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POLICY PERSPECTIVE

Neocolonial Conservation: Is Moving Rhinos to Australia Conservation or Intellectual Property Loss

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Abstract

The Australian Rhino Project (http://www.theaustralianrhinoproject.org) proposes importing 80 rhinos from South Africa to Australia by 2019 at a cost of over $US4 million, with the first six due to have been moved in 2016. This project has high-profile supporters in the private sector, zoos, and both governments, and is gaining major publicity through association with sporting teams and TedEx talks (http://www.theaustralianrhinoproject.org/index.php/news/blogs/11-news-and-blogs/242-ray-tedx). However, establishing extralimital populations of African rhinos is a very low-priority conservation action, particularly given over 800 are already in captivity, and we argue this project diverts funds and expertise away from more important conservation activities; the proposed captive conditions will lead to selection for domestic traits; the most likely species involved is the white rhino, which is the lowest priority rhino species for conservation; it removes a driver of *in situ* conservation; it does not focus on the critically endangered Asian rhino species; and it extends the historical exploitation of Africa's resources by colonial powers. There are also insufficient details in the public domain about the project for objective decision-making. We believe this is misdirected neocolonial conservation and the policy support from both governments for this project should be reconsidered.

The Australian Rhino Project (http://www.theaustralianrhinoproject.org) plans to move 80 rhinos from South Africa to Australia between now and 2019 (Agence France-Presse 2016) in an effort to combat the impacts of the poaching epidemic that is afflicting Africa (Graham-Rowe 2011; Ferreira *et al.* 2015). The current cost of this action is estimated at $AU70,000 per rhino, which equates to $AU 5,600,000 ($US4,200,000; or ZAR61,670,000 based on the exchange rate @June 21, 2016), and it is unclear whether this sum accounts for the costs of returning these animals and their progeny to South Africa when the poaching epidemic ends (Hayward *et al.* 2016). The project is partnered or supported by major corporations (Investec, Coca Cola-Amatil, Carlton & United Breweries, The Classic Safari Company inter alia), sporting teams (Waratahs Rugby), conservation management organizations (Taronga Conservation Society, Zoos South Australia, Australian Zoo and Aquarium Association), and esteemed academic institutions (University of Sydney). The project is also reported as having the support of both the Australian and South African governments (http://theaustralianrhinoproject.org/index.php/news/blogs/11-news-and-blogs/231-australian-rhino-project-moving-rhinoceros-from-africa-to-protect-against-poaching) and celebrities (Dumas 2016). A feasibility study has reportedly been conducted, but is not available on the Web site or upon request due to commercial-in-confidence restrictions (R. Dearlove,

pers. comm.; May 26, 2016), nor are the terms of reference for such a study provided. Below, we document some concerns we see with the policies of both the Australian and South African governments that reportedly support this initiative, and identify major questions that need answering.

First, even though private donations for one project are not necessarily fungible, the financing of this project is likely to have competed, and will continue to compete, for funds for higher priority *in situ* rhino conservation actions. While the creation of extralimital populations is listed as a conservation action for Africa's rhinos, it is a low priority (Magome *et al.* 2014) because there were 706 southern white rhinos (298 males, 405 females, and 3 young) in captivity in zoos at the end of 2011, according to the white rhino studbook, plus an additional 141 that have been imported to China since 2000 that are not included in the studbook (Ogden 2011). An unknown, but large, number are also held by private owners in South Africa. With appropriate management, this captive population is sufficient in number to ensure white rhinos persist without losing genetic diversity. The amount of money needed to bring 80 white rhinos to Australia equates to almost double the annual antipoaching budget used by SANParks ($US2.2 million; SANParks 2015). Were the donors provided with appropriate information, at least some might have been persuaded to fund higher priority actions, such as supplementing on-ground actions or developing new actions in South Africa (Mulero-Pázmány *et al.* 2014). In this sense, the Australian Rhino Project is directly comparable to the ex situ (i.e., foreign zoos) captive breeding initiative for the Sumatran rhino *Dicerorhinus sumatrensis* in the 1980s. As Caughley (1994) pointed out, this removal of a large number of Sumatran rhino from the wild failed to boost the population, and carried the missed opportunity costs of failing to conserve rhino habitat with its myriad of other biodiversity benefits. Alternatively, these funds could go toward reinforcing education programs in Asia to reduce the demand for rhino horn (Challender & MacMillan 2014; Challender *et al.* 2014). However, if this largely Australian-sourced money was to be dedicated to conservation actions within Australia, the money would be better served targeting Australia's 108 threatened mammal species, given Australia's appalling record in mammal extinctions (Woinarski *et al.* 2014), including two in the past 5 years (Woinarski *et al.* 2016).

