Chief Scientist's Office

Friends for Life

New partners in support of protected areas

Edited by Jeffrey A. McNeely

IUCN
The World Conservation Union

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IUCN – The World Conservation Union
2005

This publication has been made possible in part by funding from GTZ-Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, GEF and UNEP.

Published by: IUCN, Gland, Switzerland and Cambridge, UK

IUCN
The World Conservation Union

Citation: Edited by McNeely, Jeffrey A. (2005). *Friends for Life: New partners in support of protected areas.* IUCN, Gland, Switzerland and Cambridge, UK. ix + 232pp.

ISBN-10: 2-8317-0834-6

ISBN-13: 978-2-8317-0834-8

Cover design by: McHale Ward Associates

Cover photos: © Jim Thorsell, Russell A. Mittermeier/Conservation International, Haroldo Castro/Conservation International, Thomas O. McShane (see inside back cover for details)

Layout by: McHale Ward Associates

Produced by: IUCN Publications Services Unit

Printed by: Thanet Press Ltd, Margate, UK

Available from: IUCN Publications Services Unit
219c Huntingdon Road, Cambridge CB3 0DL
United Kingdom
Tel: +44 1223 277894
Fax: +44 1223 277175
E-mail: books@iucn.org
www.iucn.org/bookstore

A catalogue of IUCN publications is also available.

The text of this book is printed on Fineblade Smooth 115gsm made from low chlorine pulp.

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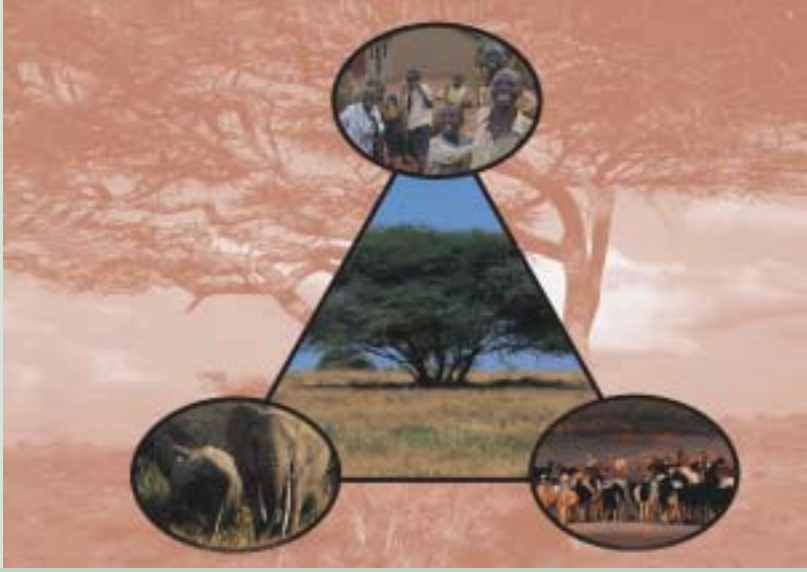

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Building support for protected areas using a "One Health" perspective

by Steven A. Osofsky, Richard A. Kock, Michael D. Kock, Gladys Kalema-Zikusoka, Richard Grahn, Tim Leyland and William B. Karesh

Editor's introduction

Issues affecting the interplay among wildlife health, the health of domestic animals, and human health are receiving inadequate attention from protected area managers. This chapter encourages an innovative framework, called the "One Health Paradigm," by taking a broad ecological definition of health that brings together many disciplines that too often have remained isolated from each other. This ecosystem approach to health issues is especially pertinent in the parts of the world where domestic animals often interact with the wild species of greatest interest to protected area managers. Steve Osofsky and his colleagues also provide a perspective on the many relationships between the health of wildlife and the health of people living in the often-remote areas adjacent to protected areas, where human health care is often in short supply. Building a more appropriate response to the problems of disease transmission across the interface between wildlife and domestic animals can also lead to improvements in the health status of the people living around protected areas, thereby building a more positive attitude towards the protected area and conservation authorities. This chapter also emphasises the highly dynamic relationship between people, domestic animals, and wildlife, calling for significant investments in training, monitoring and research in order to ensure a healthy outcome for all concerned. The elements in the "One Health" paradigm provide a solid basis for building support for protected areas from those living near them and those working on human and animal health.

Introduction

In 1933, Aldo Leopold observed that "the role of disease in wildlife conservation has probably been radically underestimated" (Leopold, 1933). Despite this recognition early in the 20th century, conservation efforts worldwide are still being hampered because of their failure to recognise the critical role that health plays in animal population dynamics, species survival, and follow-on impacts on the human condition. Improving the health of people and their domestic animals is not only a key step to raising living standards and improving livelihood security, it is the single most effective way to reduce the incidence of disease transmission to highly susceptible wildlife populations (WCS FVP, 2003c), including those that live within or utilize protected areas.

Throughout the world, domestic and wild animals are coming into ever more intimate contact. Without adequate scientific knowledge and planning, the consequences can be detrimental on one or both sides of the proverbial fence. But with the right mix of expertise armed with the tools that the animal health sciences provide, conservation and development objectives have a much greater chance of being realized, particularly at the critical wildlife/livestock interface where conservation and agricultural interests meet head-on.

