Transboundary Management of Natural Resources and the Importance of a "One Health" Approach

Perspectives on Southern Africa

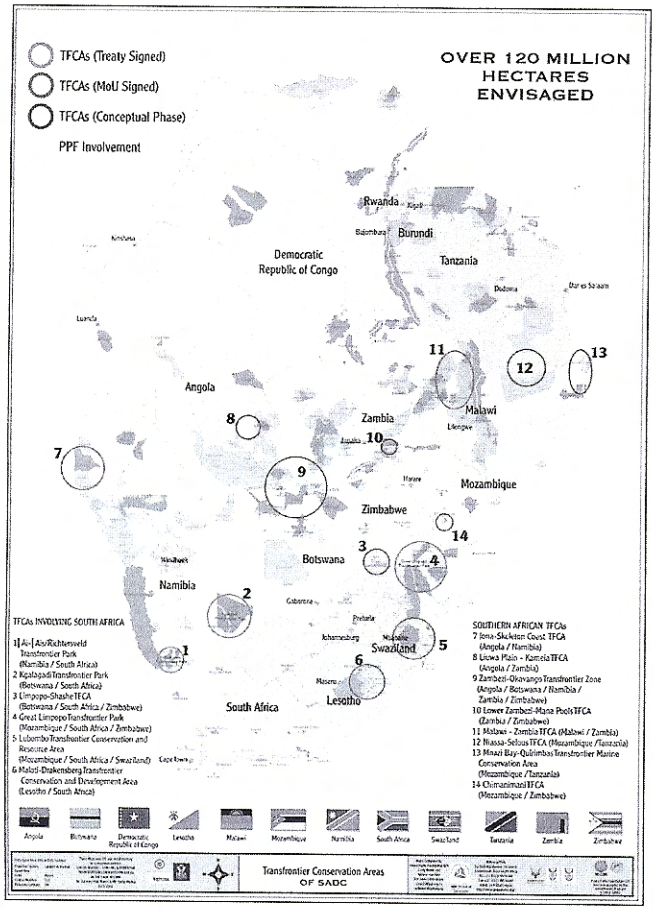
STEVEN A. OSOFSKY, DAVID H. M. CUMMING, AND MICHAEL D. KOCK

With the recent rapid growth in global tourism, the transboundary management of natural resources, particularly of water and wildlife, and the associated development of transfrontier parks and transfrontier conservation areas (TFCAs) has become a major focus of attention in southern Africa. At least 13 potential and existing terrestrial transfrontier parks and transfrontier conservation areas (also known as transboundary conservation areas) have been identified in the Southern African Development Community (SADC) region.[1] As opposed to the more discrete transfrontier parks, TFCAs often include national parks, neighboring game reserves, hunting areas, and conservancies embedded within a matrix of land under traditional communal tenure.

STEVEN A. OSOFSKY joined the Wildlife Conservation Society's Field Veterinary Program in 2002 as the Society's first senior policy adviser for wildlife health and serves as an adjunct assistant professor at the University of Maryland. He was the first wildlife veterinary officer for the Botswana Department of Wildlife and National Parks, and a Science and Diplomacy Fellow of the American Association for the Advancement of Science serving as a Biodiversity Program Specialist at the United States Agency for International Development.

DAVID H. M. CUMMING has been working in wildlife research and conservation in southern Africa since the 1960s. He is an honorary professor at the Percy FitzPatrick Institute, University of Cape Town, a research associate at the University of Zimbabwe, and a consultant to conservation and development nongovernmental organizations, including to the Wildlife Conservation Society and the AHEAD program.

MICHAEL D. KOCK joined the Wildlife Conservation Society's Field Veterinary Program in 2003. He is a veterinarian who works as a conservation practitioner, with a particular interest in the issues of ecosystems and wildlife, and their relationships to human health and well-being.



Source: Peace Parks Foundation.

Figure 1. Terrestrial Transfrontier Conservation Areas (TFCAs) of the Southern African Development Community (SADC).

Altogether, the existing and proposed transfrontier parks and TFCAs cover more than 460,000 square miles (1,200,000 km^2), just shy of the area of Texas, California, and New York combined (see Figure 1). A dominant component of the TFCA vision is the reestablishment of transboundary movement and migrations of wildlife within and between larger landscapes. A key economic driver linking these conservation and infrastructure development initiatives is nature-based tourism[2] that seeks to maximize returns from marginal lands in a sector where southern Africa enjoys a global comparative advantage. Nature-based tourism (photographic, trophy hunting, etc.) now contributes about as much to the gross domestic product of southern Africa as agriculture, forestry, and fisheries combined.[3] However, the management of wildlife and livestock diseases (including zoonoses—diseases transmissible between animals and people) within the envisaged larger transboundary landscapes remains unresolved and an emerging issue of major concern to livestock production, associated export markets and other sectors, including public health, in the region.

