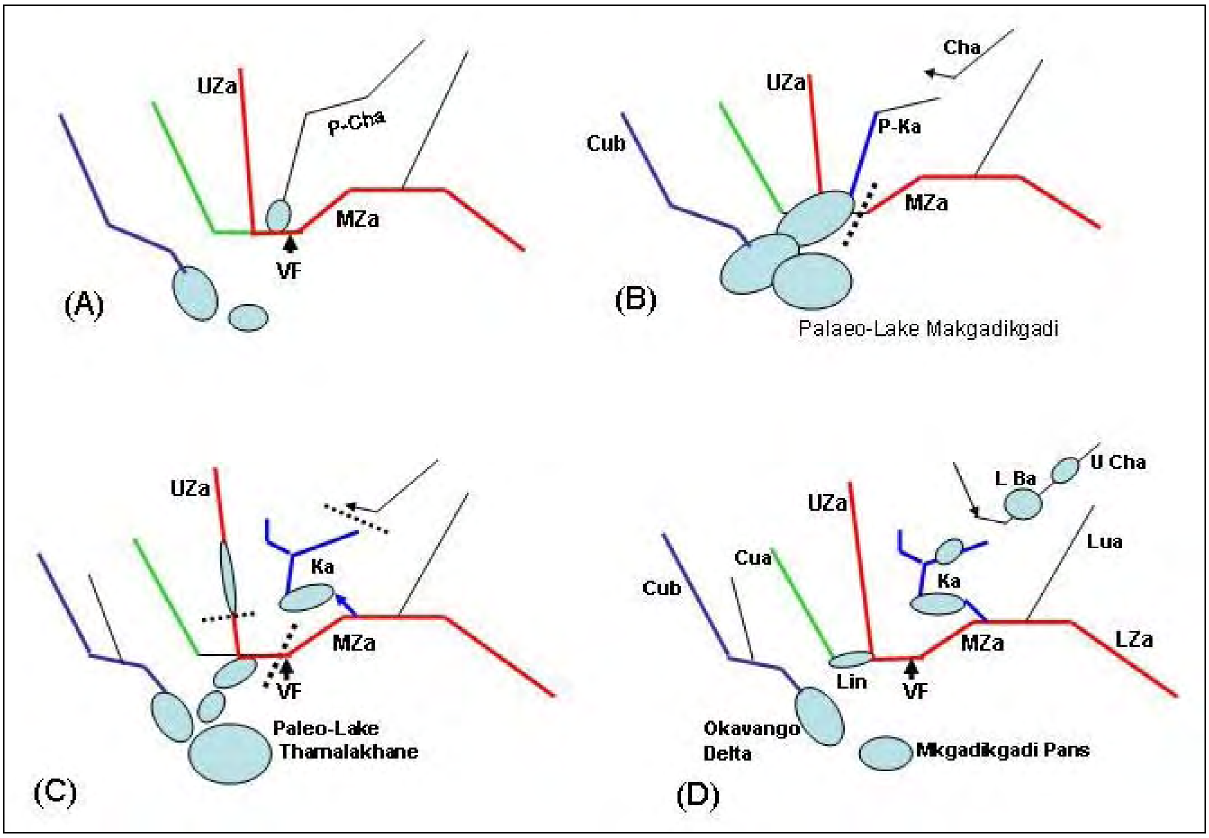

Fig. 1.3 Diagrammatic summary of the major changes during the Pleistocene in drainage patterns in the Zambezi-Okavango basin that have impacted on the KAZA area and its wetlands. (Adapted and simplified from Cotterill 2006)

(A) Late Pliocene-early Pleistocene (before c. 1,600 Kya) with the Upper-Zambezi (UZa) connected through Batoka Gorge (VF) to the Middle (MZa) and Lower Zambezi (LZa), and the Palaeo-Chambeshi (P-Cha) flowing into the Zambezi above Batoka Gorge.

(B) Early Pleistocene (c. 1,600 Kya) – an uplifting (dashed line) above Batoka Gorge severed the link between the Upper and Middle-Zambezi, diverting flow into Palaeo-Lake Makgadikgadi which may have covered >60,000 km^2 and lasted until between 970-780 Kya. Note also the scission of the upper Chambeshi with the establishment of the Palaeo-Kafue River (P-Ka). This was followed by a breach, between c. 970-780Kya, of the uplifted zone in the region of Katambora and Mambova rapids above the Victoria falls (and Batoka Gorge), resulting in a reconnection between the Upper and Middle Zambezi River which lasted between about 740 and 600 Kya. This change in flow resulted in a drying out of Palaeo-Lake Makgadikgadi during this period although the Cubango (Cub) continued to feed what is now the Okavango Delta.

(C) Middle Pleistocene - a second uplifting (c. 500 Kya) across the Zambezi River above Batoka Gorge (VF) again resulted in the diversion of river flows into a series of endoreic lakes (Okavango, Mababe and Palaeo-Lake Thamalakhane) with the Upper Kafue River supplying the Palaeo-Lake Patrick, and the incipient lower Kafue incising northwards from the Middle Zambezi towards Lake Patrick. These lakes together with Palaeo-Lake Bulozi above the Ngonye Falls spanned the period from about 500 – 300 Kkya.

D) Late Pleistocene – the Upper Zambezi is reconnected to the Middle Zambezi (c. 300Kya) and the current drainage is established. The lower Kafue has connected to Palaeo-Lake Patrick and drained it to form the Kafue Flats. The Linyanti swamps are formed at the link between the Cuando and the Zambezi along the Chobe River. The Upper Chambeshi (U-Cha) drains into the Bangweulu Basin (L Ba). (Cub = Cubango River, Cua = Cuando River, Lua = Luangwa River, Lin = Linyanti Swamps.)

More recent shocks and disturbances take the form of human movements, invasive human and animal diseases, increasing climate variability, and political and economic dynamics within the region (**Table 9.1**).

Table 9.1 Time lines of major shocks and drivers of change in social-ecological systems (SES) in the Kavango-Zambezi Transfrontier Conservation Area and partner countries.

Time Period	Events and Disturbances to linked SES	Key Drivers/Changes
Pleistocene 2 mya to 300 kya	• Major changes in drainage patterns and basins See Fig. 1.2.	• Tectonics – rifts, uplifting, erosion and river captures and scissions
Pleistocene-Holocene-Recent	• Area continuously occupied by Stone Age hunter-gatherers • Use of fire from about 250 kya	• Evolution of hominids as keystone predators, • Use of stone tools, fire, poison on spears and arrows
BC 300 to AD 500	• Invasion of domestic livestock, southward migration of Bantu speaking peoples and onset of San displacement into regions of Zimbabwe, Botswana, and Namibia.	• Migrations and invasions • Livestock-habitat interactions and diseases
AD 1100 – 1700	• Rise and fall of empires - Mapungubwe, Great Zimbabwe • First Lozi Empire in Western Zambia and Caprivi • Portuguese explorers/traders on Angolan and Southern African Coasts	• Social turmoil and rise and collapse of dynasties
1800 – 1900	• Colonisation of the sub-continent and partition by European powers in 1884 – Berlin Conference • Introduction of alien diseases after about 1830 (Human and Bovine Tuberculosis, Measles, Smallpox, Brucellosis, Contagious Bovine Pleuropneumonia) • 1830s Mfecane dispersal into Matebeleland and Barotseland (Makalolo Empire 1830-1864) • Over-exploitation of wildlife and collapse of the ivory trade (and elephant populations) by 1890 • 1894-96 Rinderpest pandemic and the collapse of livestock and wild bovid populations (and tsetse fly) across the region • Matabele wars 1893-96	• War and major movements of people • Introduced (alien) human and animal diseases • Colonisation • Collapse of wildlife and livestock populations • Severe droughts in 1830s and 1890s
1900 – 1945	• Etosha National Park declared in 1907 • 1st World War 1914-18; Caprivi placed under British military rule • 1920 start of tsetse control hunting in Zimbabwe • 1921-29 the Caprivi was part of Bechuanaland Protectorate after which it was placed under South West Africa from 1929-39, and then under South Africa from 1940-81. • 1929-30 Great Depression • 1928 Hwange and Victoria Falls game reserves gazetted • Rapid demographic changes (linked to malaria control) • Pole tax, labour laws and migrant labour to mines in SA • 2nd World War	• Earlier collapse of game populations stimulates conservation action and the establishment of reserves • Start of veterinary research, dips, vaccines and wildlife control resulting in rapid growth of livestock populations • Improved health services and rapid human population growth
1945 – 1990	• Atlantic Charter, decolonisation and independence • Trade-driven animal disease controls and fences – Botswana, Namibia and Zimbabwe • Further advances in veterinary services and growth of livestock herds • Rapid growth in protected areas • Role of buffalo in FMD established • Artificial water supplies for game in Hwange NP expanded • Elephant culls in Zw, Na. • 1989 CITES ban on ivory trade • 1970s Liberation and civil wars in Angola and Zimbabwe and collapse of wildlife conservation in Angola • Settlement of areas cleared of tsetse fly (Zw)	• Human population growth • Growth in tourism and travel from 1950s • Droughts and impacts of El Nino • Fuel prices increased greatly, 1974 • Political instability and disease outbreaks (e.g. CBPP)
1990 – 2008	• CBNRM programs initiated in Zimbabwe, Botswana, Namibia and Zambia • 1997 Zw dollar loses < 60% of its value in one day and continues to decline with inflation exceeding 2 million % in June 2008. • 2000 onset of rapid decline of tourism in Zw • End of civil war in Angola • Increasing human-elephant conflict • Extended dry period 1980 – 1998	• Ongoing civil war in Angola • Rapid spread of HIV/AIDS • Changing conservation paradigms • Green activist movements and effects on elephant management • Global climate change

9.2 Key vulnerabilities

The Pre-feasibility Study of the KAZA TFCA (Transfrontier Conservation Consortium 2006a) identified ten threats to the development of the TFCA (see page 3). Three of these dealt with impacts on tourism (seasonality, competition, and terrorism), three with economics (global recession, competing investments, and participating country policies). The remaining four threats dealt with crime and corruption, external ecological impacts, poverty, and global warming. Apart from poverty, the threats listed are essentially external threats. Both poverty, which is closely linked to population growth, and global warming would fall into the category of slow variables, i.e. changes occurring over longer time periods as opposed to those that may have immediate effects such as terror attacks, floods or serious drought. An important reason for drawing attention to fast and slow variables is that slow (or ´deep') variables are often ignored and the intersection of fast and slow variables can result in thresholds being surpassed, resulting in rapid regime change – "big effects from small causes" (Carpenter and Turner 2001).

This study has examined factors influencing or affecting the development of the KAZA TFCA at three scales. Large scale, external drivers (Fig. 3.1) included:

- the state of the global economy
- international conventions
- conservation and development values
- issues relating to disease and international markets

Drivers external to the TFCA, but within the region, included:

- water flows
- disease
- national legislation relating to conservation and natural resource management in particular
- SADC protocols
- national and regional economies

The major drivers within the TFCA itself are those relating to:

- land use and tenure
- human population growth and increasing pressures on natural resources and ecosystem services
- governance and access rights to natural resources and benefits from wildlife
- insufficient investment in the protected areas system

All of these factors, across the full range of scales, are likely to be impacted by climate change which is predicted to result in a warmer and drier KAZA TFCA.

The summary of shocks, surprises and major disturbances that the KAZA system has faced over time (**Table 9.1, Fig. 9.1**) reflect a similar set of drivers to those operating at the moment. Tectonic changes have, in geological time scales, resulted in major changes to the distribution of wetlands and, because the area is so flat very minor changes in tilt or warping of the landscape could significantly alter water flows, e.g. in the Silinda spillway and the Linyanti-Chobe system (Moore 2004). Marked changes in climate have occurred even in the recent past, and while ecosystems may have been resilient at lower human densities, the same may not apply with the current high and growing human population densities, i.e. unless efforts are made to build appropriate adaptive capacity within the KAZA TFCA and its linked social-ecological systems (SES)[1].