Infectious diseases are increasingly being recognised as important "emerging issues" by health specialists, disease ecologists, conservation biologists, wildlife managers, and protected area planners (Meffe, 1999; Deem *et al*., 2002; Lafferty and Gerber, 2002; Aguirre *et al*., 2002; Daszak and Cunningham, 2002; Graczyk, 2002; WCS FVP, 2003b; Kalema-Zikusoka, 2005; World Parks Congress Outputs 2003; Osofsky *et al*., 2005). Examples of emerging diseases that have impacts on human health and biodiversity include:

- from 2001–2003 the Ebola virus killed dozens of people and wiped out hundreds of gorillas in central Africa (WCS FVP, 2003a) and remains of major concern;
- West Nile virus has afflicted a wide range of domestic and wild animals and people in North America (Marfin *et al*., 2001);
- bovine tuberculosis (BTB) is now known to occur in buffalo, lion, and a range of other species in Kruger National Park (Clifton-Hadley *et al*., 2001; Bengis, 2005; Michel, 2005);
- brucellosis is compromising bison populations in North America in terms of management implications (Bienen, 2002; Gillin *et al*., 2002); and
- foot and mouth disease outbreaks in southern Africa affect livestock and wildlife as well as land-use policies over vast areas (Thomson *et al*., 2003).

It is clear from these examples that the issues of health and disease need to be brought into the conservation mainstream (Osofsky *et al*., 2000; Deem *et al*., 2001; WCS FVP, 2003a).

Box 5.1

The *AHEAD* Initiative

The ***AHEAD*** (***A***nimal ***H***ealth for the ***E***nvironment ***A***nd ***D***evelopment) initiative, led by the Wildlife Conservation Society and partners, focuses on several themes of critical importance to the future of livestock, wildlife, and, of course, people: competition over grazing and water resources; disease mitigation; local and global food security; zoonoses (diseases transmitted between animals and people); and other potential sources of conflict related to the overall challenges of land-use planning and the pervasive reality of resource constraints. Prior to this initiative, neither non-governmental organizations, nor aid agencies, nor academia have holistically addressed the landscape-level nexus represented by the wildlife health/domestic animal health/human health triangle, especially as it relates to protected areas.
www.wcs-ahead.org

Impacts from interactions between livestock, wildlife and people (and habitat) are profound in many parts of the world. The issues at this interface represent an unfortunately all-too-often neglected sector of critical importance to the long-term ecological and sociopolitical security of protected areas and grazing lands worldwide. Whether the issue is the ongoing bovine tuberculosis crisis in and around South Africa's Kruger National Park, or Yellowstone

Village meeting, Zambia.

National Park's ongoing brucellosis saga costing U.S. authorities millions of dollars to manage, these issues merit more proactive attention than they have received to date. It is important to note that many of the diseases of concern to landscapes of conservation importance are essentially invasive alien species, and are either already negatively affecting biodiversity or have the potential to do so. As people and their domestic animals penetrate once pristine areas and expand their range and intensity of activities, the risk of transmitting serious diseases to wildlife increases significantly. Diseases of people, domestic animals and wildlife are now being recognised as an increasing challenge to biodiversity conservation, as well as to efforts to improve the quality of life for people. Although endemic (i.e., native) wildlife diseases play important ecological roles, human activities in many cases have disrupted ecosystems, leading to both gradual and catastrophic losses of wildlife populations. A "One Health" approach is not about interfering with nature – it is about trying to help systems already perturbed by pathogens that may or may not "belong" within them to re-establish a state wherein disease does not threaten vital conservation and development objectives. Many factors affecting health and the basic epidemiology of multi-host diseases are still poorly understood, and conservation and wildlife management decisions are often made without complete information. The critical edge – where the health of wildlife, domestic animals, and people meld together and are best addressed as "One Health" – exists at the borders of most protected areas of the world.

The "One Health" paradigm: some basic concepts

People and the natural resources from which they derive their livelihoods are integral parts of their given ecosystem – a dynamic complex of plant, animal and micro-organism communities and the nonliving environment interacting as a functional unit. The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being and not just the absence of disease and infirmity (Deem *et al*., 2001; Last, 1983), and this definition implies a link between human health and ecosystem integrity. Ecosystems provide vital services to human and animal communities, for example, by providing natural filtering systems, sources of food and fibre, and clean water (Rapport, 1998). Disruption of some of these natural services, these ecosystem "products," will have impacts on air, water, and other renewable resources and thus health.

The concept of "One Health" – the interface between human health and that of the environment – is not new. During the 1960s and 1970s visionary attempts were made to construct a bridge between, for example, medicine and agriculture. Discussions on medical ecology and zoology, animal monitors of the environment, and comparative biology and medicine were the precursors to a more holistic approach to animal and human health (Schwabe, 1974). This concept has been further developed through programmes such as Envirovet (Beasley, 1993) and the development of ecosystem health as an integrative science (Rapport *et al*., 1998).

The *AHEAD* approach fosters information sharing and consensus building among, for example, wildlife health scientists and rural livestock keepers.