One could argue that fencing that has separated wildlife and livestock, cutting back on disease transmission, has in many ways been the "simplest" approach to minimizing problems at this interface. But extensive cordon fencing, essentially a subsidy from governments (southern African and donor) historically favoring livestock agriculture as a primary land use, is far from ecologically benign. With fencing cutting-off key migratory pathways that wildlife had used for eons in times of thirst and hunger, real costs have been imposed upon the natural resources sector in many parts of the SADC region. Thus conservationists are excited about the possibility of more land under wildlife, and of expanded benefits-sharing and economic opportunity sustainably linked to sound stewardship of biodiversity. But this excitement is admittedly tempered by the recognition that much remains unknown. Proponents of TFCAs must thus proceed with caution, and perhaps humility, in the face of ecosystems and processes that are not fully understood.

Realities of the Wildlife–Livestock–Human Interface

Whatever the potential of wildlife-based tourism to generate wealth in areas zoned primarily for free-ranging wildlife, the current reality is that small-scale agropastoralists living in the adjacent communal lands depend greatly on livestock for their livelihoods, as of course do many rural people in sub-Saharan Africa. The need to balance their livelihoods and environmental security with

the development of alternative land uses and opportunities gives rise to a very 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." The concept of "One Health"—with a focus on the interface between human health and that of the environment—is not new.[4] During the 1960s and 1970s visionary attempts were made to construct a bridge between, for example, medicine and agriculture.[5] Innovative applications of these interdisciplinary concepts to disease and natural resource management are now urgently needed in the TFCA context, as TFCAs have the potential to have positive as well as negative impacts on sustainable livelihoods.

Land use and tenure in southern Africa continue to be closely linked to livestock interests and disease-control efforts associated with the standards required for international (and highly subsidized) beef exports.

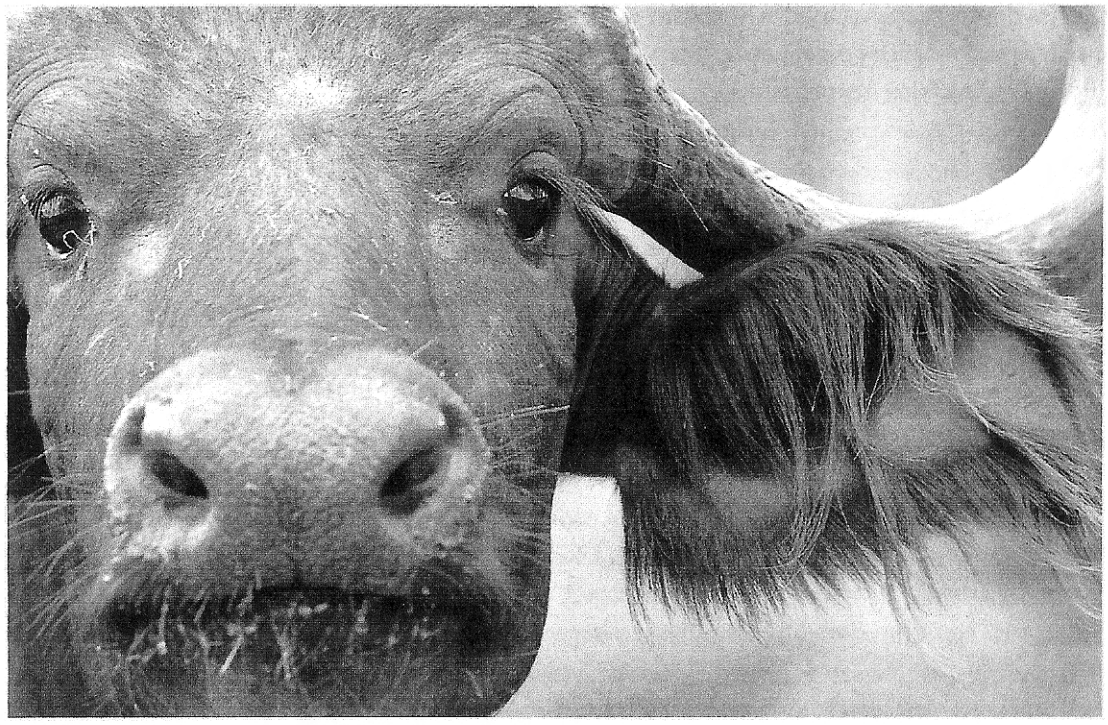
A Historical Perspective

The history of human relationships with wild and domestic animals in southern Africa is of course a long one. Livestock arrived in southern Africa between 2,000 and 1,500 years ago from East Africa and were present in the Limpopo Valley, an area shared among Zimbabwe, Mozambique, and South Africa, from about AD 600. Archaeological findings demonstrate that domestic livestock were present alongside wildlife within the area for at least 1,000 years before the introduction of alien/exotic livestock diseases approximately 150 years ago via European cattle.[6]

