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Comment

Human rights and conservation of biodiversity considerations associated with roads in the Serengeti: response to Hopcraft et al.

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We are pleased that Hopcraft et al. (2015) responded to our article (Fyumagwa et al. 2013) "Roads as a Threat to the Serengeti Ecosystem." Many of the authors of this response are senior scientists and conservationists who have worked in the Serengeti ecosystem for decades and have made substantial contributions to ecology and conservation. We therefore take their criticisms seriously. The Serengeti ecosystem contains 2 world heritage sites; thus, international input into developing the region in a sustainable way is welcome.

We believe, as do others (e.g., Kareiva 2014), that conservation efforts should consider the livelihoods of people inhabiting an area, independent of the size and density of the human population. Addressing the needs of human communities is consistent with the Convention on Biological Diversity (1992) and the 5th World Parks Congress (2003), which link conservation with human development and poverty reduction (Christ et al. 2003; Eagles 2014). In Fyumagwa et al. (2013), our primary focus is sustainable conservation and human development in the Serengeti ecosystem. We also consider the cost of road construction and the indirect consequences likely to have the greatest effects on nature. In contrast, Hopcraft et al. focus on how to connect the eastern and western towns in northern Tanzania. We believe a holistic view of the situation is needed and invite all parties to collaborate in finding viable solutions that will meet the needs of the people and biodiversity conservation in the Serengeti ecosystem.

The idea of connecting Arusha and Musoma through the alternative route suggested by Hopcraft et al. does not address the needs of the community that bears responsibility for conserving wildlife in the northern Serengeti. However, in Fyumagwa et al. (2013), we note that the purpose of the road through the northern Serengeti ecosystem is not to connect Arusha, Musoma, and Mwanza. Rather, its purpose is to address the needs of communities in the eastern and western Serengeti without compromising conservation objectives. To achieve the 2 objectives, the government is upgrading 2 separate segments, one in the east and a second in the west of Serengeti National Park. All people, including the Maasai pastoralists, Sonjo, and Kurya agropastoralists who live in the Serengeti, are entitled to the basic human right of improved infrastructure, which is one component of an improved standard of living. It should be remembered that lack of good roads may also have detrimental impacts on biodiversity.

We work under the umbrella of the TAWIRI-IPBES Capacity Building Project (see Acknowledgments). The objective of our long-term research is to study the construction of the Serengeti road, before (planning), during

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(impact), and after construction (consequences) so as to understand the dynamics of the road relative to conservation of the Serengeti ecosystem, the socioeconomic trade-offs of conservation, governance challenges, and other influencing factors. The status and dynamics of flora and fauna along the planned Serengeti road before and after construction will be assessed to enable informed decisions that will reduce adverse impacts of the road. The ultimate goal is to improve the monitoring of management actions and ecosystems, the decision-making processes, and effectiveness of the government and institutions responsible for natural resource management.

That all Tanzanians have the basic right to good infrastructure provided by their government is the basis for the arguments in Fyumagwa et al. (2013). Additionally, Hopcraft et al. acknowledge that the Serengeti ecosystem faces many threats other than those that may result from road construction, as we discuss in Fyumagwa et al. (2013). We suggest joining efforts to identify methods by which the governments of Tanzania and neighboring countries can address the threats to sustainable conservation without compromising human development. Two of the largest threats are deforestation of the Mau Forest, the catchment area of the Mara River in Kenya, and large-scale irrigation schemes of the Mara River that are affecting river flow. Drying of the Mara River concurrent with human population growth, poverty, overexploitation of natural resources, rapid spread of non-native invasive plant species, fencing of the dispersal areas in Maasai rangelands, and climate change may lead to high mortality of migratory species, ultimately affecting the sustainability of the Serengeti ecosystem (Gereta 2004; Dore 2005; Baldyga et al. 2008; Mnaya et al. 2011; Fyumagwa et al. 2013).

Failure to address human population growth, poverty, and the need for infrastructure development fuels the unsustainable use of natural resources. Sustainable ecosystem conservation can be achieved only if adjacent communities, which are the custodians of wildlife resources, particularly migratory species, have access to good social services for improved livelihoods. For the minority Maasai pastoralists and Sonjo agropastoralists, there is no alternative road except from Mto wa Mbu to Wasso (250 km). Similarly, there is no alternative road for the multiethnic peasants and agropastoralists in the western Serengeti, except from Makutano-Natta-Mugumu (150 km). The TAWIRI-IPBES project addresses the impact of infrastructure development in protected areas on biodiversity, socioecology, public and animal health, and environmental science (Røskaft et al. 2012). Consideration of all these factors is critical for improving and monitoring the effects of management and improving decision making and effectiveness of government and institutions responsible for natural resource management.

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