The "One Health" concept takes *conservation medicine* a step further by broadening an ecological definition of health (Kock, 1996), while acknowledging that conservation medicine's primary goal is the pursuit of ecological health – the health of ecosystems and the species that live within these systems (Else and Pokras, 2002; Tabor, 2002). Conservation medicine attempts to bring together many disciplines, including human and public health, epidemiology, veterinary medicine, toxicology, ecology, and conservation biology (Meffe, 1999). Adopting an ecosystem approach to health issues related to protected areas and the communities that live close to or in these areas represents an attempt to bridge the gaps that exist between the different disciplines and create an enabling environment for expanding benefits to both protected areas and local people. Conservation medicine indeed encourages practitioners to look both upstream and downstream for potential environmental impacts of land uses and activities (Tabor, 2002). A "One Health" approach can be attractive to a broader constituency, as it can be viewed with equal clarity through a conservation, development, or public health lens. Powerful biomedical tools are fortunately available to address these complex issues and develop preventive approaches.

The state of health of an ecosystem can be judged by criteria very similar to those used for evaluating the health of a person or animal, namely, homeostasis (having balance between system components), absence of disease, diversity and complexity, stability and resiliency, and vigour and scope for growth. An ecosystem can be viewed as a patient (Rapport, 1998) and can be evaluated in terms of objective standards that relate to the system's capacity for organization, vigour, and resilience. Identification and diagnosis of problems and the application of solutions along with biodiversity assessment and monitoring represent a basic approach to ecosystem health care. In biomedical terms this would be achieved through detection, diagnostics, prognostics, treatment, and prevention. In the case of ecosystem health, the precautionary principle supports an approach based on the tenets of preventive medicine – anticipatory

action to protect the environment from possible or irreversible harm (Calver, 2000). The "ecosystem as patient" metaphor can also help shape our overall approach to conservation: "Critical clinical problems mandate a rigorous diagnostic plan, a multifaceted therapeutic plan, clear communication, and short- as well as long-term monitoring. Critical conservation problems deserve no less." (Osofsky, 1997). In addition, a *preventive* medicine approach allows for action to be taken with a causal relationship being reasonably suspected if not proven, thus lessening the risks of uncertainty.

The development of ecological indicators can yield powerful tools that can generate scientific information on the status or trends of important ecosystem health parameters (Sayre *et al*., 2000). In parallel, epidemiological tools such as disease surveillance and monitoring can be linked to various indicators in terms of disease and health trends. The use of indicators will help simplify data for decision makers, and provide a focal point for strategic planning, policy formulation, resource allocation, and specific management actions (Boyce, 2003).

The wildlife-livestock disease interface in Africa

The wildlife-livestock interface means different things to different people. The many facets of the interface, such as health, conservation, environment, culture, and economics, have been issues since livestock became an integral part of the landscape. The interface has positive and negative aspects and it has been a source of conflict in many areas, often as a result of misunderstanding and polarization of opinion between ecocentric and anthropocentric forces in society (Boyd *et al.*, 1999). Attention here is given to those elements relevant to the health of the large mammal communities in Africa, where it is urgent to find solutions to the problems of abject poverty, poor health status for people and animals, and threats to the environment and biodiversity.

In Africa's dry-land pastoral systems, livestock and people share resources with the most diverse array of wild ungulates on earth (R. Kock *et al*., 2002). With improvements in human health care, the population is growing exponentially but the economies of most countries are not keeping pace correspondingly. Poverty is both acute and widespread, with significant portions of the continent's people living on less than US$1 per day (FAO/UNEP/CGIAR, 2004). Communities are often food insecure, especially where land degradation is prevalent and social systems have broken down, which often happens during times of war or other unrest. Consequently, there is considerable international pressure to accelerate development and alleviate poverty (Thrupp and Megateli, 1999). With rapid economic development, environmental change and loss of biodiversity can be expected; indeed, this has been the experience in many countries, where one form of poverty is thus replaced by another.

Eighty percent of Africa's population is rural and 70 million people are wholly dependent on livestock with no alternative source of food or wealth (AU/IBAR, 2002). Yet Africa accounts for only 2% of the total value of world trade in livestock and livestock products and imports twice as much as it exports, with the net imports increasing at 4% per year (Thambi, 2003). The single most important constraint on the African livestock export trade is the "Sanitary and Phytosanitary Measures" of the World Trade Organization (WTO) (OIE, 2003). The status of endemic livestock disease(s) in many African countries limits exports of meat, serving as a barrier to trade that is a key concern of policy makers. However, the impact of these trade-sensitive diseases is minimal within Africa, especially among pastoral livestock and poor farmers (Perry *et al*., 2002). As the maintenance of these extensive livestock systems, and to some extent the close association between wildlife and livestock, is the main reason for the current disease status, pressure is building among certain political elements in Africa for changes that may threaten both traditional pastoral society and also wildlife resources (R. Kock *et al*., 2002). These WTO rules are set up by the developed nations, essentially in their own self-interest, and African nations have not been able to influence changes in these regulations to their own advantage (Thambi, 2003).

Some feel that the international community's desire to conserve Africa's wildlife as a global environmental

good underpins its reluctance to support livestock development based on the belief that livestock is a major factor in land degradation and loss of wildlife (Bourn and Blench, 1999). However, positive environmental benefits can be attributed to well-managed livestock systems as much as poor management can lead to negative impacts (Mace, 1991). Often, livestock are only part of the picture in terms of the trend towards a general fragmentation of habitats and disruption of natural ecosystems, including the disappearance of large mammal species across much of their historic range, increases in agriculture and settlement, and disruptions to traditional systems of transhumance and mobility. Recent studies have shown that pastoralists' strategies are optimal for sustaining communities and resources, and that they are a force in conserving the environment to the benefit of wild species (Roth, 1996; Scoones, 1994).