To this day, land use and tenure in southern Africa continue to be closely linked to livestock interests[7] and disease-control efforts associated with the standards required for international (and highly subsidized) beef exports—largely to Europe. Since the late 1950s, *disease control* has often meant fences to keep wildlife (particularly African buffalo) separated from livestock because of concerns about diseases like foot-and-mouth disease (FMD). A virus, FMD is among the most commercially important livestock diseases worldwide. It is important to note that FMD is associated with high morbidity yet low mortality (i.e., many susceptible animals may experience transient illness, but relatively few die), with most of its effects being related to trade restrictions and other secondary impacts. In other words, a small subsistence cattle farmer not dependent on export markets is certainly inconvenienced by FMD and its transient impacts on livestock productivity, but a variety of common diseases (such

By the Numbers

About half of southern Africa's 47 million cattle are under threat from transboundary animal diseases, despite improvements in regional surveillance and management.



Source: Michael D. Kock.

As carriers of diseases such as foot-and-mouth, African buffalo (*Syncerus caffer*) play a crucial role at the interface between wildlife health, livestock health, and human livelihoods.

as those carried by local ticks, for example) are more likely to affect his livelihood. FMD's impacts are more of an issue for commercially oriented livestock producers, as fears of the virus lead importing countries to close their markets to exporters from areas experiencing FMD.

Getting Off the Fence

Thus, the disease control (cordon) fences criss-crossing much of southern Africa run for thousands of kilometers—with major impacts on wildlife populations.[8] This is an important image as we start to think seriously about reconnecting wildlife areas across international boundaries. Since the 1950s, there is probably no region on Earth where animal health policies have had as tangible an effect upon the biotic landscape as in Africa, where land-use choices are often driven by perverse (domestic and/or foreign) incentives or subsidies that reinforce unsustainable agricultural practices instead of favoring more ecologically sound resource management schemes. This trend has been strengthened by the donor community, with pro-poor development portfolios often emphasizing livestock to the point of excluding wildlife-related options that could be components of a more balanced approach to risk diversification.[9] African nations, no longer able to subsidize the commercial agriculture sector with fences and extensive veterinary services (something colonial governments and later foreign aid had often enabled), should logically benefit from a more sustainable approach to land stewardship and the wildlife–livestock–human interface, as would small-holders and

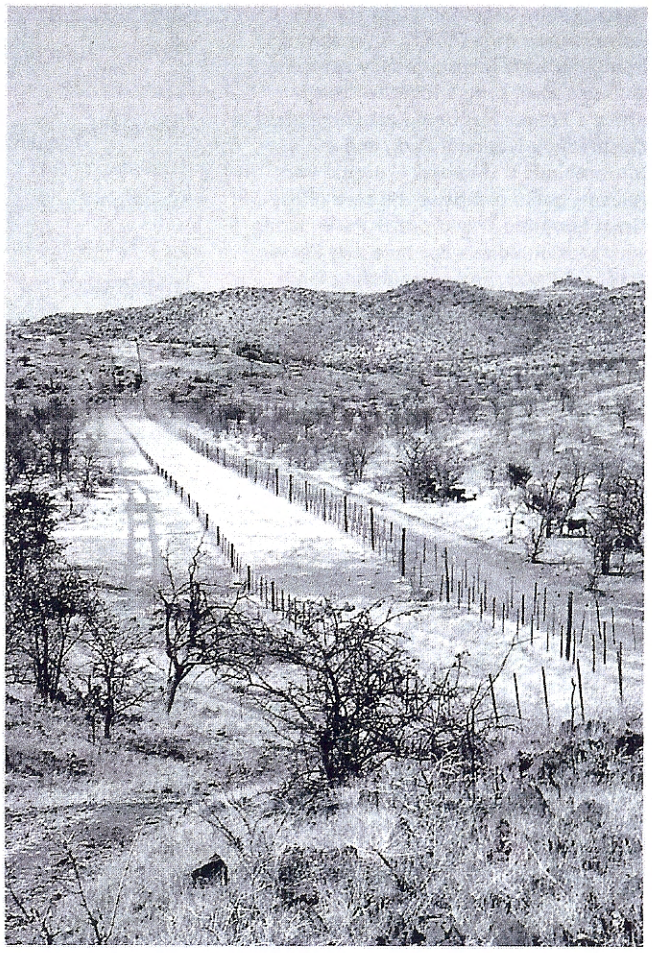
pastoralists: people who derive much of their subsistence directly from livestock as well as natural resources.