9.3 Adaptive strategies

Centrally driven, prescriptive blueprints for building adaptive capacity in relation to human livelihoods and conservation in the KAZA TFCA in the face of changing climatic regimes are unlikely to be successful. Such command and control approaches neglect the complexity and diversity of the SES involved and seldom make room for learning and adaptation as an essential part of the process of development. Large-scale development projects often reflect the following characteristics:

a) they are usually sector-based “master plans”

b) require a large injection of capital of which much is wasted

c) are mostly top-down with a “command and control” management approach

d) include little local capacity building

e) tend to collapse when the project or funding ends

In short they are seldom sustainable and do little to develop resilience and organizational capacity of the intended beneficiaries

On the other hand emerging development models, particularly those relating to natural resources tend to focus on processes with the following characteristics:

a) those that place a premium on, and invest in higher valued land uses, diversification, and intensification (e.g. irrigation, cash cropping, high value tourism, where appropriate and sustainable)

b) decouple wealth creation from primary production

c) match land use and ecological process scales

d) develop policy and supporting legal frameworks that enable, rather than stifle, innovation and adaptability at local and regional scales

Such an approach requires information, learning, strong feedback, and the freedom to adapt (i.e. to use learning and experience) at several levels. Polycentric (multi-tiered) governance (e.g. Ostrom and Janssen 2002) and appropriate devolution of resource access rights and management are more likely to work for conservation in the KAZA TFCA under climate change than is continuing central command and control (see Holling and Meffe 1996) approaches. However, as Ostrom (2007) has recently argued, there is a need to move beyond simple panaceas to the problems of resource degradation and loss of biodiversity in linked social ecological systems – and this “requires serious study of complex, multivariate, non-linear, cross-scale, and changing systems”.

[1] Walker and Salt (2006) define social-ecological systems simply as “linked systems of people and nature”. The use of the term ‘social-ecological system’ here serves to draw attention to the often inappropriate separation of human and ecological (“natural”) systems.

In discussing conservation action in relation to climate change McClanahan et al (2008) suggest four actions, or combinations of these, that would be appropriate, namely,

a) Large scale protection of ecosystems
b) Actively transforming and adapting social-ecological systems
c) Building the capacity of communities to cope with change
d) Government assistance focused on decoupling the dependence of communities on natural resources

The authors provide a helpful framework that scales environmental susceptibility against social adaptive capacity to provide four quadrants against which to assess and guide needed action. They go on to provide results from case studies in which predicted susceptibility of coral reefs to bleaching and social adaptive capacity were quantified using a range of indicators. The approach could probably be readily adapted to the KAZA TFCA, although the key issues of governance in relation to natural resources will need much greater attention. Government assistance in building social capital may not be forthcoming.

At a more encompassing level, Simon Levin (1999) in his book, "Fragile Dominion: Complexity and the Commons" concluded with eight commandments of environmental management. These have a great deal to do with building adaptive capacity and resilience and contain important prescriptions for the development of the KAZA TFCZA. The eight commandments (with some points from Levin relating to each) are:

1. **Reduce uncertainty** ((i) knowing what is present is only the first step in understanding how ecosystems function, (ii) monitoring and research provide the core and inform policy debates, (iii) spread risk by broadening the scales on which we rely on ecosystem services, (iv) diversification is imperative] .
2. **Expect surprise** ((i) adaptive management is maintaining flexibility in management structures and adjusting rules on the basis of monitoring and new information, (ii) adaptive probing is a continual exploration of alternative strategies even current strategies are working, (iii) build flexible response systems)
3. **Maintain heterogeneity** ((i) the resilience of any complex adaptive system is embodied in its diversity and in its capacity for adaptive change among component systems, (ii) management efforts to weaken reduce diversity and disturbance weaken the capacity of the system to respond)
4. **Sustain modularity** ((i) in modular structures there is buffering against cascades and disaster, (ii) the emergence of global pandemics of disease is a reflection of increase connectedness and a breakdown in modularity – which has implications for corridors)
5. **Preserve redundancy** (maintaining heterogeneity and modularity contribute to maintaining redundancy – the key feature being the maintenance of substitutability, e.g. of species, or products, or economic substitutability)
6. **Tighten feedback loops** (tight reward and punishment loops are essential to effective adaptive management and lead to empowerment)

7. **Build trust** ((i) evolution works most effectively when individuals interact most with their near neighbours, (ii) repeated interaction can allow trust and reciprocal altruism to develop)
8. **Do unto others as you would have them do unto you.**

“Building trust and environmental security is not an easy task, but it provides the only path to sustaining our fragile dominion over the Earth’s resources” (Levin 1999).

10.

PRIORITIES AND RECOMMENDATIONS

"It is inappropriate to be concerned with mice when there are tigers abroad"

G. Box (1976)

This report has examined factors affecting the KAZA TFCA at differing scales, namely, large-scale external factors such as climate change and global economies and national legislation, intermediate scale factors such as gradients in biodiversity and the broad distribution of protected areas and land tenure within KAZA. At the local scale, features of each conservation area such as the habitat, key species and threats were catalogued and a ranking system based on biological value and conservation status was developed. Information on ecosystem services has been reviewed and governance issues affecting resource management outside protected areas, corridors, and some aspects of resilience and adaptability in the KAZA TFCA have been discussed.

As the title to this study indicates, a primary aim was identify priority issues and actions for the KAZA TFCA in relation to (a) climate change, and (b) building adaptive capacity and resilience. I will argue that the following major priority areas that emerge from this short desk study – these are the 'tigers abroad' that stem very largely from the overarching threat (tiger?) of climate change:

1. Water flows and wetlands
2. Natural resource governance and benefits to rural communities. A release from central command-and-control approaches to natural resource management and conservation is needed
3. Diversification and adaptive co-management
4. Biodiversity linkages and conservation planning
5. Improved basic inventories of biophysical and social components of the system, monitoring, and participatory science

10.1 Water flows and wetlands

The centre piece of the KAZA TFCA is its wetlands. These are focal areas for a large part of the human population residing in the TFCA. They support a wide range of important wetland dependent species and play a key role in the region's tourism development. But the wetlands within KAZA are vulnerable not only because of impending climate change but also because they depend on water derived from distant highlands. As a result it will be vital for the TFCA to:

- Promote integrated catchment management and support and influence the work of catchment management authorities.

- Pay early attention to land use changes in the high water-yielding upper reaches of the major rivers flowing into the TFCA and explore ways of providing incentives to those in the upper catchments to maintain equitable water flows (e.g. payments for ecosystem services) into the future.
- Minimize land use practices that degrade wetlands within the TFCA. This requirement will depend very largely on resolving a range of natural resource governance and related livelihood issues.

These are large-scale, multi-faceted and complex issues that will require investment in ongoing information gathering, monitoring, and capacity building at the interface between biophysical and social sciences and policy. And, because policy change and needed societal change can be slow, both immediate and long term commitment by governments, NGOs and civil society will be needed.

In addition there is the need examine the connectivity and dynamics of these wetland system together with a finer scale and more critical examination of climate change projections for the KAZA area.

10.2 Natural resource governance

The dominant form of land use in the KAZA TFCA is subsistence agriculture under communal tenure in nutrient poor, mostly semi-arid systems. The potentially rich biodiversity of the area and its wetlands are undervalued, very largely because those living on the land are unable to realize the value and benefits of this rich heritage. This is largely a result of inappropriate institutions governing resource access rights and benefits streams, and associated mismatches between social and ecological scales. The success of the KAZA TFCA as a conservation and development initiative rests squarely on the extent to which rural communities will benefit from wildlife-based land uses**. Reforms in tenure and resource access rights will be crucial to the sustainability of the KAZA TFCA, and a critical comparative analysis of the trade offs of alternative policies, and of scenarios for future development, is an immediate priority.**

Namibia has taken the lead in developing community conservancies that serve to enhance livelihoods and contribute to conservation objectives but there remains a great deal to be done towards harmonizing natural resource management approaches across the participating countries, as well as between sectors (fisheries, forestry and wildlife, and agriculture) within countries, if one of the primary objectives of the TFCA is to be met. The pace of devolving natural resource management rights and responsibilities from central to local levels has been remarkably slow in the region. For example, it is nearly 30 years since CAMPFIRE was conceived and presented to the Zimbabwe Government but its primary objective of achieving wildlife management at the village level has still to be realised. The point is that policy change can be very slow and no time should be lost in vigorously addressing the issue.

10.3 Diversification and adaptive co-management

The maintenance and generation of diversity is accepted as a fundamental characteristic of resilient systems. This is true whether it be species, ecological communities, or social systems. The more homogenous systems become, the more susceptible they are to shocks and surprises. The important issue for KAZA is – how can these principles be translated into conservation action?

On the ecological front, the major disturbances that are likely to generate homogeneity in the system are human land use practices, elephants and fire. The replacement of multispecies systems of large wild mammalian herbivores with single-species livestock systems, together with fences across much of the landscape, is a case in point. The extent to which cultivation may be impacting on landscapes and land cover change does not appear to have been examined. In the past, shifting cultivation combined with low human populations may have contributed to generating heterogeneity, but higher densities of farmers with fewer options to move may have the opposite effect. Similar considerations apply to the burgeoning elephant population and increasing frequency of uncontrolled fires. The 'homogenizing' impacts of high elephant densities and fires on woodland forest resources in the region are well established (e.g. Ben Shahar 1993, 1998, Conybeare 2004, Cumming et al 1997, Cumming and Jones 2005).

Similar concerns apply to the social systems in terms of their development within the region. The recently proposed ban on safari hunting in much of Ngamiland and Chobe Districts in Botswana will immediately curtail diversity in the tourism industry. Very constrained models of community based conservation throughout the region will also do so.

Tackling these linked social-ecological issues will require influencing policy and practice in natural resource management from national to local levels. This will need greatly improved information on the current status and trends in landuse and land cover change, on biodiversity, livelihoods and natural resource use, demographics and disease, the tourism industry, and so on. As noted in the previous section (9.3), reducing uncertainty is a primary consideration in developing system sustainability.

Associated with the importance of maintaining and generating diversity is the need to develop policy frameworks within KAZA that encourage experimentation and diversification in all fields, and that foster the development of adaptive capacity. To take the tourism industry as an example;

- what is the range and nature of tourism enterprises operating in the TFCA,
- how diverse are they and how might they diversify?
- have private-public-community partnerships been introduced and effectively explored?
- What opportunities are there for joint ventures between established, well resourced tourism companies and local communities that provide for capacity building and eventual capture by local communities?

Establishing the conditions (policy frameworks?) that would allow adaptive co-management systems to emerge (see Ruitenbeek and Cartier 2001) even at a pilot project scale within the KAZA TFCA should be a priority (see also section 4.2 and tentative plans for Hwange NP and its neighbours).

10.4 Biodiversity linkages and conservation planning

Earlier in this report (Section 4) I drew attention to broad-scale southwest-northeast biodiversity gradients in the KAZA region and how habitats may change along these gradients under climate change and increasing aridity. Associated with these projected changes will be the need to maintain what I referred to as 'adaptive dispersal corridors' along these biodiversity gradients. Counterbalancing the creation of corridors and linkages, however, will be the need to maintain a measure of modularity (Section 8) within the larger landscape of the KAZA TFCA. At this stage we lack information needed to make reasonably well informed specific recommendations in this regard.

There is, as yet, little evidence of investment in systematic conservation assessment and planning. Planning for pattern and persistence and ecosystem processes (e.g. Cowling et al 1999, Rouget et al 2006) in development and management of the KAZA TFCA also appears to be lacking. New and powerful approaches have been developed to tackle these problems in the last two decades and surely merit investment in, and application to, the development of conservation planning in KAZA[1]. The recent study by Smith et al (2008) on designing a transfrontier landscape in Maputoland that takes into account the economic value of land and biodiversity threats also provides a good example of the kind of work that is urgently needed for the KAZA TFCA.

10.5 Information and participatory science

One of my overriding impressions in conducting this study has been how little sound, current information is available and accessible on a wide range of topics for the KAZA TFCA. Major gaps that need to be filled include the current distribution and status of plant and vertebrate taxa throughout the TFCA, but particularly in Angola and Zambia. The status of the few endemics, particularly the herpetofauna, urgently needs to be assessed. Some of these species and areas would almost certainly merit Alliance for Zero Extinction (ACE) ranking.

Information on protected areas (check lists, numbers or status, distribution, habitats, budgets, staff levels, etc.) and on their performance is not generally available. The WCMC database on protected areas, for example, carries no more than a simple map of Chobe National Park without even a list of the large mammals occurring in the park. This, despite more comprehensive, but possibly outdated, information being available in the IUCN Directory of Afrotropical Protected Areas published in 1987. The setting up of an open but quality controlled "Wiki" directory on the protected areas in the KAZA region may assist in filling many of the gaps.

Similar gaps exist in the information base on forest areas and on ecosystem services throughout the KAZA region.

The region has universities and research departments in its conservation agencies that, with appropriate support, could readily be enlisted in contributing towards an improved knowledge base for the KAZA TFCA.

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[1] Here I refer particularly to the work of Richard Cowling and Andrew Knight and their colleagues in South Africa in the Cape, the Valley Bushveld and the Cederberg.