The improved understanding of the role of livestock in dry lands is accompanied by an increasing awareness of a new potential value of the wildlife resource through community-based management. Ecotourism and other forms of utilization (both consumptive and non-consumptive) are becoming increasingly important in the economies of at least some African countries (Chardonnet *et al*., 2002; Jansen *et al*., 1992; Cumming and Bond, 1991). To further support this, studies of mixed systems indicate considerable environmental benefits as well as economic ones in some settings (Western, 1994). It can be argued that one of Africa's main advantages (perhaps the only one in economic terms) over the rest of the world is its extensive and diverse wildlife resource, which is so attractive to tourists. This is not to say that livestock are not important on the continent but, to put it into context, Chile and Argentina taken together currently have a larger livestock industry than all the countries of Africa combined (FAO, 2003). So to sacrifice wildlife in favour of developing a competitive commercial livestock sector has little justification, but to develop both wildlife and livestock resources together (not necessarily defaulting to one or the other exclusively) is a key to efficient utilization of available resources.

Given the economic benefits of wildlife, health issues are an increasing concern in this field especially where epidemics and chronic disease problems occur as a result of *introduced* (alien) disease. A review of the co-existence of livestock and wildlife (Bourn and Blench, 1999) reported that wildlife disease was not a constraint, but lack of information on diseases in the field makes this a risky conclusion. Other studies have found that disease can

Plains zebra, southern Africa.

adversely affect wild animal population dynamics in the short and long term (Hudson and Dobson, 1989; Rodwell *et al*., 2001; Jolles, 2003; Lankester, 2003; Hwang, 2003) and increases the risk of the extinction of rare species (Andanje, 2002). The initial impacts of exotic disease can be devastating and depress population growth for decades (Mack, 1970; Plowright, 1982; Kock *et al*., 1999); conversely, control or eradication of these pathogens can lead to dramatic recovery of populations (Sinclair, 1970). The more subtle effects of disease are to make the population more susceptible to other impacts, such as predation, and effectively depress numbers well below limitations related to food resource available (Joly, 2003). The decision on what to accept as a natural or an acceptable disease dynamic within a biological system may well in the end be a value judgement, but in terms of resource use, consumptive or otherwise, depressed populations will limit the options.

The emergence of wildlife and livestock disease in many parts of the world is partly a result of the expansion of human and livestock populations into wildlife areas, with dramatically disturbed habitats and novel interactions, but may also reflect increased awareness and monitoring of diseases. The trend towards establishing larger and more integrated wildlife systems is also evident in Africa, e.g., through transfrontier parks (Gelderblom *et al*., 1996) and extension of wildlife management areas into communities, conservancies, and wildlife corridors (IIED, 1994; Hulme and Murphree, 1999). Clearly, conserving wildlife requires a more integrated approach that will incur costs. These initiatives will inevitably be a compromise with other land use practices, and will result in complex disease phenomena (Rosenzweig, 2003) that will need novel solutions and interventions – ideally proactive ones. This is the contemporary challenge to the veterinary community, disease biologists, development specialists, and protected area managers alike. It is vital that the interests of livestock keepers living around protected areas are taken into account in the management of the wider wildlife systems.

Conditions have changed significantly over the past century, with many examples of transcontinental disease introductions (rinderpest, BTB) causing persistent problems in wildlife and livestock populations. The wild species had not been exposed to these agents for millennia, so no co-evolution of host and disease agent had developed, with serious and persistent consequences (Bengis *et al*., 2002; de Lisle *et al*., 2002). Besides these initial introductions of major diseases through importation of livestock to the continent, the co-existence of people and their livestock with wildlife is not governed by "natural" mechanisms; at best they are only partially integrated, especially in pastoral systems when contact may occur seasonally or only in drought years. Thus endemism of disease organisms is disturbed and this is another reason the interface deserves close attention.

Countries where extensive wildlife populations are integrated with pastoral systems have no possibility of effective separation. In these locations the proposed solution is the creation of small export zones from which wildlife is excluded. Effectively, this means the creation of 'protected areas' for livestock, where foot and mouth disease, for example, can be controlled. This approach could resolve the conflict and provide the opportunity for commercial livestock development without much affecting the important wildlife resources in these parts of Africa. This would also support the culture and traditions of pastoral peoples. The concept does not exclude the opportunity for links between pastoral communities and the export zones, although a system of quarantine and the mechanisms for this would need to be explored. A fundamental issue relates to product quality and market preferences, and it will be interesting to see if some improved penetration into markets can be achieved for range or pastoral cattle (Thomson *et al*., 2004). As the loss of key grazing resources has been a factor in the decline of pastoralism, this potential reconnection with mainstream livestock economics and what would amount to fattening areas could strengthen the overall livestock economy and reduce pressure on protected areas, which are frequently used for this purpose. This will also enable traditional peoples to benefit from a mixed-species system and develop wildlife-related livelihoods in addition to their livestock, while bypassing the veterinary restrictions that have been a constraint to market access.