Second, there are two species of rhinos in Africa—*Ceratotherium simum* and *Diceros bicornis* (white and black, respectively)—but no mention is made by the Australian Rhino Project as to which is being targeted or whether both are. The availability of white rhinos in private hands in South Africa suggests these will be the focus of the Australian Rhino Project. Notwithstanding the various subspecies that are currently managed as evolutionarily significant units (Amin *et al.* 2006), a breeding population of 40 or even 80 individuals is likely to be below the effective population size necessary to conserve genetic diversity (Frankham 1995), although we recognize that genetic diversity may not be lost over the short term. Rhino translocation has developed into a highly successful operation with minimal mortalities (Linklater & Swaisgood 2008; Linklater *et al.* 2011) in comparison to past attempts (Kelly *et al.* 1995) and so moving the animals to Australia is likely to be successful. However, captive breeding introduces a range of selective pressures that favor the domestication of animals that may be detrimental if they are ever returned to the wild (Snyder *et al.* 1996; Lynch & O'Hely 2001; Araki *et al.* 2007). This is still likely to occur even in open-range zoos, like Monarto or Western Plains (that are currently proposed as captive sites for the Australian Rhino Project), particularly given the important role that predation has played in rhino evolution (Berger & Cunningham 1994; Berger 1995). There are also likely to be new stressors introduced into captive animals driven by unnatural stocking densities. White rhinos in the wild live at densities of between 0.5 and 5.6 individuals km^{-2} (Owen-Smith 1981; Pienaar 1994; Shrader *et al.* 2006), which means that an area of up to 160 km^2 will be required to house the 80 animals transported to Australia in something resembling wild conditions. This seems unlikely given that Western Plains Zoo in its entirety is currently 3 km^2 and Monarto is 15 km^2 (Zoos SA; pers. comm.).

Third, Africa's rhinos are not necessarily the highest priority pachyderms for conservation actions (Ripple *et al.* 2015). White rhinos (global population estimate: 20,170) and black rhinos (4,880) (Emslie 2012a,b), are more abundant and probably more secure than the Great Indian *Rhinoceros unicornis* (2,575), Sumatran (275), and Javan *Rhinoceros sondaicus* (60) that are all listed as Critically Endangered (Talukdar *et al.* 2008; van Strien *et al.* 2008a, b; Ripple *et al.* 2015,2016). Given that these last three species combined are less common than Africa's rarest rhino, they must be seen as a higher conservation priority for ex situ conservation (Isaac *et al.* 2007). The latest population estimates for black rhino suggest a significant increase since 2012, while those for white rhino show no significant change since 2012 (AfRSG 2016) reinforcing the fact that these are the lowest priority rhino species. While making a decision to implement conservation actions are likely to be more effective when populations are large (McDonald-Madden *et al.* 2011; Martin *et al.* 2012), there already exists a viable captive population for white rhinos and the other rhino species are in much greater need of conservation action than white rhinos.