The development of a more participatory culture between governments (both central and local), NGOs, the private sector, and the range of stakeholders living within the TFCA, in terms of research and information sharing, is also urgently needed.

10.6 Specific priorities

In addition to the large scale priorities which apply across the KAZA TFCA the following specific priorities merit attention and action by government and non-governmental conservation agencies.

1. Harmonising conservation legislation and developing policies for transboundary natural resource management. This was listed as an objective by the parties to the TFCA MOU (see page 2).
2. A re-examination of the role of veterinary control fences in the control of animal diseases over large landscapes and exploring the social, economic and environmental costs of alternative disease management strategies.
3. A critical examination of polices and incentive structures relating to wildlife as a landuse – particularly as these relate to conservation and wildlife outside state protected areas.
4. Identifying Key Biodiversity Area and Areas of Zero Extinction within KAZA.
5. A detailed examination (including ground surveys and mapping) of the basis for, and the feasibility of, establishing the priority wildlife corridors of (a) Chobe – Luiana – Sioma-Ngwezi, (b) Chobe – Hwange, and (c) Sioma-Ngwezi – Kafue – Zambezi NP. Closely linked to the design of corridors is the need for research on habitat fragmentation and trends in land cover within the overall KAZA TFCA area.
6. Developing more sustainable and adequate funding streams for the effective management of protected areas in the TFCA, possibly through public-private-community partnerships.

For each of the above priorities there is scope for conservation NGOs, aid agencies and the private sector to engage with governments to effect progress and improved conservation and livelihoods in the KAZA TFCA.

The signing of an MOU by five participating countries to establish a TFCA of nearly 400,000 km^2 provides a unique window of opportunity through which to explore and develop innovative approaches to conservation in large landscapes in the region – it is an opportunity that needs to be seized by all involved.

11.

REFERENCES AND APPENDICES

References

Note: The following list includes literature cited and reference consulted

Adger, N., Brooks, N., Kelly, M., Bentham, G., Agnew, M., and Eriksen, S. (2004) New indicators of vulnerability and adaptive capacity. *Technical Report 7*, 128p. Centre for Climate Change Research, University of East Anglia, Norwich.

Allen, P. M. (1990) Why the future is not what it was. *Futures*, 555-570.

Anderssen, L., Wilk, J., Todd, M. C., Hughes, D. A., Earle, A., Kniveton, D., Layberry, R. & Savenije, H. H. G. (2006) Impact of climate change and development scenarios on flow patterns in the Okavango River. *Journal of Hydrology*, **331,** 43-57.

Andrews, P. & O'Brien, E. M. (2000) Climate, vegetation, and predictable gradients in mammal species richness in southern Africa. *Journal of Zoology, London*, **251,** 205-231.

Arntzen, J. (1998) Economic valuation of rangelands in Botswana: a case study. *CREED Working Paper Series* No. 17, 62pp. IIED, London.

Ashley, C. and Carney, D. (1999) Sustainable livelihoods: lessons from early experience. 64pp. DFID, Department for International Development, London.

Ashton, P. J. (2002) Avoiding conflicts over Africa's water resources. *Ambio*, **31,** 236-242.

Ashton, P. J. (2003) The search for an equitable basis for water sharing in the Okavango River Basin. *International Waters in Southern Africa.* (ed M. Nakamura), pp. 164-188.United Nations University Press, Tokyo.

Ashton, P. J. & Manley, R. E (1999) Potential hydrological implications of water abstraction from the Okavango River in Namibia. *Proceedings of the Ninth South African Hydrological Symposium, 29-30 November 1999, University of the Western Cape, Bellville, South Africa.*

Ashton, P. J. & Neal, M. (2003) An overview of key strategic issues in the Okavango River Basin. *Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin.* (eds A. R. Turton, P. J. Ashton & T. E. Cloete), pp. 31-63.Green Cross International Geneva.

Baars, R. M. (2002) Rangeland utilisation assessment and modelling for grazing and fire management. *Journal of Enviornmental Management*, **64,** 377-86.

Baars, R. M. T. and Mumbuna, M. M. (1991) Grazing management systems. *Supplement to "Farming in Western Province", ARPT, 1988.* Mongu, Zambia.

Barnes, J. I. (1998) *Wildlife Economics: a study of direct use values in Botswana's wildlife sector.* PhD Thesis. University of London, University College London.

Barnes, J., Burgess, J. & Pearce, D. (1992) Wildlife Tourism. *Economics for the wilds.* (eds T. M. Swanson & E. B. Barbier), pp. 136-151. Earthscan, London.

Barnes, J., Cannon, J., and Morrison, K. (2001) Economic returns to selected landuses in Ngamiland, Botswana. 59 pp + Appendices. Conservation International, Cape Town.

Beier, P. & Noss, R. F. (1998) Do habitat corridors provide connectivity? *Conservation Biology*, **12,** 1241-1252.

Bell, R. H. V. and Martin, R. B. (1984) Identification of conservation priority. *Conservation and Wildlife Management in Africa*. (eds. Bell, R. H. V.//McShane -Caluzi, E.) pp. 43-75. Office of Training and Program Support, Forestry and Natural Resources Sector, U. S. Peace Corps. Washington, D.C.

Ben-Shahar, R. (1993) Woodland dynamics under the influence of elephants and fire in northern Botswana. *Vegetatio*, **65,** 157-163.

Ben-Shahar, R. (1998) Changes in the structure of savanna woodlands in northern Botswana, following the impacts of elephants and fire. *Plant Ecology*, **136,** 189-194.

Bernard, T. & Moetapele, N. (2005) Desiccation of the Gomoti River: Biophysical process and indigenous resource management in Northern Botswana. *Journal of Arid Environments,* **63,** 256-283.

Biggs, R., Bohensky, E., Desanker, P. V., Fabricius, C., Lynam, T., Misselhorn, A. A., Musvoto, C., Mutale, M., Reyers, B., Scholes, R. J., Shikongo, S. & van Jaarsveld, A. S. (2004) *Nature supporting people: the southern African Millennium Ecosystem Assessment.* Council for Scientific and Industrial Research, Pretoria, South Africa.

Bills, R. & Marshall, B. (2004) Chapter 9. Fishes of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds J. R. Timberlake & S. L. Childes), pp. 353-380. Biodiversity Foundation for Africa Bulawayo.

Boko, M., Niang, 1., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. & Yanda, P. (2007) Africa. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* (eds M. L. Parry, O. F. Canziani, J. P. Palutikof, van der Linden P. J. & C. E. Hanson), pp. 433-467. Cambridge University Press, Cambridge UK.

Bond, I. & Cumming, D. H. M. (2006) Wildlife research and development. *Zimbabwe's agricultural revolution revisited, 2nd Edition.* (eds. M. Rukuni, P. Tawonezi, C. Eicher, M. Munyuki-Hungwe & P. Matondi), pp. 476-497.University of Zimbabwe Publications Harare.

Bonyongo, M. C. & Harris, S. (2007) Grazers species-packing in the Okavango Delta, Botswana**.** *African Journal of Ecology*, **45,** 527-534.

Boon, P. J. (2000) The development of integrated methods for assessing river conservation value. *Hydrobiologia,* **422-423,** 413-428.

Box, G. (1976) Science and statistics. *Journal of the American Statistical Association,* **71,** 791-799.

Boyd, J. & Banzhaf, S. (2006) What are ecosystem services? The need for standardized environmental accounting units. *Resources for the Future, Discussion Paper* , RFF DP 06-02, 1-26.

Boyd, J. & Banzhaf, S. (2007) What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics,* **63 ,** 616-626.

Broadley, D. G. (2004) Chapter 8. Herpetofauna of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds. J. R. Timberlake & S. L. Childes), pp. 313-350. Biodiversity Foundation for Africa, Bulawayo.

Burgess, N., D'Amico Hales, J., Underwood, E., Dinerstein, E., Olson, D., Itoua, I., Scheipper, J., Ricketts, T. & Newman, K. (2004) *Terrestrial ecoregions of Africa and Madagascar: a conservation assessment.* Island Press, Washington, DC.

Cahoon, D. R., Stocks, B. J., Levine, J. S., Cofer III, W. R. & O'Neill, K. P. (1992) Seasonal distribution of African savanna fires. *Nature* , **359,** 812-815.

Campbell, B. M. & Luckert, M. (2002) *Uncovering the Hidden Harvest.* Eathscan, London.

Carpenter, S. R., DeFries, R., Dietz, T., Mooney, H. A., Polasky, S., Reid, W. V. & Scholes, R. J. (2006) Millennium ecosystem assessment: research needs. *Science*, **314,** 257-256.

Carpenter, S. R. & Turner, M. G. (2001) Hares and tortoises: interactions of fast and slow variables in ecosystems. *Ecosystems,* **3,** 495-497.

Chafota, J. (2007) *Factors governing selective impacts of elephant on woody vegetation.* University of the Witwatersrand, Johannesburg, South Africa.

Chan, K. M. A., Shaw, M. R., Cameron, D. R., Underwood, E. C. & Daily, G. C. (2006) Conservation Planning for Ecosystem Services. *PLoS Biology,* **4,** e379. <http://dx.doi.org/10.1371%2Fjournal.pbio.0040379>

Chapin, F. S., Zavaleta, E. S., Eviner, V. T., Naylor, R. L., Vitousek, P. M., Reynolds, H. L., Hooper, D. U., Lavorel, S., Sala, O. E., Hobbie, S. E., Mack, M. C. & Diaz, S. (2000) Consequences of changing biodiversity. *Nature,* **405,** 234-242.

Child, G. F. T. & Riney, T. (1987) Tsetse control hunting in Zimbabwe, 1919-1958. *Zambezia,* **14,** 11-71.

Conybeare, A. M. (2004) Elephant impacts on vegetation and other biodiversity in the broadleaved woodlands of S-Central Africa. *Biodiversity of the Four Corners Area: Technical Reviews Volume Two (Chapters 5-15).* (eds J. R. Timberlake & Childes S. L.), pp. 477-508.Biodiversity Foundation for Africa and Zambezi Society, Bulawayo and Harare.

Cosivi, O., Grange, J. M., Daborn, C. J., Raviglione, M. C., Fujikura, T., Cousins, D., Robinson, R. A., Huchzermeyer, H. F. A. K., de Kantor, I. & Meslin, F. X. (1998) Zoonotic tuberculosis due to *Mycobacterium bovis* in developing countries. *Emerging Infectious Diseases,* **4,** 59-70.

Costanza, R. (2008) Ecological services: multiple classification systems are needed. *Biological Conservation.*, **141,** 350-352.

Cotterill, F. P. D. (2004) Chapter 6. Mammals of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds. J. R. Timberlake & S. L. Childes), pp. 231-266.Biodiversity Foundation for Africa Bulawayo.

Cotterill, F. P. D. (2006) *The evolutionary history and taxonomy of the* Kobus leche *species complex of South-Central Africa in the context of palaeo-drainage dynamics.* PhD Thesis. University of Stellenbosch, Stellenbosch, South Africa.

Cowling R.M., Lombard A.T., Rouget M., Kerley G.I.H., Wolf T., Sims-Castley R., Knight, A., Vlok J.H.J., Pierce S.M., Boshoff A.F., & Wilson, S. L. (2003) A conservation assessment for the Subtropical Thicket Biome. No. 43, 112pp + appendices. Terrestrial Ecology Research Unit (TERU), Port Elizabeth.

Cowling, R. M., Pressey, R. L., Lombard, A. T., Desmet, P. G. & Ellis, A. G. (1999) From representation to persistence: requirements for a sustainable system of conservation areas in the species-rich Mediterranean-climate desert of southern Africa. *Diversity and Distributions,* **5,** 51-71.

Cumming, D., Biggs, H., Kock, M., Shongwe, N., and Osofsky, S. (2007) *The AHEAD (Animal Health for Environment And Development) - Great Limpopo Transfrontier Conservation Area (GLTFCA) Programme: Key questions and conceptual framework revisited*. 14pp. Wildlife Conservation Society, http://wcs-ahead.org/workinggrps_limpopo.html.

Cumming, D. and Jones, B. (2005) Elephants in southern Africa: management issues and options. *WWF-SARPO Occasional Paper Series* No. 11, 98pp. WWF Southern Africa Regional Programme Office, Harare, Zimbabwe.

Cumming, D. H. M. (1984) Establishing priorities for funding and other international support for protected areas in Africa. pp 108-113, In. *Proceedings of the 22nd Working Session Committee on National Parks and Protected Areas. 22-27 May, 1983, Victoria Falls, Zimbabwe.* IUCN, Gland.