Wildlife and livestock diseases, including those that can directly affect people, will likely continue to have a significant impact on the development of sustainable land uses, transboundary natural resource management, biodiversity conservation, and human livelihoods in the marginal lands of southern Africa (see Figure 2).

Case Study: The Great Limpopo Transfrontier Conservation Area

The presidents of Mozambique, South Africa, and Zimbabwe signed the international treaty establishing the Great Limpopo Transfrontier Park in December 2002. Agreement has been reached on creating a TFCA that encompasses the Great Limpopo Transfrontier Park and the intervening matrix of conservancies and wildlife ranches on private land, together with the communal farming areas. The precise boundaries of this vast TFCA (approximately 39,000 square miles or 100,000 km^2—almost the size of the state of Virginia) are not yet completely defined, but the primary land use is expected to be wildlife-based tourism with reasonably unimpeded movement of wildlife and tourists.

The Great Limpopo TFCA encompasses several land-



Source: Michael D. Kock.

Cordon fences such as this one in northern Namibia separate wildlife and livestock as part of national and regional disease control efforts.

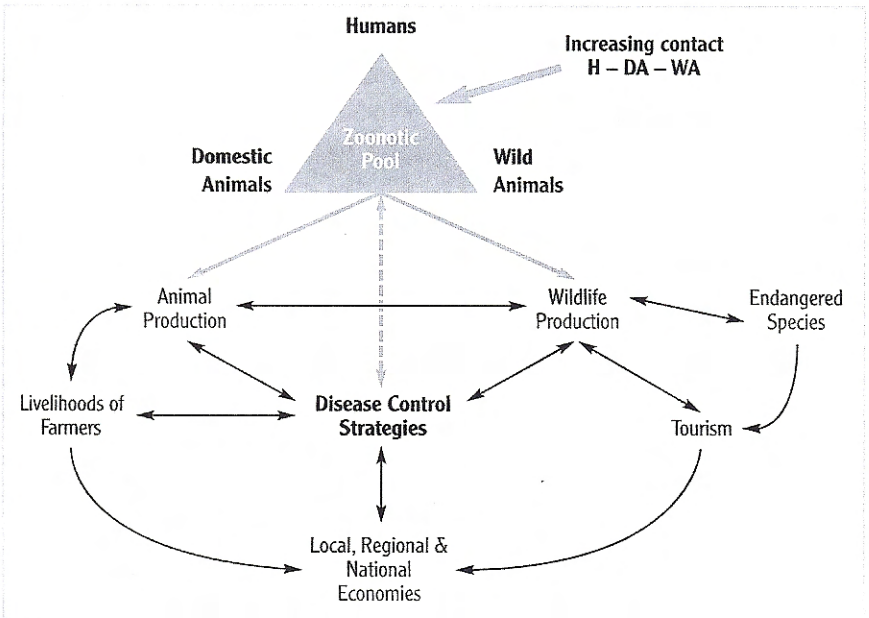
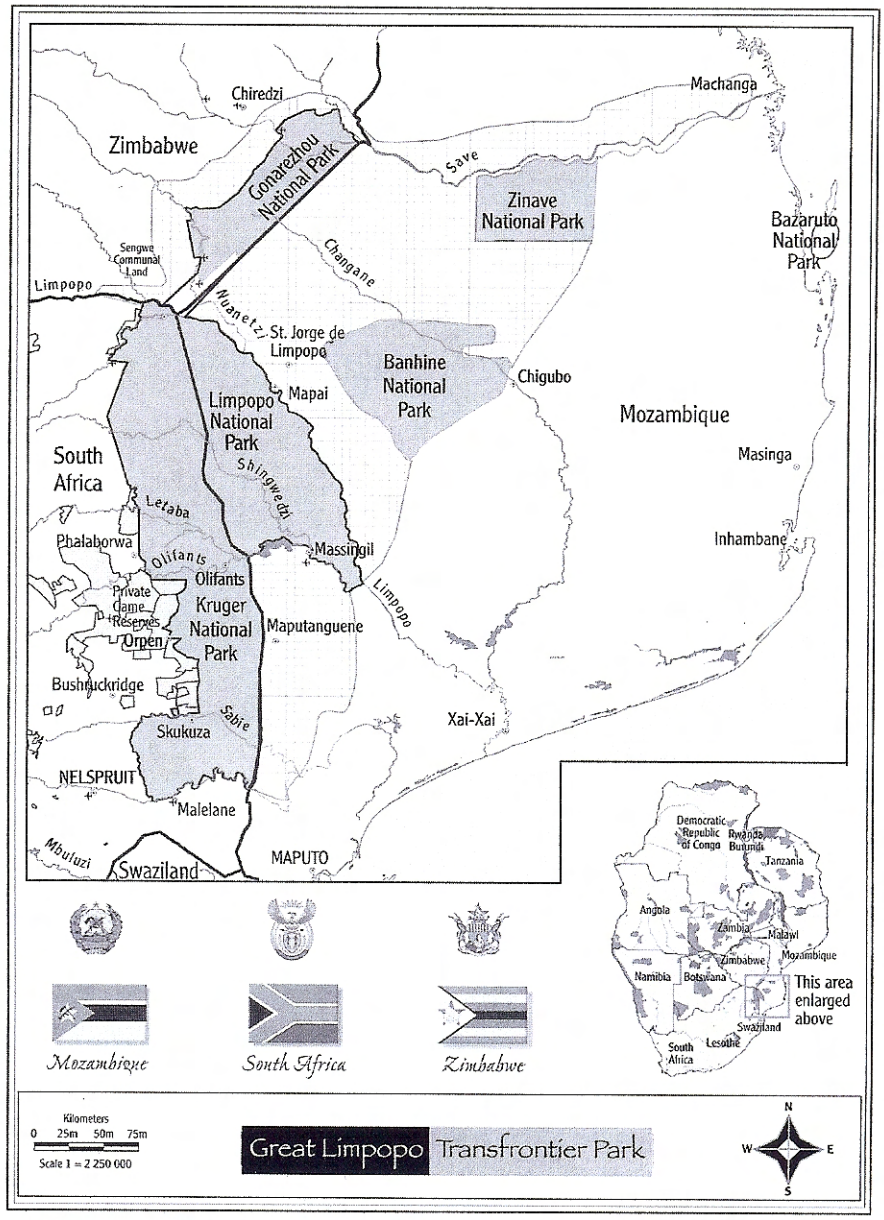