Fourth, *in situ* conservation has multiple benefits beyond single species. As megaherbivores, rhinos are keystone species that play many key ecological roles (Fritz *et al.* 2002; Kerley & Landman 2006; Ripple *et al.* 2015), including holding together complex multitrophic interspecific relationships (Plotz 2014) and the creation of grazing lawns for other species that have cascading impacts on ecosystem structure and lead to an alteration of fire regimes (Waldram *et al.* 2008; Cromsigt & te Beest 2014). Rhinos also inhabit sites occupied by a suite of other threatened fauna. The presence of rhinos ensures the protection of areas where other threatened species, such as elephants *Loxodonta africana*, lions *Panthera leo*, African wild dogs *Lycaon pictus*, and pangolins *Smutsia temminckii,* persist. Furthermore, rhinos have a suite of commensal and parasitic organisms living on and in them (Zumpt 1964) and so the translocation process is likely to lead to them being removed (Stringer & Linklater 2014) and thereby placing these species under greater risk of extinction than the rhinos themselves (i.e., the relationship between rhino density and parasite abundance suggests the Australian Rhino Project places rhino conservation above their host-specific microbiota; Stringer & Linklater 2015). Moreover, early parasite exposure is central to the development of a host organism's fully functioning immune system (Spencer & Zuk 2016), and this limited exposure to parasites in captivity will reduce the survivability of any offspring that may ultimately be returned to the wild.

Fifth, the people involved in the Australian Rhino Project are experienced business leaders, marketing specialists, and scientists with considerable international involvement with major funding agencies. Their talent and experience is being diverted away from raising money and the profile of other species of higher conservation priority than Africa's rhinos.

Finally, and most importantly, the proposal extends the history of exploitation of Africa's resources. Taking biodiversity assets, like rhinos, for "safe-keeping" in the west is as patronizing and disempowering as the historical appropriation of cultural artifacts by colonizing nations (Nicholas & Wylie 2009). Such artifacts are currently being returned worldwide now that local institutions are strengthened. The same approach should be taken for biodiversity, via institutional strengthening, improved governance, and improved protection of existing biodiversity assets in the country. Indeed, the genetic resources embodied in charismatic rhinos should be as protected under the Convention on Biological Diversity as those producing commercial products.

Notwithstanding the above points, we acknowledge that there are potential benefits from this project. Individual rhinos may be safer in Australia, although illegal wildlife capture and trade does occur there (Alacs & Georges 2008). Their removal from South Africa and transportation to Australia may serve to raise awareness in both countries, and globally, of the plight of rhinos and possibly even the importance of prioritizing conservation actions (Carwardine *et al.* 2012).

Yet, there remain important unanswered questions. If these translocated animals breed successfully, they will need to be repatriated to South Africa. Where will those funds come from? Does South Africa—whose natural heritage is being sent to Australia—retain ownership rights to the founder stock and their progeny? This may have been the plan in the 1992 importation of black rhinos to Australia from Zimbabwe, but neither the survivors of that operation or their progeny have been returned (Kelly *et al.* 1995). In this respect, the giant panda *Ailuropoda melanoleuca*, all of which remain the property of China even when made available to 122 foreign zoos, provides an interesting model of how the rights to a species can be retained by the source nation. The loan agreements for panda include an annual payment (approx. $US 1 million), retention of progeny and have limited duration. Is the Australian Rhino Project and/or the South African government considering such an arrangement, and if not, why not? Which species of African rhino will be transported to Australia? The conservation status of white rhinos means a captive population of these offers little conservation benefit, although it seems most likely to be the focus. This information is not available on the project Web site (@ October 20, 2016) or upon request from the Founder.

Conservation projects are ultimately more legitimate, politically acceptable and successful when led locally (Rodríguez *et al.* 2007; Smith *et al.* 2009). The Black Rhino Range Expansion Project (BRREP), for example, is a partnership between the World Wildlife Fund-South Africa, provincial conservation agencies (Ezemvelo KwaZulu-Natal Wildlife and Eastern Cape Parks and Tourism Board) and private landowners, aiming to increase the overall range and growth rate of South Africa's black rhino population (Sherriffs 2006, 2007, 2010). Since 2004, more than 70 calves have been born from the relocation of 160 black rhinos to create 10 new rhino populations spanning 220,000 hectares (11th translocation is planned for 2017; WWF-South Africa Undated). After a decade, the BRREP now manages an estimated 6% of the total black rhino population in state-, provincial-, and private-owned lands in South Africa, supporting a 21% growth rate in KwaZulu-Natal's overall black rhino population alone—the highest level since counting began (WWF-BRREP Bulletin 2009). While the donor conservation agency retains ownership of founder rhinos, private custodians equally share the benefits of rhinos born in these populations (Knight *et al.* 2010). Other benefits include the facilitation of partnerships among