Cumming, D. H. M. (1991) Wildlife products and the market place: A view from southern Africa. *Wildlife Production: Conservation and Sustainable Development.* (eds. L. A. Renecker & R. J. Hudson), pp. 11-30.University of Alaska, Fairbanks. Fairbanks, Alaska.

Cumming, D. H. M. (1999) *Study on the Development of Transboundary Natural Resource Management Areas in Southern Africa, Environmental Context: Natural Resources, Land Use, and Conservation.* Biodiversity Support Program, Washington, DC, USA. (66 pp. + 44 Figs.).

Cumming, D. H. M. (2004a) *Sustaining animal health and ecosystem services in large landscapes-2nd draft-Concept for a programme to address wildlife, livestock and related human and ecosystem health issues in the Greater Limpopo Trans-frontier Conservation Area*. 24pp. Wildlife Conservation Society, <http://www.wcs-ahead.org/workinggrps/limpopo.html>

Cumming, D. H. M. (2004b) Chapter 13. Movements and migrations of large mammals in the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds J. R. Timberlake & S. L. Childes), pp. 447-460. Biodiversity Foundation for Africa, Bulawayo.

Cumming, D. H. M. (2004c) Park Performance in a Century of Change. *Parks in Transition: Biodiversity, Rural Development and the Bottom Line.* (ed. B. Child), pp. 105-124.Earthscan, London.

Cumming, D. H. M. (2005) Wildlife, livestock and food security in the South East Lowveld of Zimbabwe. *Conservation and development interventions at the wildlife/livestock interface: implications for wildlife, livestock and human health.* (eds S. A. Osofsky, S. Cleaveland, W. B. Karesh, M. D. Kock, P. J. Nyhus, L. Starr & A. Yang), pp. 41-48, .IUCN - The World Conservation Union. Gland, Switzerland and Cambridge, UK.

Cumming, D. H. M (2006) Stakeholder Workshop to Explore Options for the Management of Elephant, and other Wildlife Resources, in Hwange National Park and Surrounding Areas. *Workshop Report.* 37pp. National Parks & Wildlife Management Authority, Harare.

Cumming, D. H. M. (2007) Transfrontier conservation areas, animal diseases, and human livelihoods: issues of system health and sustainability. *Protected areas and human livelihoods.* (eds K. H. Redford & E. Fearn), pp. 160-170. Wildlife Conservation Society, New York.

Cumming, D. H. M., du Toit, R. F. & Stuart, S. N. (1990) *African elephants and rhinos: Status survey and conservation action plan.* IUCN, Gland, Switzerland.

Cumming D H M, Fenton M B, Rautenbach I L, Taylor R D, Cumming G S, Cumming M S, Dunlop J M, Ford G A, Hovorka M D, Jonston D S, Kalcounis M, Mahlangu Z & Portfors C V R (1997) Elephants, Woodlands and Biodiversity in Southern Africa. *South African Journal of Science.*, **93,** 231-236.

Cumming, D. H. M., Guveya, E., and Matose, F. (2002) A Framework for Examining Social-ecological Linkages in the Conservation of the Miombo Ecoregion. 45pp. WWF Southern Africa Regional Programme Office, Harare.

Cumming, D. H. M. and Jackson, P. (1984) *Proceedings of the IUCN/SSC African Elephant Specialist Group and African Rhino Specialist Group Joint Meeting , Wankie Safari Lodge, Zimbabwe*. (Ed. IUCN, Gland.

Cumming, D. H. M. and Lynam, T. J. P. (1997) Land use changes, wildlife conservation and utilisation, and the sustainability of agro-ecosystems in the Zambezi Valley: Final Technical Report - Volume 1. European Union Contract B7-5040/93/06. 138pp. WWF Programme Office, Harare, Zimbabwe.

Cumming, G. S., Cumming , D. H. M. & Redman, C. (2006) Scale mismatches in social-ecological systems: causes, consequences and solutions. *Ecology and Society,* **11,** 14. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art14/.

Daily, G. C. (1997) Introduction: what are ecosystem services? *Nature's services: societal dependence on natural ecosystems.* (ed G. C. Daily), pp. 1-10. Island Press Washington, DC.

Damschen, E. A., Haddad, N. M., Orrock, J. L., Tewksbury, J. J. & Levey, D. J. (2006) Corridors Increase Plant Species Richness at Large Scales. *Science*, **313,** 1284-1286.

Dangerfield, J. M. (2004) Chapter 11. Soil fauna of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds J. R. Timberlake & S. L. Childes), pp. 411-426. Biodiversity Foundation for Africa, Bulawayo.

de Groot, R. S., Wilson, M. A. & Boumans, R. M. J. (2002) A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics,* **41,** 393-408.

Drechsel, P., Gyiele, L., Kunze, D. & Cofie, O. (2001) Population density, soil nutrient depletion, and economic growth in sub-Saharan Africa. *Ecological Economics*, **38,** 251-258.

du Toit, R. F. (1992) Large-Scale Wildlife Conservancies in Zimbabwe: Opportunities for Commercial Conservation of Endangered Species. *Wildlife Ranching. A Celebration of Diversity.* (eds. van Hoven, W., Ebedes, H., and Conroy, A.), South African Game Organization, Pretoria.,

Dunham, K. M. (2008) Detection of anthropogenic mortality in elephant *Loxodonta africana* populations: a long-term case study from the Sebungwe region of Zimbabwe. *Oryx*, **42,** 36-48.

East, R. (1998) *African antelope database 1998*. 434pp. IUCN Species Survival Commission, Antelope Specialist Group, Gland.

Eken, G., Bennun, L., Brooks, T. M., Darwall, W., Fishpool, L. D. C., Foster, M., Knox, D., Langhammer, P., Matiku, P., Radford, E., Salaman, P., Sechrest, W., Smith, M. L., Spector, S. & Tordoff, A. (2004) Key biodiversity areas as site conservation targets. *BioScience*, **54,** 1110-1118.

Emerton, L. (2001) *Economic Measures for Biodiversity Planning: An Annotated Bibliography of Methods, Experiences and Cases.* IUCN – The World Conservation Union, Eastern Africa Regional Office, Nairobi.

Emerton, L. (2005) *Values and Rewards: Counting and Capturing Ecosystem Water Services for Sustainable Development.* IUCN Water, Nature and Economics Technical Paper No. 1. Gland, IUCN - The World Conservation Union, Ecosystems and Livelihoods Group Asia.

Erasmus, B. F. N., Van Jaarsveld, A. S. & Chown, S. L. (2002) Vulnerability of South African animal taxa to climate change. *Global Climate Change Biology*, **8,** 679-693.

Farber, S. C., Costanza, R. & Wilson, M. A. (2002) Economic and ecological concepts for valuing ecosystem services. *Ecological Economics*, **41,** 375-372.

Fischer, B. & Turner, R. K. (2008) Ecosystem services: classification for valuation. *Biological Conservation,* **In Press,** 1-3.

Fishpool, L. D. C. & Evans, M. I. (Eds.) (2001) *Important bird areas in Africa and associated islands. Priority areas for conservation.* Birdlife International & Pisces Publications, Cambridge.

Fleishman, E., Blair, R. B. & Murphy, D. D. (2001) Empirical validation of a method for umbrella species selection. *Ecological Applications*, **11,** 1489-1501.

Freitag, S., van Jaarsveld, A. S. & Biggs, H. C. (1997) Ranking priority biodiversity areas: an iterative conservation value-based approach. *Biological Conservation*, **82,** 263-272.

Frost, P. G. H. (199?) Community-based management of fire: lessons from the Western Province in Zambia. *Report on public policies affecting forest fires.* Unpublished Report. Lusaka, Government of Zambia.

Gardiner, A. (2004) Chapter 10. Butterflies of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds J. R. Timberlake & S. L. Childes), pp. 383-408. Biodiversity Foundation for Africa, Bulawayo.

Garner, A., Rachlow, J. L. & Hicks, J. F. (2005) Patterns of genetic diversity and its loss in mammalian populations. *Conservation Biology*, **19,** 1215-1221.

Golding, J. S. ed. (2002) Southern Africa Plant Red Data Lists. *Southern African Botanical Diversity Network Report* No. 14, SABONET, Pretoria .

Government of Botswana (2007) *Government Policy Paper No. 2 of 2007. Community based natural resources management policy*. Government Printer, Gaborone.

Griffin, M. & Grobler, H. J. W. (1991) Wetland-associated mammals of Namibia - a national review. *Madoqua*, **17,** 233-237.

Gunderson, L. H. & Holling, C. S. (2002) *Panarchy: understanding transformations in human and natural systems.* Island Press, Washington, D.C.

Hannah, L., Wetterberg, G., and Duvall, L. (1988) Botswana biological diversity assessment. 77pp + appendices. USAID, Bureau for Africa, Office of Technical Resources, Natural Resources Branch, Washington, DC.

Hansen, A. (1994) The illusion of local sustainability and self sufficiency: famine in a border area of northwestern Zambia. *Human Organisation* , **53,** 11-20.

Herremans, M. (1999) Waterbird diversity, densities, communities and seasonality in the Kalahari Basin, Botswana. *Journal of Arid Environments*, **43,** 319-350.

Higgins, J. V., Bryer, T., Khoury, M. L. & Fitzhugh, T. W. (2005) A freshwater classification approach for biodiversity conservation planning. *Conservation Biology*, **19,** 432-445.

Hobbs, R. J. (1992) The role of corridors in conservation: solution or bandwagon. *TREE*, **7,** 389-392.

Holling, C. S. (2001) Understanding the complexity of economic, ecological, and social systems. *Ecosystems* , **4,** 390-405.

Holling C. S. & Meffe, G. K. (1996) Command and control and the pathology of natural resource management. *Conservation Biology*, **10,** 328-337.

Huebschle, O. B. J., Bamhare, O. & Tjipura-Zaire, G. (2007) The situation of CBPP in Namibia in view of a new outbreak in the Caprivi region. Accessed June 2008. <http://www.fao.org/docrep/007/y5510e/y5510e00.HTM>

Hughes, D. A., Anderssen, L. W. J. & Savenije, H. H. G. (2006) Regional calibration of the Pitman model for the Okavango River. *Journal of Hydrology*, **331,** 30-42.

Hulme, M. (1996) *Climate Change and Southern Africa: an exploration of some potential impacts and implications in the SADC region*. Climate Research Unit, University of East Anglia, Norwich, U.K.

Humphrey, G. J. (2008) *Influence of large termitaria on species composition and tree height structure in a modified Brachystegia/Julbernardia miombo woodland in Chizarira National Park, Zimbabwe.* M.Sc. Thesis, Percy FitzPatrick Institute of African Ornithology. University of Cape Town, Cape Town, South Africa.

Huntley, B. J. (1974) Outlines of conservation in Angola. *Journal of the Southern Africa Wildlife Management Association*, **4,** 157-166.

IPCC (2007a) Climate Change 2007: Synthesis Report. Summary for Policy Makers. An assessment of the Intergovernmental Panel on Climate Change. 22pp.

IPCC (2007b) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, C.E. Hanson, Eds.. Cambridge University Press, Cambridge, UK, 976pp.

IUCN/UNEP (1987) *The IUCN Directory of Afrotropical Protected Areas.* IUCN, Gland, Switzerland and Cambridge, UK xix +1034pp.

Johnstone, P. A. (1975) Evaluation of a Rhodesian game ranch. *Journal of the Southern African Wildlife Management Association*, **5,** 43-51.

Jones, B. T. B. (2008) *Legislation and Policies relating to Protected Areas, Wildlife Conservation, and Community Rights to Natural Resources in countries being partner in the Kavango Zambezi Transfrontier Conservation Area*. First Draft. 75pp. Windhoek.

Joseph, G. J. (2008) *Large termitaria provide refugia for cavity-using birds in a modified miombo woodland system.* M. Sc. Thesis, Percy Fitzpatrick Institute of African Ornithology. University of Cape Town, Cape Town.

Justus, J. S. S. (2002) The principle of complementarity in the design of reserve networks to conserve biodiversity: a preliminary history. *Journal of Bioscience*, **27,** 421-435.

Katerere, Y., Hill, R., and Moyo, S. A. (2001) *Critique of Transboundary Natural Resource Management in Southern Africa*. Paper no.1, IUCN-ROSA Series on Transboundary Natural Resource Management, 36. Harare, IUCN-ROSA.

Knight, A. T. & Cowling, R. M. (2007) Embracing opportunism in the selection of conservation areas. *Conservation Biology*, **21,** 1124-1126.

Knight, A. T., Cowling, R. M. & Campbell, B. M. (2006a) An operational model for implementing conservation. *Conservation Biology*, **20,** 408-419.

