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#### RESPONSE

# Grevy's zebra conservation: overcoming threats of isolation, genetic hybridization and demographic instability

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Thousands of years ago, equids were one of the most abundant herbivores on the plains of Africa and Asia. Now only seven species remain: one of which is vulnerable, three of which are classified as endangered or critically endangered and one of which is extinct in the wild (Moehlman, 2002). For the latter five species, population declines have been related to human driven factors, such as hunting and competition with livestock. Within at least two of these species, population declines have resulted in such low genetic diversity within their population that this factor alone threatens their long-term persistence. For these species, researchers have proposed management programmes that, first and foremost, concentrate on trying to increase genetic variation within subpopulations through active management (Smith et al., 2007). Often, even if the original drivers of population decline are stopped, small, isolated populations have suffered such a reduction in genetic diversity that they can still be at risk of extinction (Spielman, Brook & Frankham, 2004). Grevy's zebra Equus grevyi are estimated to have declined by 75% since the late 1970s (Williams, 2002). The remaining populations are becoming increasingly isolated, especially in the northern part of their range. It is very likely that both the recent population decline and increasing isolation will have had a negative effect on their genetic diversity (Hill, 2009). As the commentaries on our study suggest, it is essential to establish levels of genetic variation between and within subpopulations of Grevy's zebra. It has been suggested that small populations of Grevy's zebra could be bolstered with individuals from larger populations (Kenya Wildlife Service, 2008). Currently there is no genetic data on which to base translocation decisions. Taking individuals from a few large populations

could lead to the situation Hill (2009) described for Cape mountain zebra *Equus zebra zebra*, although the total Grevy's zebra population is not nearly as small. Determining genetic variation within Grevy's zebra populations could prevent a similar situation from developing. Such data could also identify populations that are currently at risk for isolation effects (Schwartz, Luikart & Waples, 2007). In a collaboration between Denver Zoo and molecular ecologists at the University of California, Los Angeles, the process of documenting the genetic variation within the species has already begun. Between June and August 2009, 10 populations within Kenya were sampled with the eventual aim of sampling nearly every population in Kenya.

While all the commentators agree that removing hybrids would be unnecessary, they have also stressed the need to establish whether the plains zebra Equus burchelli mtDNA found in two Grevy's zebra females is the result of a sampling error or is representative of backcrossing. While it is unlikely that this mtDNA is a result of plains zebra males mating with Grevy's females, Chiyo & Alberts (2009) outline a scenario that could explain how the unidirectional hybridization we described (Cordingley et al., 2009) may have led to plains mtDNA in Grevy's zebra. Since the Grevy's population in our study are thought to have only moved into the area during 1992, we believe that there may not have been enough time for this situation to arise. However, more intensive sampling of the Grevy's zebra within the study area will allow us to determine whether backcrossing has occurred.

If Grevy's populations were to become smaller, more isolated and increasingly concentrated further south (all factors which would increase their contact with plains zebra)

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the occurrence of hybridization could increase. Each occurrence would be context specific and the factors leading to hybridization and the threat it poses to Grevy's zebra would need to be determined in each situation (Genovart, 2009). Measures could then be put in place to prevent it from occurring again where necessary. Monitoring to identify whether hybridization is occurring elsewhere is ongoing. The wider genetic study proposed above will also enable us to delve deeper into the recent evolutionary history of these two species to determine if any hybridizations have taken place in the past as species ranges expanded and contracted (Ryder & Steiner, 2009). Other, more urgent threats, such as competition of Grevy's zebra with livestock for grazing and water, require our primary attention. The drought in Kenya throughout 2009 has only increased these pressures, while adding additional ones, such as disease (Muoria et al., 2007). While it is not going to be easy to address these issues, we believe that community conservancies in the north of Kenya hold some promise in providing 'protected' areas for Grevy's zebra (Low et al., 2009). We will need to monitor vital rates within different Grevy's zebra populations to determine where and why population growth is or is not occurring. In addition, once we have data on the genetic variation within the population we will be able to assess the level of threat isolation poses to the long-term persistence of the species.

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