private landowners to remove internal fences to expand the area of suitable land before rhinos are relocated, while also providing financial and logistical support to help with fencing, monitoring (telemetry), and antipoaching measures (e.g., light aircraft; Sherriffs 2006, 2007, 2010). This has increased opportunities for local socioeconomic development and biodiversity protection as almost 50% of the land area is community-owned/managed (Sherriffs 2006, 2007, 2010). These large protected land areas have also supported the range expansion of other threatened species (e.g., elephant; Slater & Knights 2011).

Although the establishment of new rhino populations is a low conservation priority, efforts to create a viable rhino breeding herd in Botswana are underway. Botswana has one of the lowest poaching rates in Africa, and Rhinos Without Borders (RWB, http://www.rhinoswithoutborders.com/) is a partnership between conservation and ecotourism agencies in Botswana to relocate 100 white rhino from South Africa, where, with Kenya and Zimbabwe, nearly 95% of rhino poaching events have been recorded since 2006 (Milliken & Shaw 2012; Howard 2015). Supported by bilateral agreements (between countries), crowd funding and ongoing monitoring (telemetry) and protection, RWB has already successfully moved 26 white rhinos to wildlife concessions and national parks throughout Botswana. RWB, including ongoing monitoring and security, requires less money than proposed by the Australian Rhino Project ($45,000 per rhino and a total budget of US$4.5 million). Although relocations of rhino are crowd-funded, ongoing ecotourism opportunities help sustain the monitoring and protection of rhino while supporting jobs, income, and ongoing biodiversity protection in local communities. Other community-based ecotourism initiatives for rhino conservation in northwest Namibia have catalyzed improved species protection and a large-scale rhinoceros population recovery, where a strong social foundation allowed for more effective protection strategies (i.e., law enforcement; Muntifering *et al.* 2015). Thus, community-based conservation has a significant role to play in rhino protection and population recovery (Berkes 2007; Muntifering *et al.* 2015) and there are clearly still relatively safe areas within range states that can accommodate new rhino populations, further reducing the need to establish more captive populations on other continents.

In summary, we see this project as: (1) diverting funds and public interest away from the real actions necessary to conserve rhinos, and, as currently construed, appears *prima facie* as an example of (2) neocolonial conservation that distracts public interest away from the real actions necessary to conserve rhinos. The Australian Rhino Project does nothing to solve the poaching crisis and the real issue of dampening demand for rhino horn. As such, the translocated rhinos and their offspring will likely remain as zoo animals in Australia, as the poaching crisis is likely to continue. The project, while well-meaning, potentially takes funds, attention, and skills away from where it is needed, while disempowering local organizations. Far better would be identifying "safe" *in situ* areas to relocate sufficient numbers of rhinos from large source populations (McDonald-Madden *et al.* 2011) to establish breeding populations within Africa, as is occurring with translocations of rhinos to Botswana and even within South Africa (e.g., under the BRREP and RWB initiatives; Knight *et al.* 2010; Sherriffs 2010; Howard 2015; Knight *et al.* 2015), and then adequately funding their protection. The RWB provides a holistic model to establish extralimital populations in "safer" countries, such as Botswana, but even this is a very low priority for rhino management in South Africa (Magome *et al.* 2014). For rhinos, generally a more appropriate focus for establishing extralimital populations would be the more highly threatened Asian rhinos—but there are few suitably forested, free-range enclosures of sufficient size to enable captive breeding in semi-wild conditions of these species in Australia. Those donating money to this project would be better off investing in strengthening education policies in Asia to reduce consumer demand for rhino horn (Johnson 2015) or supporting incentives for locally led initiatives so that communities are supported to act as a more effective first line of defense against poaching (Smith *et al.* 2009; Muntifering 2015; Biggs *et al.* 2016). Rather than reinforcing colonial stereotypes by removing assets to the west for safekeeping, investors would sustain not just rhinos but all species sharing their environment by strengthening local conservation institutions and capacity. After all it was local institutions and capacity at the centre of one of the world's greatest conservation success stories, bringing white rhino back from the brink of extinction (i.e., Operation Rhino from c.100 individuals to over 20,000 today; Rochat & Steele 1968; Emslie 2011). The policies of the IUCN Species Survival Commission Rhino Specialist Group, and the South African and Australian governments need clarification to ensure this project is: (1) refocused to deliver real conservation benefits for taxa that are most in need and (2) not used as justification for this type of activity becoming a regular conservation intervention. Africa has a strong track record in rhino conservation and is currently using within-Africa translocations to strengthen international relations in a politically neutral fashion (Knight & Kerley 2009).