Knight, A. T., Driver, A., Cowling, R. M., Maze, K., Desmet, P. G., Lombard, A. T., Rouget, M., Botha, M. A., Boshoff, A. F., Castley, J. G., Goodman, P. S., Mackinnon, K., Pierce, S. M., Sims-Castley, R., Stewart, W. I. & von Hase, A. (2006b) Designing systematic conservation assessments that promote effective implementation: best practice from South Africa. *Conservation Biology*, **20,** 739-750.

Knight, A. T., Smith, R. J., Cowling, R. M., Desmet, P. G., Faith, D. R., Ferrier, S., Gelderblom, C. M., Hedley, G., Lombard, A. T., Maze, C., Nel, J. L., Parrish, J. D., Pence, G. Q. K., Possingham, H. R., Reyers, B., Rouget, M., Roux, D. & Wilson, K. E. (2007a) Improving the key biodiversity areas approach for effective conservation planning. *BioScience*, **57,** 256-261.

Koch, E., de Beer, G. & Elliffe, S. e. al. (1998) International perspectives on tourism-led development: some lessons for the SDIs. *Development Southern Africa*, **15,** 907-914.

Kremen, C., Cameron, A., Moilanen, A., Phillips, S. J., Thomas, C. D., Beentje, H., Dransfield, J., Fisher, B. L., Glaw, F., Good, T. C., Harper, G. J., Hijmans, R. J., Lees, D. C., Louis, Jr. E., Nussbaum, R. A., Raxworthy, C. J., Razafimpahanana, A., Schatz, G. E., Vences, M., Vieites, D. R., Wright, P. C. & Zjhra, M. L. (2008) Aligning conservation priorities across taxa in Madagascar with high-resolution planning tools. *Science*, **320,** 222-226.

Langhammer, P. F., Bakarr, M. I., Bennun, L. A., Brooks, T. M., Clay, R. P., Darwall, W., De Silva, N., Edgar, G. J., Eken, G., Fishpool, L. D. C., Fonseca, G. A. B. d., Foster, M. N., Knox, D. H., Matiku, P., Radford, E. A. , Rodrigues, A. S. L., Salaman, P., Sechrest, W. & Tordoff, A. W. (2007) *Identification and Gap Analysis of Key Biodiversity Areas: Targets for Comprehensive Protected Area Systems.* IUCN, Gland, Switzerland.

Larsen, F. W., Bladt, J. & Rhabek, C. (2007) Improving the performance of indicator groups for the identification of important areas for species conservation. *Conservation Biology*, **21,** 731-740.

Lent, P. C. (1969) A preliminary study of the Okavango lechwe (*Kobus leche leche* Gray). *East African Wildlife Journal*, **7,** 147-157.

Levin, S. (1999) *Fragile dominion: complexity and the commons.* Perseus Publishing, Cambridge, Massachusetts.

Luck, G. W., Daily, G. C. & Ehrlich, P. R. (2003) Population diversity and ecosystem services. *Trends in Ecology and Evolution*, **18,** 331-336.

Mangani, M. P. C. (2007) Contagious bovine pleuropneumonia in Zambia. Accessed June, 2008. <http://www.fao.org/docrep/007/y5510e/y5510e0y.htm>.

Margules, C. R. & Pressey, R. L. (2000) Systematic conservation planning. *Nature,* **405,** 243-253.

Marshall, B. (2004) Chapter 12. Aquatic invertebrates of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds. J. R. Timberlake & S. L. Childes), pp. 427-446. Biodiversity Foundation for Africa, Bulawayo.

Martin, R. B. (1984) *Communal Areas Management Programme for Indigenous Resources (CAMPFIRE).* 110pp. Branch of Terrestrial Ecology, Department of National Parks and Wild Life Management, Harare, Zimbabwe.

Martin, R. B. (2004) Species Report for Reedbuck, Waterbuck, Lechwe and Puku. 78pp. Study conducted in support of *The Transboundary Mammal Project* of the Ministry of Environment and Tourism, Namibia facilitated by the Namibia Nature Foundation and the World Wildlife Fund LIFE Programme., Windhoek, Namibia.

Martin, R. B. (2007) Wildlife Management in the Kwando area of the Caprivi: The Mudumu North Complex. 115pp. Ministry of Environment and Tourism , Windhoek, Namibia.

Martin, R. B. (2008a) Development of Strategic Options to Improve the Performance of The Botswana Department of Wildlife and National Parks. Final Report. 58pp. Atos Origin, Belgium, & Department of Wildlife and National Parks, Ministry of Environment Wildlife & Tourism, Botswana,

Martin, R. B. (2008b) Potential of tourism-based business of Kafue National Park and associated GMAs. 58pp. Unpublished Consultant's Report,

Mbaiwa, J. E. (2003) The socio-economic and environmental impacts of tourism development on the Okavango Delta, north-western Botswana. *Journal of Arid Environments*, **54,** 447-457.

Mbaiwa, J. E. (2005) Wildlife resource utilisation at Moremi Game Reserve and Khwai community area in the Okavango Delta, Botswana. *Journal of Environmental Management*, **77,** 144-156.

McClanahan, T. R., Cinner, J. E., Maina, J., Graham, N. A. J., Daw, T. M., Stead, S. M., Wamukota, A., Brown, K., Ateweberhan, M., Venus, V. & Polunin, N. V. C. (2008) Conservation action in a changing climate. *Conservation Letters*, **1,** 53-59.

Mendelsohn, J. & el Obied, S. (2003) *Sand and water: a profile of the Kavango region.* Struik Publishers, Cape Town.

Mendelsohn, J. & el Obied, S. (2004) *Okavango River: The flow of a lifeline.* Struik Publishers, Cape Town.

Mendelsohn, J. & Roberts, C. (1997) *An environmental profile and atlas of Caprivi.* Directorate of Environmental Affairs, Windhoek, Namibia.

Metcalfe, S. C. (2006) *Communal Land reform in Zambia: governance, livelihood and conservation*. M.Phil. Programme for Land and Agrarian Studies (PLAAS), Faculty of Economic and Management Sciences, University of the Western Cape., Cape Town.

Millennium Ecosystem Assessment (2005) Chapter 1, MA Conceptual Framework. *Millennium Ecosystem Assessment, 2005.* pp. 22-33. World Resources Institute Washington, DC.

Millennium Ecosystem Assessment, 2. (2005) *Ecosystems and human well-being: wetlands and water synthesis.* World Resources Institute, Washington, DC.

Mittermeier, R. A., Mittermeier, C. G., Brooks, T. M. P. J. D., Konstant, W. R., da Fonseca, G. A. B. & Kormos, C. (2003) Wilderness and biodiversity conservation. *Proceedings National Academy of Sciences*, **100,** 10309-10313.

Moore, A. (2004) Chapter 2. The geomorphology of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume One (Chapters 1-4).* (eds J. R. Timberlake & S. L. Childes), pp. 27-66. Biodiversity Foundation for Africa, Bulawayo, Zimbabwe.

Mundy, P. (2004) Chapter 7. Birds of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds. J. R. Timberlake & S. L. Childes), pp. 269-312. Biodiversity Foundation for Africa, Bulawayo.

Murindagomo, F. (1997) *Wildlife, cattle and comparative advantage in semi-arid communal lands and implications for agropastoral options and government policy: a case study in the Sebungwe region, Zimbabwe.* D. Phil Thesis. Department of Agricultural Economics and Extension, University of Zimbabwe, Harare.

Musisi, F. L., Dungu, B., Thwala, R., Mogajane, M. E. & Mtei, B. J (2007) The threat of contagious bovine pleuropneumonia and challenges for its control in the SADC region. Accessed June 2008, <http://www.fao.org/docrep/007/y5510e/y5510e0d.htm#bm13>.

NACSO (2004) *Namibia's communal conservancies: a review of progress and challenges.* NACSO, Windhoek.

Nakayama, M. (1998) Politics behind Zambezi Action Plan. *Water Policy*, **1,** 397-401.

Norberg, J. (1999) Linking Nature's services to ecosystems: some general ecological concepts. *Ecological Economics*, **29,** 183-202.

Northon-Griffiths, M. (2007) How many wildebeest do you need? *World Economics*, **8,** 41-64.

O'Brien, E. M. (1993) Climatic gradients in woody plant species richness: towards an explanation based on an analysis of southern Africa's woody flora. *Journal of Biogeography*, **20,** 181-198.

O'Brien, E. M., Whittaker, R. J. & Field, R. (1998) Climate and woody plant diversity in southern Africa: relationships at species, genus and family levels. *Ecography*, **21,** 495-509.

O'Connor, P. W. & Thomas, D. S. G. (1999) The timing and environmental significance of late Quaternary linear dune development in Western Zambia. *Quaternary Research* , **52,** 44-55.

Osofsky, S. A., Cumming, D. H. M. & Kock, M. D. (2008) Transboundary Management of Natural Resources and the Importance of a "One Health" Approach: Perspectives on Southern Africa. *State of the wild: a global portrait of wildlife, wildlands, and oceans.* (eds. E. Fearn & K. H. Redford), pp. 89-98, .Island Press Washington.

Ostrom, E. (2007) A diagnostic approach for going beyond panaceas. *Proceedings of the National Academy of Sciences*, **104,** 15181-15187.

Ostrom, E. and Janssen, M. A. (2002) Beliefs, multi-level governance, and development. *Workshop in political theory and policy analysis. Annual Meeting of the American Political Science Association.* Bloomington.

Parker, I. S. C. (1984) Conservation of the African elephant. *Proceedings of IUCN/SSC African Elephant Specialist Group and African Rhino Specialist Group Joint Meeting* . (eds. Cumming, D. H. M. and Jackson, P.), IUCN, Gland, Switzerland.

Patz, J. A., Daszak, P., Tabor, G. M., Aguirre, A. A., Pearl, M., Epstein, J., Wolfe, N. D., Kilpatrick, A. M., Foufopoulos, J., Molyneuz, D., Bradley, D. J. & Members of the Working Group and Land Use Change and Disease Emergence. (2004) Unhealthy landscapes: policy recommendations on land use changes and infectious diseases emergence. *Environmental Health Perspectives*, **112,** 995-997.

Perkins, J. S. (2005) Status and perspectives of regional tourism in the context of the KAZA-TFCA initiative. 79 pp. In: WEnt Internationale Weiterbildung und Entwicklung gGmbH, Transnet Programme and Biotrack Botswana (Pty) Ltd, Gaborone ,

Poiani, K. A., Richter, B. D., Anderson, M. G. & Richter, H. E. (2000) Biodiversity conservation at multiple scales: Functional sites, landscapes, and networks. *Bioscience*, **50,** 133-146.

Porporato, A., Laio, F., Ridolfi, L., Caylor, K. K. & Rodriguez-Iturbe, I. (2003) Soil moisture and plant stress dynamics along the Kalahari precipitation gradient. *Journal of Geophysical Research*, **108**.

Poynton, J. C. & Broadley, D. G. (1985a) Amphibia Zambeziaca 1: Scolecomorphidae, Pipidae, Microhylidae, Hemisidae, Arthroleptidae. *Annals Natal Museum*, **26,** 503-553.

Poynton, J. C. & Broadley, D. G. (1985b) Amphibia Zambeziaca 2: Ranidae. *Annals Natal Museum*, **27,** 115-181.

Poynton, J. C. & Broadley, D. G. (1987) Amphibia Zambeziaca 3: Rhacophoridae and Hyperolidae. *Annals Natal Museum*, **28,** 161-229.

Poynton, J. C. & Broadley, D. G. (1988) Amphibia Zambeziaca 4: Bufonidae. *Annals Natal Museum*, **29,** 447-490.

Poynton, J. C. & Broadley, D. G. (1991) Amphibia Zambeziaca 5: Zoogeography. *Annals Natal Museum*, **32,** 221-277.

Pressey, R. L. & Cowling, R. M. (2001) Reserve selection algorithms and the real world. *Conservation Biology*, **15,** 275-277.

Pressey, R. L. & Logan, V. S. (1995) Reserve coverage and requirements in relation to partitioning and generalization of land classes: analyses for Western New South Wales. *Conservation Biology*, **9,** 1506-1517.

Ramberg, L., Hancock, P., Lindholm, M., Meyer, T., Ringrose, S., Sliva, J., Van As, J. & VanderPost, C. (2006) Species diversity of the Okavango Delta, Botswana. *Aquatic Science* , **68,** 310-337.

Ringrose, S., VanderPost, C. & Matheson, W. (1997) Use of image processing and GIS techniques to determine the extent and possible causes of land management/fenceline induced degradation problems in the Okavango area, northern Botswana. *International Journal of Remote Sensing*, **18,** 2337-2364.