Figure 2. Conceptual diagram of the linkages among the diseases of wild animals (WA), domestic animals (DA), and humans (H), and the potential implications of disease control strategies for livelihoods, economies at various scales, and conservation.



Source: Peace Parks Foundation.

Figure 3. The Great Limpopo Transfrontier Conservation Area (GLTFCA), resulting from a recently internationally agreed land-use plan, brings together South Africa's Kruger National Park, Zimbabwe's Gonarezhou National Park, and Mozambique's Limpopo National Park (these 3 parks comprise the core of the Great Limpopo Transfrontier Park), along with Mozambique's Banhine and Zinave National Parks, and surrounding lands. The core area involved is almost 14,000 square miles (36,000 km²), with the broader GLTFCA matrix covering approximately 39,000 square miles (100,000 km²).

use/land-tenure regimes, including five national parks, state and private safari and hunting areas, conservancies and game ranches on private land, small-scale agropastoral farming areas under communal tenure, large-scale commercial irrigation schemes, and smaller irrigation schemes within the communal areas (see Figure 3). About 35 percent of the area comprises state protected areas and a further approximately 10 percent is private land under wildlife. Most of the remaining land, the matrix between the designated national parks, is under communal tenure with varying forms of small-scale agropastoralism.

The extraordinary conservation and economic opportunities represented by this transboundary concept are matched in magnitude by the management chal-

lenges such a land-use complex poses—not the least of which relates to the management of biologically and economically important diseases contagious between wildlife and livestock and, for some pathogens, people. The control and containment of livestock diseases have, in the past, relied heavily on fences and the control of domestic and wild animal movements and translocations. The prospect of removing barriers to wildlife and livestock movement therefore has major implications for animal health and disease control strategies within the Great Limpopo TFCA and will likely have broader implications for livestock disease control, livestock production, and export market access for the three countries involved.

Priority Animal Diseases in the Great Limpopo Transfrontier Conservation Area

Some of the animal health issues of greatest concern in the Great Limpopo TFCA include the following:

- The breakdown of controls for FMD related to ongoing political and economic chaos in Zimbabwe and the virus's spread (including novel strains of FMD) within the southeastern sector of the country.
- Evidence of a return of the tsetse fly to the Save-Rundi junction area of the Gonarezhou National Park in Zimbabwe. The southern expansion of the tsetse fly and trypanosomiasis is thus of concern, again, because official tsetse control programs in Zimbabwe have essentially collapsed. Apart from information on the control of tsetse flies during the 1970s, and some recent information on the spread of the fly, little published information is available on animal health and diseases in the Mozambique sector of the TFCA, although that is gradually changing. Trypanosomiasis here affects cattle and can affect some wildlife species such as white rhinos (*Ceratotherium simum*)—but fortunately not people (although human trypanosomiasis is an issue in more northern reaches of the SADC region). South Africa's Kruger National Park has not seen trypanosomiasis since 1903 and, with the largest white rhino population on Earth—doesn't want to see a resurgence of this disease.
- The northward spread of bovine tuberculosis (a zoonosis) across the entirety of Kruger National Park,[10] with buffalo and other species involved. Its possible entry into Zimbabwe and its status in Mozambique are of great concern.