The "One Health" paradigm and protected areas

In balancing the needs and expectations of Africa's rural inhabitants with those of wildlife conservationists, including protected area managers, it is necessary to consider how disease interactions influence human, livestock, and wildlife health (WCS, FVP, 2003a, 2003b; Kalema-Zikusoka, 2005; Kock, 2005b; Bengis, 2005) while keeping in mind that the role of wildlife health in conservation goes beyond the presence or absence of disease (Mainka, 2001; Deem *et al*., 2001). Wildlife health, in the broadest sense, is a holistic concept with a focus on populations and the environments in which they live. This focus must of course include human populations and livelihood needs, especially at the wildlife-livestock interface. While some caution is merited to prevent making too simplistic a linkage between "ecosystem health" and "human health," potentially at the expense of wildlife and conservation funding (Osofsky *et al*., 2000), it is clear that a paradigm shift in Africa is needed. Health is the key linkage that can contribute to human well-being and, therefore, serve as a logical entry point to promote environmental stewardship and healthy ecosystems (Margoluis *et al*., 2001).

In many instances, both historically and currently in Africa (Kock *et al*., 2002), disease control methods that have been adopted by veterinary and health authorities have been drastic, have had a significant negative impact on ecosystem health and biodiversity, and have rarely considered the broader issues surrounding and influencing health. Classic disease control methods include vaccination, test and slaughter, blanket slaughter, vector control, and movement controls including fencing. Many of these require "out-of-the-box" thinking by traditional veterinary and animal health authorities, including the promotion and legalization of community-based animal health systems. The indiscriminate use of fencing to control disease transmission between livestock and wildlife without considering connectivity and vital linkages between ecosystems is an example of a cause for concern (Albertson, 1998; Keene-Young, 1999; Scott Wilson and EDG, 2000; Thomson *et al*., 2003; Kock *et al*., 2002; Martin, 2005).

Historically, African protected areas have been managed without due concern for the communities that live nearby. This "hard edge" approach has done little to foster support for conservation and environmental issues and this legacy can be seen in the lukewarm response that the wildlife industry receives from politicians and other decision makers in many parts of postcolonial Africa (Kock, 2005a). In southern Africa, the adoption of community-based approaches to resource management, such as CAMPFIRE (Communal Areas Management Program For Indigenous Resources) in Zimbabwe, softened the hard edge and allowed communities to benefit from protected areas, be they national parks, game reserves, safari areas, or private conservation initiatives (Child, 1995). Other Community-Based Natural Resource Management (CBNRM) programmes continue to be developed and evaluated

Oxcart, Zambia.

in East and southern Africa (Murphree, 2000; DFID, 2002; Weaver and Skyer, 2005; Murphree, 2005; Lewis, 2005) including the DFID-funded Mpomiba project with 19 villages close to the Ruaha National Park in Tanzania and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)-funded project with forty villages adjacent to the Selous Game Reserve. In Namibia, the National Community Wildlife Conservancy Programme has led to the registration of significant numbers of community-owned conservancies, many of which have entered into joint ventures with the private sector.

In general, pastoralist communities are likely to perceive the main CBNRM benefits to be the managed and more sustainable cropping of bush meat; increased revenues gained from consumptive tourism (hunting) and nonconsumptive tourism (wildlife viewing), or enterprise and employment opportunities in the tourism sector; as well as access to grazing and water resources for their own animals. Indirect gains come from investments in wildlife-related tourism, which lead to improved infrastructure such as roads, water mains, electricity and communications.

To ensure that these protected areas are able to provide the resource base for these benefits to communities, addressing disease issues should be an integral part of protected area planning and management and should involve veterinary and other health authorities. This is crucial as the impact of emerging and resurging diseases on the health of people, their livestock, and wildlife is likely to constrain the maintenance and development of protected areas and compromise conservation initiatives into the future. The potential for spread of bovine tuberculosis from Kruger National Park to surrounding human communities (Michel, 2005) is a case in point. In the 21st century, management of protected areas needs to go beyond just concern for improved relationships with communities through benefits such as cash returns related to CBNRM. It must consider the health of the overall ecosystem, including people, their livestock, and the flora and fauna that are part of the larger community.

Box 5.2

Transboundary management of natural resources and the importance of a "One Health" approach

The transboundary management of natural resources, particularly of water and wildlife, and the associated development of transfrontier conservation areas (TFCAs) has been a major focus of attention over the last few years in southern Africa. Twenty potential and existing TFCAs have been identified in the Southern African Development Community (SADC) region, involving 12 continental African member states. The TFCAs include many national parks, neighbouring game reserves, hunting areas and conservancies, mostly occurring within a matrix of land under traditional communal tenure. Altogether the proposed TFCAs cover about 120 million hectares.

Transboundary natural resource management and TFCA development have also been closely linked to emerging Spatial Development Initiatives (SDIs) and corridors within southern Africa. A key economic driver linking these conservation and infrastructure development initiatives is wildlife-based tourism that seeks to maximize returns from marginal lands in a sector where southern Africa enjoys a global comparative advantage. However, the management of wildlife and livestock diseases within the envisaged larger transboundary landscapes remains unresolved and an issue of major concern to other economic sectors in the region. The interactions at the interface between animal health, ecosystem services, and human health and well-being are also poorly understood, with the result that policy development is compromised by a lack of appropriate information and understanding of the complex systems and issues involved.

Whatever the potential of wildlife-based tourism to generate wealth in such areas, the current reality is that small-scale agro-pastoralists living in the adjacent communal lands depend greatly on livestock for their livelihoods. The need to balance their livelihoods and environmental security with the development of alternative land uses and opportunities gives rise to a very

Box 5.2 (cont.)

complex set of development issues. A central focus of these issues, and one that provides a unifying theme across sectors and disciplines, is that of animal, human and environmental health – "One Health". Innovative and integrated approaches to disease and natural resource management based on sound knowledge and understanding are urgently needed. An integrated, interdisciplinary approach offers the most promising route forward in tackling these issues.

