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COMMENT

Elephant populations and CITES trade resolutions

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) regulates trade in species and their products. The original listing of the African elephant (*Loxodonta africana*) in Appendix II limited international trade, but their listing on Appendix I at the 7th CITES Conference of Parties (CoP) in 1989 (CITES 1989) banned international trade (Stiles 2004). In 1997, the 10th CITES CoP allowed sales of ivory from Botswana, Namibia and Zambia (CITES 1997) and the 12th CITES CoP conditionally refined further sales by these countries in 2007 (CITES 2007*a*). All these decisions relied on trends in numbers and poaching derived from the Elephant Trade Information System (ETIS; CITES 2007*b*) and Monitoring the Illegal Killing of Elephants Programme (MIKE; CITES 2007*c*). Such information clearly ignores demographic and spatial variables that drive these trends in elephant populations. We propose that clusters of conservation areas are required as spatial and demographic units on which to frame CITES decision-taking processes for elephants, and suggest that information on the demographic profiles of subpopulations within clusters should supplement census information from MIKE and ETIS.

Debate around the 'ivory ban' of CITES stems from suggestions that poaching will reduce elephant numbers in Central, East and West Africa (Blake *et al.* 2007). Supporters of the ban argue that international trade provides a demand for ivory (IFAW [International Fund for Animal Welfare] 2004), but opponents thereof argue that ivory from culled elephants in southern Africa can fund conservation (for example Cumming 2000). Few studies support the effectiveness of the ban to reduce the illegal trade, the intensity of poaching or the bush meat trade (for example Stiles & Martin 2001; Courouble *et al.* 2003; Martin & Stiles 2003; IFAW 2004; Stiles 2004). Recent confiscations suggest that elephant poaching is rife in parts of Africa (Blake *et al.* 2007; Wasser *et al.* 2007). Proponents of the ivory trade claim that local circumstances, political instability and lack of law enforcement rather than the partial lifting of the ban influence ivory demand and supply (Stiles 2004). These observations and a lack of precise information on numbers may further hinder CITES decision making.

Claims of elephant numbers declining before the 1989 Ivory Ban were based on inept censuses; 47% of estimates for southern and eastern Africa were based on guesses. Many structured elephant censuses yield estimates with low precision (CERU [Conservation Ecology Research Unit], unpublished data 2008), but reveal variation in regional population trends. Because elephant numbers are increasing (for example van Aarde *et al.* 2008), some southern African countries claim that their elephants are well managed and wish to trade in ivory (CITES 2007*a*). However, country specific assessments can be misleading. For instance, elephant numbers in two Zambian populations are decreasing and in two others are relatively stable (CERU, unpublished data 2008). Numbers in Zambia's neighbour Botswana and in Zimbabwe's Hwange National Park may be stable (Chamaillé-Jammes *et al.* 2008; Junker *et al.* 2008), while populations in Mozambique are recovering, albeit from low numbers (Ntumi *et al.* 2009). At the same time, some Namibian, Zimbabwean and most South African populations are increasing (van Aarde *et al.* 2008). Death and birth rates vary between populations (van Aarde *et al.* 2008) and demographic variation, confounded by the unknown effects of movements across international boundaries (van Aarde & Jackson 2007), makes it difficult to interpret trends, a problem not provided for by CITES resolutions.

Furthermore, for CITES, the unit for resolutions on trade in elephant products centres on the Range State; consequently the population is an administrative rather than ecological entity. Decisions depend on country-specific information, mostly of limited precision, provided by MIKE and ETIS. MIKE monitors elephant population trends and the illegal killing of elephants, while ETIS tracks the illegal trade in ivory and elephant products (Hunter & Milliken 2004). However, most major populations span several countries and elephants move freely across borders (Mpanduji *et al.* 2002; CERU, unpublished data 2008). Resolutions for one country therefore may be undermined by factors affecting elephants in another country (Frank & Maurseth 2006).

The limitations imposed by low quality data and short time series that restrict the statistical power to detect trends (Junker 2009), as well as variability in population numbers due to changes in living conditions that influence demography and dispersal, may diminish the scientific reliability of CITES decisions. How can these shortcomings be addressed? We propose an approach that relies on the population as an ecological unit, rather than a political unit dictated by artificial boundaries. Furthermore, by supplementing censuses with demographic information, conservationists can target management towards the drivers of numerical trends.