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References

AfRSG. (2016). *IUCN reports deepening rhino poaching crisis in Africa*. African Rhino Specialist Group of the IUCN, Gland, Switzerland.

Agence France-Presse. (2016). Horns of a dilemma: retiree to fly 80 South African rhinos to Australia. *The Guardian* http://www.theguardiancom/environment/2016/may/14/horns-of-a-dilemma-retiree-to-fly-80-south-african-rhinos-to-australia?CMP=soc_567. Accessed 26 May, 2016.

Alacs E. & Georges A. (2008). Wildlife across our borders: a review of the illegal trade in Australia. *Aust. J. Forensic Sci.*, **40**, 147-160.

Amin R., Thomas K., Emslie R., Foose T. & Strien N. (2006). An overview of the conservation status of and threats to rhinoceros species in the wild. *International Zoo Yearbook*, **40**, 96-117.

Araki H., Cooper B. & Blouin M.S. (2007). Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. *Science*, **318**, 100-103.

Berger J. (1995). Predation, sensitivity, and sex: why female black rhinoceroses outlive males. *Behav. Ecol.*, **6**, 57-64.

Berger J. & Cunningham C. (1994). Active intervention and conservation: Africa's pachyderm problem. *Science*, **263**, 1241-1242.

Berkes F. (2007). Community-based conservation in a globalized world. *P. Natl. Acad. Sci.*, **104**, 15188-15193.

Biggs D., Cooney R., Roe D., *et al*. (2016). Developing a theory of change for a community-based response to illegal wildlife trade. *Conserv. Biol*, **31**, 5-12.

Carwardine J., O'Connor T., Legge S., Mackey B.G., Possingham H.P. & Martin T.G. (2012). Prioritizing threat management for biodiversity conservation. *Conserv. Lett.*, **5**, 196-204.

Caughley G. (1994). Directions in conservation biology. *J. Anim. Ecol.*, **63**, 215-244.

Challender D.W. & MacMillan D.C. (2014). Poaching is more than an enforcement problem. *Conserv. Lett.*, **7**, 484-494.

Challender D.W.S., Wu S.B., Nijman V. & MacMillan D.C. (2014). Changing behavior to tackle the wildlife trade. *Front. Ecol. Environ.*, **12**, 203-203.

Cromsigt J.P.G.M. & te Beest M. (2014). Restoration of a megaherbivore: landscape-level impacts of white rhinoceros in Kruger National Park, South Africa. *J. Ecol.*, **102**, 566-575.

Dumas D. (2016). *Jean-Claude Van Damme's dream to bring rhinoceroses to Broken Hill*. http://www.smh.com.au/nsw/jeanclaude-van-dammes-dream-to-bring-rhinoceroses-to-broken-hill-20161203-gt20161239ml.html. *Sydney Morning Herald*. Fairfax, Sydney, Australia. Accessed 12 December, 2016.

Emslie R. (2011). Summary of continental rhino numbers as at 31st December 2010. Page 329 in C. Dean, editor. *Proceedings of the tenth meeting of the IUCN African Rhino Specialist Group held at Mokala National Park, South Africa from 5 to 10 March 2011*.