With the ongoing philosophical and practical expansion of the transfrontier conservation area concept, the needs of communities living in and near these areas must be addressed, as transfrontier conservation areas have the potential to have both positive as well as negative impacts on sustainable livelihoods. In particular, disease issues are a significant concern when contact between wild animals and domestic stock increases with changes in land-use patterns. Corridors themselves, designed to (re)connect protected areas, can serve not only as biological bridges for wildlife, but also for vectors and their pathogens – so thorough assessments of disease risks should be made *before* areas with potentially different pathogen or parasite loads are joined.

Livestock will remain critically important culturally and economically – and of course as a vital source of sustenance – in much of the region. However, when it comes to animal health programmes and policies in transboundary landscapes, where domestic as well as wild animals have opportunities to cross international borders, making the right decisions becomes even more critical.

There is probably no region on earth where animal health policies have had as tangible an effect upon the biotic landscape as in Africa. In many parts of the world, land-use choices are often driven by government (domestic and/or foreign) incentives or subsidies that can favour unsustainable agricultural practices over more ecologically sound resource management schemes. And the most obvious beneficiaries of more holistic management are small landholders and pastoralists: people who derive much of their subsistence directly from livestock, people who are almost always marginalized in African economies and political systems.

Wildlife and livestock disease issues will likely have a significant impact on the future development of sustainable land uses, transboundary natural resource management, biodiversity conservation, and human livelihoods in the marginal lands of southern Africa. Some 65% of southern Africa is semi-arid to arid where extensive livestock and wildlife production systems are the most suitable and potentially sustainable forms of land use. The need to arrest desertification and enhance the capacity of these marginal areas to generate wealth and sustain improved human livelihoods is of paramount importance to the region. There does not appear to be an existing formal policy on animal health and disease control for the TFCAs being developed, and this must be addressed sooner rather than later.

Source: Adapted from Cumming *et al.*, 2004 and Osofsky *et al.*, 2005.

Protected areas, human livelihoods, and healthy animals: how to improve conservation and development interventions

Disease is becoming increasingly recognised as a threat to wildlife conservation, especially for endangered species (Werikhe *et al*., 1998). The relative risk is often increased by diseases that can be transmitted between closely related species, such as people and primates or cattle and buffalo. Transmission of such diseases at the interface of protected areas with human settlements can be exacerbated by mixing of people, wildlife, and domestic animals, for example, when wild animals leave the park boundaries, when domestic animals graze illegally within the park (Bengis *et al*., 2002), and when tourists, researchers, and field staff enter protected areas to view primates (Macfie, 1992; Woodford *et al*., 2002).

Protected areas and diseases

Disease transmission is of particular concern for local communities around protected areas, which in developing countries tend to be surrounded by some of the poorest of the population (Balmford and Whitten, 2003). Problem animals threaten these people's lives and property (Karanth and Madhusudan, 2002), in some cases reducing the value of land around protected areas. In Uganda, with a gross domestic product (GDP) per capita-purchasing power parity of $1200 (CIA, 2003), those community and rural settings have very limited basic health care because most people have no transportation and live at least 30km from the nearest health centre (Ministry of Planning and Economic Development, 1997; Homsey, 1999). This marginalized group also has very little access to information on zoonotic disease prevention because very little content has been developed for local education (Grant, 2002). Even when people manage to get to health centres, many centres are not adequately equipped to diagnose and treat diseases. This has resulted in a persistence of preventable diseases such as tuberculosis (TB) and scabies that can be transmitted between people, wildlife, and domestic animals.

Although there are relatively few documented cases of disease transmission between people and wild primates, the number of cases of suspected disease transmission is growing. A disease for which transmission from primates to people has been proven is Ebola, from a chimpanzee in Cote d'Ivoire (Formenty *et al*., 1999) and, more recently, in outbreaks involving western lowland gorillas and chimpanzees (Leroy *et al*., 2004). The origins of HIV in chimpanzees are of course now well-known (Gao *et al*., 1999).

Chimpanzee.

Diseases that have reportedly been transmitted between domestic cattle and Cape buffalo *(Syncerus caffer)* in Africa include BTB (Woodford, 1982; De Vos *et al*., 2001), rinderpest (Plowright, 1968; Kock, 1999), and foot and mouth disease (Dawe *et al*., 1994; Chilonda *et al*., 1999; Sutmoller *et al*., 2000). Examples of disease transmission between species that are only distantly related include mongooses (*Mungos mungo*) in Botswana and suricates (*Suricata suricatta*) in South Africa that have contracted human TB (*Mycobacterium tuberculosis*) from rubbish heaps outside tourist lodges visited by someone with a chronic cough (Alexander *et al*., 2002). A particularly dramatic example of disease transmission from people to wildlife is the outbreak of scabies – a skin affliction caused by mites – affecting mountain gorillas in southwestern Uganda's Bwindi Impenetrable National Park (BINP) in 1996 (Kalema-Zikusoka *et al*., 2002). This outbreak is thought to have been associated with scabies in the local human community.