Rondinini, C. & Boitani, L. (2007) Systematic conservation planning and the cost of tackling conservation conflicts with large carnivores in Italy. *Conservation Biology*, **21,** 1455-1462.

Rondinini, C., Stuart, S. & Boitani, L. (2005) Habitat suitability models and the shortfall in conservation planning for African vertebrates. *Conservation Biology*, **19,** 1488-1497.

Root, K. V., Akcakaya, R. & Ginsburg, L. (2003) A multispecies approach to ecological evaluation and conservation. *Conservation Biology*, **17,** 196-206.

Rouget, M., Cowling, R. M., Lombard, A. T., Knight, A. T. & Kerley, G. I. H. (2006) Designing large-scale conservation corridors for pattern and process. *Conservation Biology*, **20,** 549-561.

Ruitenbeek, J. and Cartier, C. (2001) The invisible wand: adaptive co-management as an emergent strategy in complex bio-economic systems. *Occasional Paper* 34, 47pp. CIFOR , Bogor.

SADC (1999) . *Protocol on Wildlife Conservation and Law Enforcement*. Accessed June 2008 <http://www.sadc.int/english/documents/legal/protocols/index.php.

Sanderson, J., Alger, K., da Fonseca, G. A. B., Galindo-Leal, C., Inchausty, V. H. & Morrison, K. (2003) *Biodiversity corridors: planning, implementing, and monitoring sustainable landscapes.* Conservation International, Washington, D.C.

Sarkar, S., Justus, J., Fuller, T., Kelley, C., Garson, J. & Mayfield, M. (2005) Effectiveness of environmental surrogates for the selection of conservation area networks. *Conservation Biology*, **19,** 815-825.

Schadt, S., Knauer, F., Kaczensky, P., Revilla, E., Weigand, T. & Trepl, L. (2002) Rule-based assessment of suitable habitat and patch connectivity for the Eurasian lynx. *Ecological Applications*, **12,** 1469-1483.

Scheffer, M. & Brock, W. (2000) Socioeconomic mechanisms preventing optimum use of ecosystem services: An interdisciplinary theoretical analysis. *Ecosystems*, **3,** 451-471.

Schlettwein, C. H. G., Simmons, R. E., MacDonald, A. & Grobler, H. J. W. (1991) Flora, fauna and conservation of East Caprivi wetlands. *Madoqua*, **17,** 67-76.

Scholes, R. J. & Biggs, R. (2004) *Ecosystem services in southern Africa: a regional assessment.* Council for Scientific and Industrial Research , Pretoria.

Scholes, R. J. & Biggs, R. (2005) A biodiversity intactness index. *Nature*, **434,** 45-49.

Scholes, R. J., Parsons, D. A. B., Kamuhuza, A., Davis, G., Ringrose, S., Gambiza, J., and Chileshe, E. (1997) The Kalahari Transect: Research on Global Change and Sustainable Development in Southern Africa.IGBP Report 42, 52pp. IGBP Secretariat, Royal Swedish Academy of Sciences, Stockholm, Sweden.

Schulze, R., Meigh, J. & Horan, M. (2001) Present and potential future vulnerability of eastern and southern Africa's hydrology and water resources. *South Africa Journal of Science*, **97,** 150-160.

Shela, O. N. (2000) Management of shared river basins: the case of the Zambezi River. *Water Policy*, **2,** 65-81.

Siachoono, S. M. (1995) Contingent valuation as an additional tool for evaluating wildlife utilisation management in Zambia: Mumbwa Game Management Area. *Ambio*, **24,** 246-249.

Smith, R. J., Easton, J., Nhancalea, B. A., Armstrong, A. J., Culverwell, J., Dlamini, S. D., Goodman, P. S., Loffler, L., Matthews, W. S., Monadjem, A., Mulqueeny, C. M., Ngwenya, P., Ntumi, C. P., Soto, B. & Leader-Williams, N. (2008) Designing a transfrontier conservation landscape for the Maputaland centre of endemism using biodiversity, economic and threat data. *Biological Conservation*, In Press (URL: doi:10.1016/j.biocon.2008.06.010).

Smithers, R. H. N. (1971) The mammals of Botswana. *Memoirs of the National Museums and Monuments of Rhodesia*, **4,** 1-340.

Stokes, S., Haynes, G., Thomas, D. S. G., Horrocks, J. L., Higginson, M. & Malifa, M. (1998) Punctuated aridity in southern Africa during the last glacial cycle: The chronology of linear dune construction in the northeastern Kalahari. *PALAEO (Geography, Climatology, Ecology),* **137,** 305-322.

Stokes, S., Thomas, D. S. G. & Washington, R. (1997) Multiple episodes of aridity in southern Africa since the last interglacial period. *Nature*, **388,** 154-158.

Swallow, B., Kallesoe, M., Iftikhar, U., van Noordwijk, M., Bracer, C., Scherr, S., Raju, K. V., Poats, S., Duraiappah, A., Ochieng, B., Mallee, H., and Rumley, R. (2007) Compensation and Rewards for Environmental Services in the Developing World: Framing Pan-Tropical Analysis and Comparison. ICRAF Working Paper No. 32, World Agroforestry Centre., Nairobi.

Taylor, R. D. and Murphree, M. W. (2007) Successful southern Africa NRM projects and their effect on poverty and governance. Zimbabwe: Masoka and Gairezi. 92pp. IUCN South Africa Country Office , Pretoria, South Africa .

Taylor, R. D. & Martin R. B. (1987) Effects of veterinary fences on wildlife conservation in Zimbabwe. *Environmental Management*, **11,** 327-334.

Thomas, D. S. G., Knight, M. & Wiggs, G. F. S. (2005) Remobilization of southern Africa desert dune systems by twenty-first century global warming. *Nature,* **435,** 1218-1221.

Thomas, D. S. G., O'Connor, P. W., Bateman, M. D., Shaw, S., Stokes, S. & Nash. D. J. (2000) Dune activity as a record of late Quaternary aridity in the Northern Kalahari: new evidence for Northern Namibia interpreted in the context of regional arid and humid chronologies. *Palaeogeography, Palaeoclimateology, Palaeoecology*, **156,** 243-259.

Thomas, D. S. G. & Twyman, C. (2005) Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global Environmental Change*, **15,** 115-124.

Thomson, G. (2008) A short overview of regional positions on foot-and-mouth disease control in southern Africa. *Transboundary animal disease and market access: future options for the beef industry in southern Africa.* Working Paper 2, Institute of Development Studies, Brighton.

Thuiller, W., Broennimann, O., Hughes, G., Alkemade, J. R. M., Midgley, G. F. & Corsi, F. (2006) Vulnerability of African mammals to anthropogenic climate change under conservative land transformation assumptions. *Global Change Biology*, **12,** 424-440.

Timberlake, J. (1998) Biodiversity of the Zambezi Basin Wetlands: Review and preliminary assessment of available information. Phase 1. Final Report. 232pp. Biodiversity Foundation for Africa, Bulawayo .

Timberlake, J. R. (2004) Chapter 5. Plants of the Four Corners area. *Biodiversity of the Four Corners Area: Technical Reviews, Volume Two (Chapters 5-15).* (eds J. R. Timberlake & S. L. Childes), pp. 155-228. Biodiversty Foundation for Africa Bulawayo, Zimbabwe.

Timberlake, J. R. & Childes, S. L. (eds.) (2004) *Biodiversity of the Four Corners Area.* Biodiversity Foundation for Africa, Bulawayo, Zimbabwe.

Tipping, R., Buchanan, J., Davies, A. & Tisdall, E. (1999) Woodland biodiversity, palaeo-human ecology and some implications for conservation management. *Journal of Biogeography*, **26,** 33-43.

Transfrontier Conservation Consortium (2006a) *Final Report: Pre-feasibility study of the proposed Kavango-Zambezi transfrontier Conservation Area. Volume 1.* 109pp. Peace Parks Foundation , Stellenbosch, South Africa.

Transfrontier Conservation Consortium (2006b) *Final Report: Pre-feasibility study of the proposed Kavango-Zambezi transfrontier Conservation Area. Volume 2.* Annexes. 18pp. Peace Parks Foundation , Stellenbosch, South Africa.

Turpie, J., Barnes, J., Arntzen, J., Nherera, B., Lange, G-M, and Buzwani, B. (2006) Economic value of the Okavango Delta, Botswana, and its implications for management. 139pp. IUCN-Regional Office for Southern Africa, Harare.

Turpie, J., Smith, B., Emerton, L., and Barnes, J. (1999) Economic value of the Zambezi Basin wetlands. 346pp. IUCN-Regional Office for Southern Africa, Harare.

Turton, A., Ashton, P. & and Cloete, E. (2003) An Introduction to the Hydropolitical Drivers in the Okavango River Basin. *Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin.* (ed A. A. P. &. C. E. Turton), pp. 9-30.African Water Issues Research Unit and Green Cross International, University Pretoria, Pretoria.

Vale, G. A., Lovemore, D. F., Flint, S. & Cockbill, G. F. (1988) Odour-baited targets to control tsetse flies, *Glossina* spp., in Zimbabwe. *Bulletin of Entomological Research* , **78,** 31-49.

van Aarde, R. J. & Jackson, T. P. (2007) Megaparks for metapopulations: addressing the causes of locally high elephant numbers in southern Africa. *Biological Conservation*, **134,** 289-297.

Walker, B. & Salt, D. (2006) *Resilience thinking; sustaining ecosystems and people in a changing world.* Island Press, Washington, D.C..

Wallace, K. J. (2007) Classification of ecosystem services: problems and solutions. *Biological Conservation ,* **139,** 235-246.

Wallace, K. J. (2008) Ecosystem services: multiple classifications or confusion? *Biological Conservation* , **141,** 353-354.

Weaver, L. C. & Skyer, P. (2005) Conservancies: Integrating wildlife land-use options into the livelihood, development and conservation strategies of Namibian communities. *Conservation and development interventions at the wildlife/livestock interface: implications for wildlife, livestock and human health.* (eds S. A. Osofsky, S. Cleaveland, W. B. Karesh, M. D. Kock, P. J. Nyhus, L. Starr & A. Yang), pp. 89-104 .IUCN - The World Conservation Union. Gland, Switzerland and Cambridge, UK.

White, F. (1983) *The vegetation of Africa.* UNESCO, Paris.

Wilcox, B. A. & Colwell, R. R. (2005) Emerging and reemerging infectious diseases: biocomplexity as an interdisciplinary paradigm. *EcoHealth*, **2,** 244-257.

Wild, H. & Grandvaux Barbosa, L. A. (1967) *Vegetation Map of the Flora Zambesiaca area.* Government Printer, Salisbury, Rhodesia.

Williamson, D. T. (1986) Notes on the sitatunga in the Linyanti Swamp, Botswana. *African Journal of Ecology*, **24,** 293-297.

Williamson, D. T. (1990) Habitat selection by red lechwe (*Kobus leche leche* Gray, 1950). *African Journal of Ecology*, **28,** 89-101.

Wilson, M. A. & Howarth, R. B. (2002) Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics*, **41,** 431-442.

Wilson, V. J. (1975) The mammals of Wankie National Park, Rhodesia. *Memoirs of the National Museums and Monuments of Rhodesia*, **5,** 1-147.

Windsor, R. S. & Wood, A. (1998) Contagious Bovine Pleuropneumonia: The Costs of Control in Central/Southern Africa. *Annals of the New York Academy of Sciences*, **849,** 299-306.

Winston, M. R. & Angermeier, P. L. (1995) Assessing conservation value using centers of population density. *Conservation Biology*, **9,** 1518-1527.

Zambia Wildlife Management Authority (2008) Integrated Development Plan for the Zambian component of the Kavango-Zambezi Transfrontier Conservation Area. 146pp. Zambia Wildlife Management Authority, Chilanga, Zambia.