It is critical to remember from history that many of the diseases affecting the Great Limpopo ecosystem are essentially alien invasive species, and are either already negatively impacting biodiversity or have the potential to do so. Today, bovine tuberculosis is found across South Africa's Kruger National Park but as yet has not been thoroughly studied in the wildlife of Zimbabwe's Gonarezhou

National Park. It has not been found in a preliminary survey of cattle in the intervening Sengwe Communal Land to the north of the Limpopo River, nor via initial wildlife and livestock disease surveillance in and around Mozambique's Limpopo National Park. Although hard data on the incidence of zoonotic diseases in Great Limpopo TFCA communities are largely unavailable, the high incidence of HIV/AIDS in the region increases the threat posed by zoonoses like bovine tuberculosis. Rabies is a serious public health problem in Mozambique's portion of the Great Limpopo TFCA (vaccination and stray dog control are inadequate, and children often suffer the consequences) but had never been reported in Kruger until 2006, when a side-striped jackal in the north of the park represented the first reported case, thought to be related to a deteriorating domestic dog rabies situation across the border in Zimbabwe. Canine distemper has not yet threatened the wild carnivores of the region.

Because the basic premise of the GLTFCA vision is reconnecting the various wildlife areas in this landscape, it is imperative not to allow any wildlife corridors we create to inadvertently become biological bridges for dangerous pathogens to utilize to travel to new areas where they can exploit naïve wildlife, as well as the livestock and people nearby—depending on the specific disease agent. This issue is not about interfering with nature—it is about the importance of trying to help a system already perturbed by diseases that in many cases don't belong there to reestablish a state wherein disease does not threaten vital conservation and development objectives.

Health as a Logical Entry Point for Conservation and Development Efforts

As in the Great Limpopo example, addressing disease challenges at the wildlife–livestock–human interface is critical to successfully facilitating wildlife as a socioculturally acceptable and economically rational land-use choice. If local people—whose very livelihoods are often closely linked to livestock-keeping at the household level—see expanding contact with wildlife as a threat to the health of their animals, or even to their own health in the case of zoonotic diseases, what hope do we have for building strong local constituencies for conservation, something the last several decades have hopefully taught us is sorely needed for sustained success?[11] Education and outreach efforts are critical in the face of disease threats that involve or are believed to involve wildlife: we ignore local perceptions at the peril of our conservation mission.

Addressing human health concerns in the context of our work should not be seen as diminishing the importance of critical conservation issues, but rather can actually be utilized to reinforce the value of maintaining biodiversity and the importance of respecting wildlife and wild places.[12] Done thoughtfully, linking human health with wildlife and environmental health can enhance the relevance of nature to a much broader constituency. Similarly, livestock disease

control issues must be addressed within a broader environmental context that considers not only biodiversity conservation but, as importantly, the long-term provision of key environmental goods and services that the improvement of human livelihoods depends on.

Cross-Sectoral Approaches Critical

Too frequently, decisions focused on single resources have had multiple adverse resource and economic consequences. Examples include the control of foot-and-mouth disease via game fencing to support a subsidized beef export market in Botswana and the control of tsetse fly in the Zambezi Valley in Zimbabwe. In Botswana, inappropriately sited FMD fences decimated major wildlife populations[13] and preempted many sustainable wildlife tourism options. In Zimbabwe, subsistence farmers rapidly migrated into marginal areas cleared of tsetse fly where they overwhelmed the indigenous culture, displaced a rich wildlife resource, and developed an area that now depends on food aid in most years.[14] Tackling disease and designing pest control schemes within a framework of environmental and social impact assessments, coupled with the use of science-based epidemiological approaches, would contribute to more integrated and sustainable interventions. Utilizing extensive fences to control transboundary livestock diseases like contagious bovine pleuropneumonia, which does not actually involve wildlife at all, undermines potential options for other land uses that might rival livestock in terms of productivity per unit area and sustainability, particularly the types of land uses envisioned for TFCAs.

If those of us whose mandate is biodiversity conservation do not proactively address the threats that the politically and economically powerful livestock sector associates (rightly or wrongly) with wildlife and disease, our vision for protected areas (and TFCAs) in many parts of the world will likely fail. And if our job is to help make wildlife conservation a socioculturally acceptable and economically rational land-use choice, then leveling the playing field by identifying perverse incentives that support environmentally unsustainable agricultural practices becomes a critically important strategy. Southern African TFCAs may provide some excellent models within which to study and mitigate the pressures from and responses to the real political and socioeconomic tensions between biodiversity conservation and livestock agriculture (both commercial and smallholder) in the broader region. Given the economic importance and political clout of the livestock sector in much of southern Africa, proponents of biodiversity conservation ignore the livestock sector's concerns (and the policy constructs largely put in place at that sector's behest) at their own risk.