Box 5.3

Case Study – Mountain Gorillas in Bwindi and the Virungas

Mountain gorillas and people are very closely related and are therefore potentially at risk of transmitting pathogens to each other (Ott-Joslin, 1993; Wallis and Rick, 1999). Approximately 300 of the estimated 655 mountain gorillas (*Gorilla gorilla beringei*) live in the 33,100ha of Uganda's Bwindi Impenetrable National Park (BINP). A small forest remnant in Sarambwe, Democratic Republic of Congo (DRC), is contiguous with BINP. The remaining individuals of this highly endangered species are found in Rwanda, DRC and Mgahinga National Park in Uganda (McNeilage *et al*., 2001). The area surrounding Bwindi and the Virungas has one of the densest human populations in Africa, with an estimated 200–300 people per km^2 (UWA, 2001). The establishment of BINP in 1991 restricted people's access to the forest to controlled activities such as tourism and research, while allowing multiple-use access for products such as medicinal plants, basket-weaving materials, and honey (UWA, 2001).

Bwindi gorillas have close contact with tourists and researchers (Macfie, 1992) and with local farmers when crop raiding (Madden, 1998) or foraging on community land. In addition to receiving inadequate health services and information, the local communities lack hygienic amenities such as clean water and pit latrines (Ministry of Planning and Economic Development, 1997; Homsey, 1999). These factors have resulted in a large percentage of people suffering from preventable diseases that can spread to gorillas. These include scabies, diarrhoeal diseases, measles, and TB (WHO, 2002). TB is exacerbated by a greater than 35% co-infection with HIV/AIDS (Kibuga, 2001) of which Uganda, Rwanda, and DRC are among the highest prevalence nations in the world (Castro, 1995) and are among the 22 countries contributing to 80% of the global TB burden (WHO, 2002).

Uganda Wildlife Authority (UWA), a national conservation authority, has developed an ecotourism programme in BINP. Sustainable ecotourism is dependent on maintaining gorilla health, improving the welfare of local communities through tourism, and promoting the national economy. The welfare of local communities in BINP has been improved through tourism revenue (via sharing of funds), development of income-generating activities (selling crafts, food, and lodging), and employment in restaurants and lodging facilities (Kamugisha *et al*., 1997; Ratter, 1997). The national economy is enhanced by the funds generated by mountain gorilla tourism, which amount to up to 50% of the overall income of the Uganda National Park System in some years (McNeilage *et al*., 2001). However, successful management of gorilla health is undermined by an unhealthy buffer zone surrounding the gorilla habitat. According to the district medical personnel surrounding BINP, the most commonly treated diseases in people are malaria, respiratory tract infections, diarrhoeal diseases, scabies, ringworm, intestinal parasites, tropical ulcers, and eye infections, including river blindness (Robert Sajjabi and Benon Nkomejo, personal communication, 2001).

The first reported scabies outbreak in mountain gorillas occurred in 1996 in a tourist-habituated group of four gorillas adjacent to the Buhoma tourist site in BINP (Kalema-Zikusoka *et al*., 2002). The source of the scabies was never determined, although people were suspected for two reasons: scabies is common in the local communities; and the gorillas' severe reaction to the disease indicated a lack of prior exposure to this mite from a closely related host. Four years later, a scabies outbreak occurred in another group of gorillas being habituated for tourism in Nteko parish, also in BINP, resulting in morbidity of some of the group. They, too, recovered with ivermectin treatment (Graczyk *et al*., 2001). While the ivermectin treatment was successful, interventions addressing the public health situation around BINP were needed to prevent further outbreaks. In early to mid-2000, UWA conducted health education workshops with local communities to improve the situation. Over 1000 people in five of 19 parishes

Box 5.3 (cont.)

surrounding BINP participated in the community outreach, which included eight villages. During these participatory rural appraisal workshops, the team presented lectures in the local language to introduce diseases common in the BINP area that can be transmitted between gorillas and people. Prevention strategies were also discussed.

Protected area managers were initially concerned that the local community would believe the park authorities valued gorillas more than people. However, those communities that had directly benefited from the creation of the national park were actually very receptive to these ideas, and gave more recommendations than those communities that had received fewer benefits from the creation of Bwindi Impenetrable National Park. Recommendations from the communities were divided into three categories: medical, non-medical, and hygiene. Responsibility for implementation of improved practices was shared among government and local communities.

Having a multidisciplinary team of community conservation, wildlife health, human health, and education personnel appears to have been helpful. Additionally, the target communities seem to realize that healthy gorillas can generate income to support villages, which have already become trading centres as a result of ecotourism. Encouragingly, communities that received conservation education appear to have a greater understanding of the need to protect mountain gorillas both for conservation and a sustainable income (Kalema-Zikusoka *et al*., 2001). By contrast, one community in DRC that had received very little conservation education and virtually no tourism or gorilla research benefits did not trust the participatory rural appraisal team enough to admit that they had seen gorillas.

Silverback Gorilla.

Health education appears to be a conservation tool that can bring the public health, wildlife conservation, and ecotourism sectors together. Local communities that received mountain gorilla ecotourism benefits recognised that they could protect mountain gorillas from human diseases by doing things like digging better pit latrines and covering rubbish heaps. However, some recommendations were beyond the communities' control, such as improving access to better health services or safer water. The lack of access to clean water not only contributes to a range of gastro-intestinal illnesses but also undermines efforts to control scabies, as the mites survive on dirty clothes that can be handled by curious wild animals, such as mountain gorillas (Fossey, 1983).