We plead that clusters of protected areas be recognized as conservation units. Such clusters should include existing protected areas close to each other, or those that share boundaries along international borders. Sub-populations within a cluster may function as a metapopulation and cluster boundaries may be defined by elephant movements (van Aarde & Jackson 2007). The cluster as a principle unit for CITES

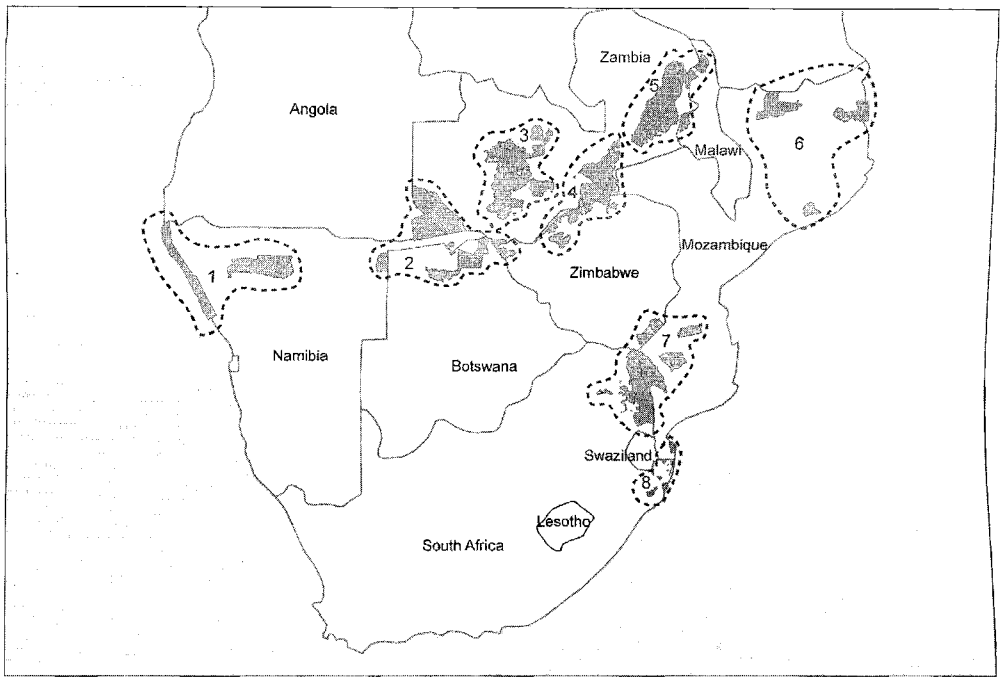

Figure 1 Clusters of elephant conservation areas in southern Africa based on proximity as examples of management units for CITES resolutions. (1) Etosha Cluster, (2) Chobe Cluster, (3) Kafue Cluster, (4) Zambezi Cluster, (5) Luangwa Cluster, (6) Niassa Cluster, (7) Limpopo Cluster and (8) Maputo Cluster.

elephant decisions thereby recognizes the population as an ecological, rather than administrative entity. For the southern African region we propose that eight such clusters should be recognized (Fig. 1). Our lack of field experience beyond southern Africa does not allow us to posit similar delineations for other regions in Africa. We hope that our approach will stimulate similar delineations for the other major regions in Africa.

By extracting subpopulation-specific demographic profiles (Ferreira & van Aarde 2008) for each of these clusters and combining these with census data, CITES decisions may be based on predicted population trends rather than past trends alone. Demographic profiling extracts population growth rates from age-specific birth and survival rates and allows for the assessment of skewness in age structures induced by age-specific ivory poaching (Spinage 1973), as is the case in Zambia (CERU, unpublished data 2008). This can complement information from MIKE, and the stability in age distributions in addition to trends in numbers can serve as robust criteria on which CITES may set resolutions.

We acknowledge that similar approaches to extract demographic profiles may not be valid for elephants living in forested areas, such as those in central and western Africa. Under these conditions, other indirect measures, such as the counting and measuring of dung boli can yield some of the demographic data that can complement population estimates derived from dung or registration counts (Morley & van Aarde 2007, Olivier *et al.* 2009).

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