Recognizing and addressing issues emerging at an intensifying wildlife–livestock–human interface will be of critical importance to successful biodiversity conservation (as well as to public health and agribiosecurity). Conservation and development donors have been learning, over time, that biodiversity con-

servation does not occur in a vacuum but, rather, needs to be undertaken within a complex socioeconomic matrix that must be (1) recognized and (2) understood, not disregarded if said matrix does not fit with preconceived notions of how biodiversity's future can be secured. We all must continue to learn from disciplines with which we may not have communicated well (if at all) historically, and we must consciously work to break down sectoral barriers and the walls each discipline's technical language and vocabulary help to reinforce. Can the donor community, steeped in the traditions of monosectoral approaches, also make this integrative leap? We believe it can, but it will require a broadening of perspectives, an openness to ideas that, although potentially unfamiliar to many, are grounded in sound biomedical and ecological principles.

While challenges at the wildlife–livestock–human health interface are perhaps amplified by the scale and inherent complexity of TFCAs, these challenges are not unique to TFCAs or even new. These same issues of course impact conservation and development initiatives at a range of scales. Whether we are looking at a large, complex international land-use matrix such as a TFCA or at a small, isolated protected area surrounded by human-dominated activities, these issues simply merit more attention than either the conservation or development communities have given them to date. With a healthy respect for the complexity of the social-ecological systems we care about and adequate resources to fill key gaps in knowledge, a successful "One Health" approach in southern Africa and beyond is certainly within our grasp.

4. S. R. Ostfeld and F. Keesing, "Biodiversity and Disease Risk: The Case of Lyme Disease," *Conservation Biology* 14 (2000): 722–28.

5. K. A. Schmidt and R. S. Ostfeld, "Biodiversity and the Dilution Effect in Disease Ecology," *Ecology* 82 (2001): 609–19.

6. Food and Agriculture Organization of the United Nations, *Global Forest Resources Assessment 2005*, FAO Forestry Paper 147 (Rome: FAO, 2006).

7. M. Coluzzi, "Malaria and the Afrotropical Ecosystems: Impact of Man-Made Environmental Changes," *Parassitologia* 36 (1994): 223–27; W. P. Tadei et al., "Ecologic Observations on Anopheline Vectors of Malaria in the Brazilian Amazon," *American Journal of Tropical Medicine and Hygiene* 59 (1998): 325–35.

8. A. Prüss-Üstün and C. Corvalan, *Preventing Disease through Healthy Environment: Towards an Estimate of the Environmental Burden of Disease* (Geneva: WHO, 2006).

9. J. D. Zulueta, "Malaria and Ecosystems: From Prehistory to Posteradication," *Parassitologia* 36 (1994): 7–15.

10. W. G. Downs and C. S. Pittendrigh, "Bromeliad Malaria in Trinidad, British West Indies," *American Journal of Tropical Medicine and Hygiene* 26 (1946): 47–66.

11. N. Minakawa et al., "Spatial Distribution of Anopheline Larval Habitats in Western Kenyan Highlands: Effects of Land Cover Types and Topography," *American Journal of Tropical Medicine and Hygiene* 73 (2005): 157–65.

12. N. Tuno et al., "Survivorship of *Anopheles gambiae sensu stricto* (Diptera: Culicidae) Larvae in Western Kenya Highland Forest," *Journal of Medical Entomology* 42, no. 3 (2005): 270–77.

13. G. Calderon et al., "Especies de la fauna anofelina, su distribucion y algunas consideraciones sobre su abundancia e infectividad en el Peru," *Revista Peruana de Entomologia* 8 (1995): 5–23.

14. M. M. Povoa et al., "Malaria Vectors, Epidemiology, and the Re-emergence of *Anopheles darlingi* in Belem, Para, Brazil," *Journal of Medical Entomology* 40 (2003): 379–86.

15. A. Y. Vittor et al., "The Effect of Deforestation on the Human-Biting Rate of *Anopheles darlingi*, the Primary Vector of Falciparum Malaria in the Peruvian Amazon," *American Journal of Tropical Medicine and Hygiene* 74 (2006): 3–11.

16. M. C. De Castro et al., "Malaria Risk on the Amazon Frontier," *Proceedings of the National Academy of Sciences of the United States of America* 103 (2006): 2452–57.

17. B. Matthys et al., "Urban Agricultural Land Use and Characterization of Mosquito Larval Habitats in a Medium-Sized Town of Côte d'Ivoire," *Journal of Vector Ecology* 30, no. 2 (2006): 319–33.