Annex 1. Summary characterization of conservation areas in the KAZA TFCA (Levels of ecosystem service provision are indicated for Wetlands (Wet), Forest and woodlands (For), Grazing and forage (Graz), Recreation (Rec) at High (H), Medium (M) and Low (L) levels and an estimate of intactness (Int) is imndicated on a scale of 1- 5)

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	**For**	**Graz**	**Recr**	**Int**	
ANGOLA								
Luiana Partial Reserve 8,400 km2 1966 1	Extensive plains drained by Kwando and Luiana rivers with marshes on main rivers. Burkea, Baikiaea and mopane woodlands Kalahari dune system	• Lion, cheetah, wild dog, leopard, hyaena • Red lechwe, puku, hippo sitatunga, elephant, buffalo, oribi, sable, roan, wildebeest • Wattled crane, slaty egret (?)	M	L	?	?	5	Civil war zone - mine fields Undeveloped, little recent data on status Refugees will return when minefields cleared
Mavinga Partial Reserve 5,950 km2 1966	Undulating plains with marshes on rivers, *Brachystegia bakerana* thickets, *Baikiaea-Burkea* woodlands and Kalahari dunes	• Lion, cheetah, wild dog, leopard, hyaena • Red lechwe, puku, hippo sitatunga, elephant, buffalo, oribi, sable, roan, wildebeest • Wattled crane, slaty egret (?)	H	L	?	?	5	Civil war zone - mine fields Undeveloped, little recent data on status Refugees will return when minefields cleared
Longa-Mavinga Coutada	No data – probably as above	•						No data – probably as above
Mucosso Coutada 25,000 km^2	No data – probably as above	•						No data – probably as above
Luengue Coutada 16,700 km2	No data – probably as above	•						No data – probably as above
Luiana Coutada Xxxx km^2	No data – probably as above	•						No data – probably as above
BOTSWANA								
Chobe National Park 9,980 km^2 GR in 1961 NP in 1968	Chobe River *Acacia* riparian, Mababe depression and pans along fossil rivers, Savuti Marsh, *Baikiaea* and *C. mopane* woodlands	• Highest density of elephants in Africa • Annual wildebeest-zebra migration • Lion, leopard, hyaena, wild dog, cheetah • Puku, red lechwe, sitatunga, buffalo • Slaty egret	M	M	M	H	3	High elephant density and loss of riparian habitat along the Chobe River High elephant and fire impacts in dry woodlands
Makgadikgadi Pan NP 4,140 km^2 GR in 1970 NP in ???	Large salt pan with halophytic grassy plains and palm trees (*H. vetnricosa*)	• Key breeding area for flamingoes and pelicans • Migration area for wildebeest and zebra • Lion, cheetah • Springbok, gemsbok • Palm nut vulture	H	-	-	L	2	Only western part of the pan in NP Fences restricting movement of zebra and wildebeest Lions and Human-Wildlife (H-WC) Conflict
Nxai Pan NP 2,590 km^2k	Fossil lake bed with 2 pans, halophytic grasslands and scattered islands of trees, with *Hyphaene ventricosa*	• Migratory area for wildebeest and zebra • Lion, cheetah, aardwolf • Giraffe	M	-	L	L	2	Fences constraining migrations Mian road Francistown to Maun (?fencing)

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	For	Graz	Recr	Int	
Moremi Game Reserve 1,800 km^2 Tribal GR declared 1962 Gazetted 1965	Part of Okavango delta with swamps and seasonal flood plains, mopane woodland on Chief's Island, *Acacia, Combretum* and *Terminalia* woodlands	• Red lechwe, sitatunga, hippo • Lion, leopard, hyaena, cheetah, wild dog • Slaty egret, wattled crane, Pel's fishing owl	H	M	M	H	3	High tourism pressure Elephant impacts on woodlands
Chobe Forest Reserve 2,400 km^2 1976	Swamps and flood plains along the Linyanti, *Baikiaea* woodlands	• Sable, hippo, buffalo • Lion, wild dog • White pelican	M	H	L	L	3	Fire and elephants, timber leases No tourist facilities? ? hunting blocks and quotas
Kazuma FR 128 km^2	*Baikiaea /Burkea* woodlands	No data not leased	-	H?	L	L	3?	No data
Kasane FR 1,200 km^2	*Baikiaea /Burkea* woodlands	No data not leased	-	H?	L	L	3?	No data
Sibuyu FR 1,010 km^2	*Baikiaea /Burkea* woodlands	No data – not leased in 2008	-	H?	L	L	3?	No data
Maikaelolo FR 300 km^2	*Baikiaea /Burkea* woodlands	No data - commercial non-hunting lease	-	H?	L	L	3?	No data
Okavango Delta ~ 13,800 km^2	Full range of wetland habitats with mopane woodlands on sandveld tongues projecting into the delta	• Red lechwe, sitatunga, hippo • Lion, leopard, hyaena, cheetah, wild dog • Slaty egret, wattled crane, Pel's fishing owl Important Bird Area	H	L	M	H	4	Possibility of over-development of tourism and resulting environmental impacts **Note**: it is difficult to separate the Delta from the Ngamiland WMA (see below) which is divided into some 43 blocks under a range of lease hold arrangements (See Fig. Xx)
Chobe WMA 2,436 km^2	Situated south-east of Chobe NP and a link between the NP and Sibuyu FR	No data – leased to commercial hunting concession						No data
Ngamiland WMA 25,800 km^2	Divided into three separate areas: a) the Swamps, b) the northern sector to Linyanti with mopane woodland and flooded grasslands and swamps on the Linyanti, c) the eastern sector , east of Moremi and north west of Nxai Pan NP of Terminalia savanna	Swamps: as indicated above under the Okavango Delta Northern sector: No data, probably as for the delta Eastern sector: no data	H	L	M	H	4	The WMA is divided into some 43 blocks that are leased out under a variety of lease arrangements (see also above under Okavango Delta

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	For	Graz	Recr	Int	
Central WMA 10,890	Situated south of Chobe District and between Ngamiland and the Zw border *Terminalia* savanna with *Baikiaea* woodlands in the east	No data, 3 blocks leased to commercial hunting (?) concessions.						No data
Makgadikgadi WMA 8,257 km^2	Covers much of Ntetwa and Sowa Pans Halophytic plains and palm trees	No data	H	-	L	L	?	Commercial salt extraction on Sowa pan?
NAMIBIA								
Bwabwata NP 5,715 km^2 1963 Caprivi GR 200? NP	Kalahari sands and ancient ergs (dunes) with Baikiaea – Burkea woodlands and shrublands and Okavango and Kwando Rivers with flood plains and aluval riparian woodlands on western and eastern boundaries respectively	• Red lechwe, hippo, sable, elephant • Includes an Important Bird Area	M	H	M	?	4	History of political unrest associated with Angolan civil war Former San homeland Dense settlement on eastern and western river boundaries
Mudumu NP 1010 km^2	Mainly *C. mopane – Burkea* woodland		L	L	M	?	3	No data
Mamili NP 319 km^2	Mainly dry grasslands of the Kwando-Linyanti							No data
Khaudom NP 3,841 km^2								No data
Caprivi Forest ?? km^2	*Baikiaea - Burkea* woodlands with sparse grass cover		-	L	L	?	2	Badly degraded woodlands as result of past logging and fires
Kwandu 190 km^2	Effective wildlife area = 46% Grasslands along the Kwando with *Acacia* riparian woodlands on alluvial terraces and *Baikiaea* woodlands away from the river							No data
Mayuni 151 km^2	Effective wildlife area = 46% Habitats as for Kwandu							No data
Mashi CC and extension 297 km^2 + 131 km^2	Effective wildlife area = 64% Habitats as for Kwandu but including mopane and *Burkea* woodlands							No data

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	For	Graz	Recr	Int	
Masida EC 380 km2 (from RBM)	Effective wildlife area = 65% Mopane – Burkea- Terminalia woodlands		-	M	M	L	2	No data
Balyerwa ECC ?? km^2	Dry grasslands and mopane woodlands							No data
Wuparo CC 148 km^2	Dry grasslands and mopane woodlands	No data						No data
Malengalenga ?? km^2	Dry grasslands and mopane woodlands	No data						No data
Salambala 930 km^2		No data						No data
Impalila ?? km^2		No data						No data
Bamumu ?? km^2		No data						No data
Lusese ?? km^2		No data						No data
Nakabolewa ?? km^2		No data						No data
Butabaja/Kapani 400 km2		No data						No data
ZAMBIA								
Kafue NP 22,400 km^2 1951 GR 1972 NP	Undulating plateau area with some hills, perennial swamp in NW, and floodplain areas along Kafue River. Mainly Miombo woodland with patches of *Cryptosepalum* forest	• Wild dog, lion, leopard, hyaena • Red lechwe, elephant, buffalo, (black rhino), yellow-backed duiker, Crayshaw's waterbuck • Wattled crane	M	H	L	M	4	Under resourced park management Itshe-teshe dam on the Kafue flooded about 300km^2 of the park Lusaka – Mongu main road bisects the park Wildlife populations low – poaching?
Sioma-Ngwezi NP 5,276 km^2 GR managed by Lozi Chief 1972 NP	Mosaic of woodlands and sandy plains – arid with few isolated waterholes. Baikiaea, Burkea, mopane woodlands	• Lion, cheetah, wild dog? • Sable, buffalo, giraffe, tsessebe,	M	M	L	L	2	Settlement, refugees, poaching, bush fires, teak extraction Minimal development but depeleted wildlife populations

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	For	Graz	Recr	Int	
Liuwa Plain NP 3,660 km^2 GR managed by Lozi Chief 1972 NP	Very flat, sandy, short grass plains with seasonally inundated areas and flood plain grasslands along rivers. Some Baikiaea and Burkea-mopane woodlands on edges	• Large seasonal wildebeest migration • Red lechwe, buffalo, Lichtenstein's hartebeest, tsessebe • Wattled crane, slaty egret	H	L	H	?	3	Uncontrolled fires, illegal fishing grazing of livestock, settlements within park No visitor facilities
Mosi-oa-Tunya NP 66 km^2 1972 NP	Miombo woodland and riparian fringe to Zambezi River	• Elephant, warthog, buffalo, zebra, roan, sable, Lichtenstein's hartebeest, • Leopard (White rhino)	-	M	M	H	2	Protection? Only 10 km2 totally protected (IUCN 1987 – 947)
Mulobezi GMA 3,420 km^2	Miombo woodlands	No data						No data
Sichifula GMA 3,600 km^2	Miombo woodlands	No data						No data
Bilili Springs GMA 3,080 km^2	Miombo woodlands	No data						No data
Namwala GMA 3,600 km^2	Miombo woodlands	No data	H	M	L	?	3?	No data
Mumbwa GMA 3,370 km^2	Miombo woodlands	No data						No data
Lunga-Luswishwi 13.340 km^2	Moist Miombo woodlands with extensive wetlands	No data						No data
Machiya-Fungulwe 1,530 km^2	Moist Miombo woodlands with extensive wetlands	No data						No data
Kasonso-Busanga 7,780 km^2	Moist Miombo woodlands with extensive wetlands	No data						No data
Mufunta GMA Xxx km2	Miombo woodlands	No data						A newly designated GMA on the western boundary of Kafue NP
West Zambezi (part) 38,000 km^2	Extensive wetlands, *Baikiaea* and miombo woodlands	No data						No data
Forest Areas?								

Area	**Landscapes & habitats**	**Key mammal and bird species / populations and endemics**	**Ecosystem services**					**Key conservation issues & conservation status**
			Wet	**For**	**Graz**	**Recr**	**Int**	
ZIMBABWE								
Hwange 14,651 km^2 1928 GR 1949 NP	Kalahari sands and dune fields in the southern and western 2/3^{rds} of the park (Baikiaea, Terminalia woodlands) and basalts with mopane woodlands in the NE. Southern sector drains into the Makgadikgadi basin, the north into the Zambezi	• Black and white rhino, wild dog • Lion, leopard, cheetah, hyaena, • Large elephant population • Roan, sable, buffalo, giraffe						Artificial waterholes Wild fires Poaching of black rhino (EPZ) Past logging, elephant impacts
Zambezi 564 km^2 1931 NP	Undulating Kalahari sands and Baikiaea woodlands with vleis, exposed basalt with mopane woodlands and riparian fringe along the Zambezi River – about 50 km of river front.	• Elephant hippo, buffalo, sable, roan (white rhino) • Lion, leopard, cheetah, hyaena, wild dog?						Riparian fringe on the Zambezi River heavily impacted by elephants
Victoria Falls 19 km^2 1931 NP	Includes the Victoria Falls and Zambezi River above the falls and the deep gorges below the falls. Small patch of rainforest	• Taita falcon						Visitor pressure Town planning and development in a World heritage site shared with Zambia
Kazuma Pan 313 km^2 1949 NP	Flat grassland plains on basalt clays with large seasonally inundated pans in the SW. Plains surrounded by mopane and miombo woodlands	• Oribi, gemsbok, roan, tsessebe • Cheetah						Fires?
Chizarira NP 1,910 km^2 1963 Game Reserve 1975 NP	Highly dissected plateau and escarpment overlooking the Zambezi Valley. Mainly miombo woodland with some mopane woodland and *Combretum* thickets in the Buzi valley	• (black rhino), elephant, buffalo, sable, Oribi? • Lion, leopard, hyaena, cheetah? Wild dog?						Heavily impacted by elephant and fire Poaching
Matusadona NP 1,370 km^2 Non-hunting reserve in 1958 NP 1975	On Kariba lake shore. Lowland area of mopane woodland and escarpment/highlands of miombo	• Depleted black rhino population • Lion, leopard, cheetah, hyaena, wild dog • Hippo,						Offshore commercial fishing Rhino poaching Elephant impacts and fire