Improving conservation and development interventions

An integrated approach to controlling disease transmission between wildlife, people and domestic animals in a given area needs to be developed by a full range of stakeholders. This could start with dialogue among the affected communities and professionals from the wildlife, human health, veterinary, agriculture, education, media, and communication technology sectors, and could lead to sharing of knowledge using print, radio broadcasts, video, CD-ROM, handheld computers, databases, or the internet to play a supportive role in improving education and enhancing access to health information and services (Grant, 2002).

Multidisciplinary teams from these sectors could be established to carry out joint education, health training, and research programmes while helping to maximize the use of limited resources. Close collaboration among governments, non-governmental organizations, the private sector, universities, and schools is needed to develop effective and efficient programmes, focusing specifically on interrelated human and animal diseases such as (for example) TB, scabies, brucellosis, rabies, Ebola, avian influenza, West Nile virus and HIV/AIDS. Local involvement in designing these programmes is crucial for long-term success. These grassroots programmes would benefit from input from all key stakeholders to ensure that the materials developed would be relevant to the local situation and available in local languages. Participatory rural appraisal techniques can also help to promote local community ownership of the recommendations put forward.

Joint training programmes could involve medical and veterinary technicians carrying out laboratory work together; and could help wildlife personnel, veterinarians, medical doctors, and other health workers to carry out integrated education campaigns on interrelated wildlife conservation and public health issues. In addition to promoting collaboration, local community involvement could be encouraged through "training of trainers" to educate others.

Research on interrelated wildlife conservation and public health issues should be encouraged to increase understanding of these links, and results should be shared with policy makers. Such research could help to identify the most common diseases that pose a threat to public health, wildlife conservation, animal agriculture, and ecotourism in a given area. Other research studies could help to evaluate local community attitudes and behaviour that facilitate disease transmission at the interface. Because public health is dependent on people's behaviour, evaluation of programmes integrating wildlife conservation and public health should focus on how people's behaviour is changing (or not) over time. Studies to determine how poor wildlife conservation and public health practices are affecting socio-economic development would be useful. Furthermore, research could explore models for sustainability for integrated conservation and public health programmes.

Kenyan children.

Developing "multiple use" health care and diagnostic services and facilities can potentially be more effective in preventing diseases that spread between people, domestic animals, and wildlife because information can be shared more easily. Sharing facilities and services could also save costs. Many places with wildlife have poorly developed infrastructure and few resources for transporting needed goods to the population. Tour operators and wildlife managers with access to good vehicles could help by transporting free medication, such as TB medication (WHO, 2002), to the people who need it. Such a programme has been carried out via the Healthy Community Initiative of the Kayapo Health Project in Brazil, where researchers bring malaria medication to people residing next to the forest (Margoluis *et al*., 2001). Joint domestic and wild animal laboratories at the interface of protected areas and human settlements could help to facilitate information sharing and better control of disease outbreaks, as could functional community-based animal health systems made up of trained community members, under the supervision of veterinarians, who can provide services to the animals of fellow community members as well as assist in disease surveillance.

Finally, an integrated approach to wildlife conservation and public health can maximize the limited resources available to control disease transmission between wildlife, people and domestic animals at the interface. Funds from wildlife conservation could be allocated to public health, where it directly affects conservation, such as the case of scabies in the Bwindi mountain gorillas. Similarly, donor funds earmarked for health improvement could be allocated to wildlife conservation where it directly affects public health, such as the situation of people contracting Ebola from eating gorillas or chimpanzees (Leroy *et al*., 2004). Beyond reducing the risks of disease transmission across the human-wildlife-domestic animal interface, a favourable outcome of improving the health status of local communities living around protected areas and of the domestic animals on which they depend is the potential to cultivate a more positive attitude towards wildlife conservation and public health. Developing new constituencies for conservation, especially local ones, is certainly worthwhile.

Conclusions

Disease is becoming an important issue in conflicts between protected area authorities and adjacent communities. These frequently poor communities increasingly perceive wildlife negatively, especially where they have no stake in the management or use of that wildlife resource. Under these circumstances disease outbreaks can trigger conflict, and historically, politics have dictated that interventions by public health and (agriculturally oriented) state veterinary services take priority: this usually has negative impacts on the wildlife resource. On the other hand, those same poor communities and livestock are seen as a threat to many protected areas as they compete with wildlife for resources and also because of a history of disease introductions. This situation is counterproductive for all concerned and cannot lead to better decisions being made for healthier ecosystems or human environments.

To reduce this conflict, as well as the risks and impacts of disease, in particular at the interface between wildlife and livestock but also at the interface with people, a "One Health" approach is required. Public education, training and awareness-raising regarding human, domestic animal, and wildlife health issues are crucial. In addition, more research on land-use and disease management at the interface is needed, as are new philosophies, attitudes, and approaches to livelihoods and resource use. New practical measures, such as multiple-use diagnostic centres, should be introduced in order to improve both animal and human health. This will be beneficial to community development and biodiversity conservation alike.

By raising the profile of the management, development, and research implications of the impacts of infectious diseases on the ecological and socio-political security of protected areas, especially in (but not by any means limited to) Africa, this chapter has sought to sensitize the reader to the critical importance of these issues. As socio-economic progress demands sustained improvements in health for people, their domestic animals, and the environment, the value of moving towards a "One Health" perspective is hopefully clear.

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