18. J. A. Omumbo et al., "Modelling Malaria Risk in East Africa at High-Spatial Resolution," *Tropical Medicine and International Health* 10 (6) 2005: 557–66.; J. A. Patz and J. M. Balbus, "Methods for Assessing Public Health Vulnerability to Global Climate Change," *Climate Research* 6, no. 2 (1996): 113–25.

Transboundary Management of Natural Resources and the Importance of a "One Health" Approach: Perspectives on Southern Africa by Steven A. Osofsky, David H. M. Cumming, and Michael D. Kock

1. SADC consists of Angola, Botswana, the Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe.

2. E. Koch et al., "SDIs, Tourism-led Growth and the Empowerment of Local Communities in South Africa," *Development Southern Africa* 15 (1998): 809–26.

3. R. Biggs et al., *Nature Supporting People: The Southern African Millennium Ecosystem Assessment, Integrated Report* (Pretoria, South Africa: Council for Scientific and Industrial Research, 2004).

4. S. A. Osofsky et al., "Building Support for Protected Areas Using a 'One Health' Perspective," in *Friends for Life: New Partners in Support of Protected Areas*, ed. J. A. McNeely, 65–79 (Gland, Switzerland and Cambridge, UK: IUCN, 2005).

5. C. W. Schwabe, *Veterinary Medicine and Human Health* (Baltimore, Maryland: Williams & Wilkins, 1969).

6. D. H. M. Cumming and *AHEAD*-GLTFCA Working Group, 2004. "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 Transfrontier Conservation Area," www.wcs-ahead.org/workinggrps_limpopo.html (accessed August 10, 2006).

7. I. R. Phimister, "Meat Monopolies: Beef Cattle in Southern Rhodesia, 1890–1938," *Journal of African History* 19 (1978): 391–414; S. Milton, "The Transvaal Beef Frontier: Environment, Markets and the Ideology of Development, 1902–1942," in *Ecology and Empire: Environmental History of Settler Societies*, ed. T. Griffiths and L. Robin, 199–212 (Edinburgh, UK and University of Natal, Pietermaritzburg, South Africa: Keele University Press, 1997).

8. R. D. Taylor and R. B. Martin, "Effects of Veterinary Fences on Wildlife Conservation in Zimbabwe," *Environmental Management* 11 (1987): 327–34.

9. D. Bourn and R. Blench, eds., *Can Livestock and Wildlife Co-Exist? An Interdisciplinary Approach* (London: Overseas Development Institute and The Environment Research Group Oxford, 1999).

10. T. C. Rodwell et al., "Prevalence of Bovine Tuberculosis in African Buffalo at Kruger National Park," *Journal of Wildlife Diseases* 37 (2001): 258–64.

11. S. A. Osofsky et al., eds., *Conservation and Development Interventions at the Wildlife/Livestock Interface: Implications for Wildlife, Livestock and Human Health* (Gland, Switzerland and Cambridge, UK: IUCN, 2005); S. A. Osofsky et al., "Building Support for Protected Areas Using a 'One Health' Perspective," in *Friends for Life: New Partners in Support of Protected Areas*, ed. J. A. McNeely, 65–79 (Gland, Switzerland and Cambridge, UK: IUCN, 2005).

12. S. A. Osofsky et al., "Conservation Medicine: A Veterinary Perspective," *Conservation Biology* 14 (2000): 336–37.

13. D. T. Williamson and B. Mbano, "Wildebeest Mortality during 1983 at Lake Xau, Botswana," *African Journal of Ecology* 26 (1988): 341–44.

14. D. H. M. Cumming and T. J. P. Lynam, *Landuse Changes, Wildlife Conservation and Utilisation, and the Sustainability of Agro-Ecosystems in the Zambezi Valley*, Final Technical Report to the European Union, Contract B7-5040/93/06 (Harare, Zimbabwe: WWF Southern Africa Regional Programme Office, 1997).

An Ounce of Prevention: Lessons from the First Avian Influenza Scare by William B. Karesh and Kristine Smith

1. Gavin MacGregor-Skinner, pers. comm., 2007.

2. "Bird Watching 101: Expert Offers Basics on What Some Call Nation's No. 1 Spectator Sport," *CBS News*, 2007, www.cbsnews.com/stories/2007/06/01/earlyshow/main2874584.shtml.

3. R. G. Webster et al., "H5N1 Outbreaks and Enzootic Influenza," *Emerging Infectious Diseases* 12, no. 1 (2006): 3–8.

2008–2009

STATE OF THE WILD

A Global Portrait of Wildlife, Wildlands, and Oceans

With a special section

Emerging Diseases and Conservation:
One World—One Health

VOLUME EDITOR
Eva Fearn

SERIES EDITOR
Kent H. Redford

Wildlife Conservation Society

FOREWORD BY
Ward Woods

ISLANDPRESS

WASHINGTON • COVELO • LONDON