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	For	Graz	Recr	Int	
Matetsi Safari Area 2,930 km^2 Previous ranching area purchased by Govt. 1973 1975 SA	*C mopane, Combretum on basalt soils and Baikiaea* woodlands on areas of Kalahari sand	• Sable, buffalo, elephant, • Lion, leopard, cheetah, hyaena, wild dog • Endemic frog and grass species	L	M	M	M	3	
Deka SA 510 km^2 1963 CHA 1975 SA	Mainly mopane woodlands on broken basalt terrain with *Commiphora-Combretum* thickets or *Terminalia* woodlands on sandy ridges.	Situated between Hwange NP and Matetsi SA and will include the range of species for these two areas	L	M	M	L	3	
Chirisa SA 1,713 km^2 1968 - Game Reserve in Communal Lands 1975 SA	Karroo forest sandstones and mudstones with miombo and mopane woodlands bisected by Sengwa river and with well developed alluvial communities at Sengwa-Lutope River junction.	• Elephant, buffalo, sable, (black rhino) • Lion, leopard, cheetah, hyaena, (wild dog)	L	M				Southern section of 374 km2 is the Sengwa Wildlife Research Area (1964) reserved for research until recently. Presently leased to a safari operator Intrusion of livestock Poaching and wild fires, HEC
Chete SA 1,081 km^2	Shallow soils on rugged Karroo sandstones of Zambezi escarpment – mainly stunted mopane and miombo woodlands. On Lake Kariba shore.							
Charara SA 1,700 km2	Steep escarpment slopes with Miombo woodland that grade into mopane woodlands and Combretum thickets in the valleys. Adjoins Lake Kariba							
Lake Kariba RP 2,830 km^2	Artificial impoundment established in 1961							
Sijarira Forest Area 256 km^2	Adjacent to lake Kariba and Chete Safari Area on very rugged and broken terrain – stunted mopane and miombo woodlands							Very limited potential for timber production
Kavira FR 282 km^2	On western end of Lake Kariba, limited indigenous timber resources on very rugged an broken terrain							Used mainly for safari hunting, angling and tourism by state forestry department

Area	Landscapes & habitats	Key mammal and bird species / populations and endemics	Ecosystem services					Key conservation issues & conservation status
			Wet	For	Graz	Recr	Int	
Mzola FR 627 km^2	Miombo woodlands on deep sands	No data	-	L	L	L	1	Wildlife eliminated during tsetse control operations Uncontrolled grazing and fuel wood harvesting
Ngamo FR 1,029 km^2	Kalahari sands and Baikiaea, Guibourtia, Pterocarpus woodlands, vleis	• Elephant, sable, roan, buffalo • Lion, leopard, hyaena, wild dog	-	M	L	L	3	
Sikumi FR 1,173 km^2	Kalahari sands and Baikiaea, Guibourtia, Pterocarpus woodlands with areas of miombo woodlands	• Elephant, sable, roan, buffalo • Lion, leopard, hyaena, wild dog	-	M	L	L	3	
Pand-Masuie FR 335 km^2	Kalahari sands and Baikiaea, Guibourtia, Pterocarpus woodlands with areas of miombo woodlands	As for Sikumi FR	-	M	L	L	2	Wildlife resources managed within the Matetsi SA complex
Fuller FR 233 km^2	Kalahari sands and Baikiaea, Guibourtia, Pterocarpus woodlands with areas of miombo woodlands	As for Sikumi FR	-	M	L	L	2	
Kazuma FR 240 km^2	Kalahari sands and Baikiaea, Guibourtia, Pterocarpus woodlands with areas of miombo woodlands	As for Sikumi FR	-	M	L	L	2	
Panda Masuie FR 335 km^2	Kalahari sands and Baikiaea, Guibourtia, Pterocarpus, Ricinodendron woodlands	As for Sikumi FR	-	M	L	L	2	
Gwaai Conservancy ??? km^2	No data							Area has been resettled and current status of habitat and wildlife not clear
Campfire Areas in Zimbabwe								
Hwange CL 3,975 km2								
Binga District Siabuwa CL 2,126 km2	Mainly rugged terrain with mopane woodland							
Manjolo CL 5,098 km2								

Area	**Landscapes & habitats**	**Key mammal and bird species / populations and endemics**	**Ecosystem services**					**Key conservation issues & conservation status**
			Wet	**For**	**Graz**	**Recr**	**Int**	
Busi CL 546 km2	Acacia riparian woodlands on the Busi River, Combretum thickets and grasslands on black cotton soils							
Kariba District Omay CL 2,866 km2								
Gatshe-Gatshe CL 140 km2								
Kanyati CL 625 km2								
Gokwe N District Gokwe North CL 2,669 km2								

Appendix 2. Terms of Reference

Large-scale conservation planning for resilience to Climate Change, threats to Wetlands and Ecosystem Services: Ranking of conservation priorities in the general Kavango-Zambezi Transfrontier Conservation Area

Location

The Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) is a five-nation conservation and development initiative committed to by Angola, Botswana, Namibia, Zambia and Zimbabwe, by way of a formal Memorandum of Understanding signed by the Ministers of Environment and Tourism of the five countries in December 2006. The TFCA is located in the general border areas of the five countries but reaching deep into adjoining areas.

Project Scale

The Kaza TFCA currently embraces 278,000km^2 but government officials associated with the project anticipate it to be expanded to 300,000km^2. The TFCA embraces about 36 current protected areas of various IUCN categories, connected by intervening pieces of other land uses. It includes the Okavango Delta and major parts of a number of important rivers such as the Kavango, Quito, Kwando, Linyanti, Chobe and Zambezi, which are critical for sustaining both wildlife and people; the portions of these rivers included in the TFCA are all in the upper (although in some cases not upmost) catchment areas…therefore critically important.

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Context of project

Protected Areas, in particular those making up Categories 1-6 of the IUCN classification, have historically been the most powerful tool available to conservationists for conserving biodiversity. However, Climate Change and other emerging threats have the very real potential to significantly transform such traditional ‘island’ pockets of land set aside in a surrounding mosaic of competing land uses, mostly agricultural land for food production for a human population expected to continue increasing to a peak around 2050.

New, larger scale approaches, as well as social initiatives, are therefore required to promote resilience in wildlife populations & communities facing the uncertain consequences of Climate Change. Most effective of these is likely to be the ‘meta-habitat’ approach, similar to conserving a network of low-density endangered species such as rhino, wild dogs and others by way of the ‘meta-population’ approach, done in a manner which integrates social imperatives.

The easiest and most immediate opportunities to conserve ecosystem resilience reside in current large scale Wilderness Areas, where viable habitat still exists for having a network of key areas which are linked by corridors, thus creating refuges and pathways whereby species and species-assemblages can disperse, survive and re-colonize in the event of catastrophic episodes such as mega-fires, disease epidemics, and the effects of war and plunder.

Overview of Proposed Study Area

At least 50% of the KAZA TFCA – mostly in Angola, Zambia and portions of Zimbabwe – overlaps with Miombo-Mopane High Biodiversity Wilderness Area. It embraces habitat for multiple species included in the IUCN Red Lists, such as black and white rhino, wild dog, sitatunga and various other antelopes, several cranes and other birds, and several amphibian and fish species which have distributions limited to the KAZA TFCA region. All these species have been impacted to varying degrees by an estimated 2 million rural people, most of whom practice subsistence livelihoods within the KAZA TFCA, and compete with wildlife for space and resources. Despite the often negative effects of this competitive interface, the TFCA hosts an extraordinary abundance and richness of biodiversity, as evidenced by the worlds largest single population of elephants anywhere in the world, estimated at around 250,000 (which brings its own problems and challenges due to grossly distorted distributions). It includes well-established and well visited tourism areas such as the Okavango Delta and Victoria Falls, as well as well-stocked and well-managed conservation areas such as Chobe National Park and Moremi Game Reserve.

However, the KAZA TFCA is not a homogeneous block of land, not in the distribution of wildlife, nor in wildlife management capacity, general governance capacity, legislation and policies, distribution of people, poverty, pressure on natural resources, water and other resource availability, and especially forms of land use. In particular, the designation of borders of the KAZA TFCA did not follow a rigorous scientific process of evaluating which areas should be included in the KAZA TFCA, and conservation prioritization. Instead it was a process of drawing a line which would capture the bulk of the key existing protected areas near the border areas of the five countries, thus producing a polygon with deep dips and arcs based on boundaries of current land use. This should therefore be viewed as a preliminary approximation of the core area of KAZA TFCA, but unless taken further it would preclude valuable opportunity to identify important buffer zones, catchment areas requiring protection, and key linkage opportunities. Governments are willing to undergo such a process of refinement, as evidenced not only by a recommendation in the "KAZA TFCA Pre-feasibility Study" wherein it is stated that prioritization and characterization of key areas would need to be done at a later stage, but also the current estimate that the KAZA TFCA is likely to expand from its present 278,000km^2 to around 300,000km^2.

Project Purpose and Objective

The KAZA TFCA currently comprises a mosaic of protected areas and intervening land of multiple use. These protected areas vary from big to small, from well-managed to completely unmanaged, from well-stocked to completely over-poached, from wetlands to grasslands to forests, from well-visited to completely unvisited, from having formal management plans to being mere paper parks with no management guidance, and the only common factor is that none of them have been prioritized in terms of their value and importance regarding key species, key habitats, key services, and key resources for human sustenance.

The *Purpose* of this project will therefore be to determine the relative importance of the existing protected areas in KAZA TFCA (and they may differ in terms of what they are important for…some will be for conserving globally threatened species, some for conserving key water-provisioning and other ecosystem services, some as key reservoirs for limited natural resources such as over-utilized hardwood timbers, and so on), and to identify shortfalls in the existing network of protected areas, and to define key corridors that will be essential to provide resilience and viability of populations and communities in the face of changing and often unpredictable pressures, to enable connections and linkages that will enable species to seek alternative rangelands and foraging areas in times of need, and in which nuclei of populations can persist to re-colonize other areas again in the event of catastrophic events.

The *Objective* of the study will be to provide conservation institutions with a scientifically-based guide to the key areas and corridors which require priority allocation of resources and management effort. At an anticipated 300,000km^2, and given the African priorities of poverty alleviation, HIV/AIDS and multiple other conflicting demands for limited resources, no government or NGO has the capacity to uniformly allocate time and funds and human resources to such a massive area…it is therefore important to identify where resources should be directed in a prioritized way.

Importantly, it will enable CI and other NGOs to determine where priority attention and interventions are required, and therefore provide the basis for establishing conservation partnerships to address these priorities and supplement resources.

Proposed Technical Approach
The proposed approach is to appoint an expert consultant to undertake, in sequence:

a. A desk-top study to characterize (size, biodiversity range and value, threatened species, scale of current and potential future threats, freshwater resources and relative importance, other ecosystem services and relative value, other key attributes) each of the protected areas throughout the KAZA TFCA,
b. To identify possible shortfalls in the protected area network in KAZA TFCA based on the need to effectively protect threatened species and natural resources or ecosystem services,
c. To develop an initial value ranking of the various protected areas in KAZA TFCA,
d. To identify logical and key corridors necessary to ensure long-term sustainability and viability of key biodiversity and ecosystem services areas,
e. To consult with appropriate persons knowledgeable on the subject and gain their input for the purpose of refining the ranking of key areas,
f. If requested to do so, to participate in a regional workshop to present the draft findings of the consultancy, for the purpose of final refinement of priority areas and to achieve common regional understanding of the "Big Picture" priorities in KAZA TFCA,
g. To produce full and effective documentation which will provide stakeholders with the necessary guidance and recommendations to implement a prioritized allocation of resources and attention.

CI will supervise this consultancy.

Expected Deliverables
A document which will provide key biodiversity attributes as well as freshwater and other ecosystem products and services for each of the key biodiversity areas in the general KAZA TFCA region, also identifying shortfalls in the protected area network, prioritizing such key biodiversity areas in terms of value and importance, and identifying key corridors for long-term maintenance of biodiversity and also ecosystem functioning, and making recommendations for prioritizing of resource allocation to ensure adequate protection of key priority habitats, resources and services, designed and presented in a way that will be usable by governments and NGOs.