Emslie R.H. (2012a). *Ceratotherium simum. IUCN Red List of Threatened Species*. http://wwwiucnredlistorg (visited May 17, 2016). IUCN, Gland, Switzerland.

Emslie R.H. (2012b). *Diceros bicornis. IUCN Red List of Threatened Species*. http://wwiucnredlistorg (visited May 17, 2016). IUCN, Gland, Switzerland.

Ferreira S.M., Greaver C., Knight G.A., Knight M.H., Smit I.P. & Pienaar D. (2015). Disruption of rhino demography by poachers may lead to population declines in Kruger National Park, South Africa. *PLoS ONE*, **10**, e0127783.

Frankham R. (1995). Inbreeding and extinction: a threshold effect. *Conserv. Biol.*, **9**, 792-799.

Fritz H., Duncan P., Gordon I. & Illius A. (2002). Megaherbivores influence trophic guilds structure in African ungulate communities. *Oecologia*, **131**, 620-625.

Graham-Rowe D. (2011). Biodiversity: endangered and in demand. *Nature*, **480**, S101-S103.

Hayward M.W., Ripple W.J., Plotz R.D. & Garnett S.T. (2016). Don't bank African rhinos in Australia. *Nature*, **534**, 475.

Howard B.C. (2015). First rhinos in massive African airlift released in Botswana. *National Geographic*, Published online 7/5/2015: http://www.news.nationalgeographic.com/2015/2005/150507-rhinos-without-borders-airlift-botswana-south-africa-conservation/. Accessed 26 May, 2016.

Isaac N.J.B., Turvey S.T., Collen B., Waterman C. & Baillie J.E.M. (2007). Mammals on the EDGE: conservation priorities based on threat and phylogeny. *PLoS ONE*, **2**, e296.

Johnson L. (2015). Breaking the brand to stop the demand. *Animal Keepers Forum*, **42**, 108-112.

Kelly J., Blyde D. & Denney I. (1995). The importation of the black rhinoceros (Diceros bicornis) from Zimbabwe into Australia. *Aust. Vet. J.*, **72**, 369-374.

Kerley G.I.H. & Landman M. (2006). The impacts of elephants on biodiversity in the Eastern Cape subtropical thickets. *S. Afr. J. Sci.*, **102**, 395-402.

Knight M.H. & Kerley G.I.H. (2009). Black rhino translocations within Africa. *Afr. Insight*, **39**, 70-83.

Knight M.H., Balfour D. & Emslie R. (2010). *Biodiversity management plan for the black rhinoceros (Diceros bicornis) in South Africa 2011-2020*. Pages 5-76. *Government Gazette (South Africa)*. South African Government, Pretoria, South Africa.

Knight M.H., Emslie R., Smart R. & Balfour D. (2015). *Biodiversity management plan for the white rhinoceros (Ceratotherium simum) in South Africa 2015-2020*. Department of Environmental Affairs, Pretoria, South Africa.

Linklater W.L. & Swaisgood R.R. (2008). Reserve size, conspecific density, and translocation success

for black rhinoceros. *J. Wildlife Manage.*, **72**, 1059-1068.

Linklater W.L., Adcock K., du Preez P., *et al.* (2011). Guidelines for large herbivore translocation simplified: black rhinoceros case study. *J. Appl. Ecol.*, **48**, 493-502.

Lynch M. & O'Hely M. (2001). Captive breeding and the genetic fitness of natural populations. *Conserv. Genet.*, **2**, 363-378.

Magome H., Ferreira S., Hofmeyr M., *et al.* (2014). *Management update (03/2014) - SANParks rhino management strategy*. Page 16. SANParks, Skukuza, South Africa.

Martin T.G., Nally S., Burbidge A.A., *et al.* (2012). Acting fast avoids extinction: plight of the Christmas Island Pipistrelle and orange-bellied parrot. *Conserv. Lett.*, **5**, 274-280.

McDonald-Madden E., Runge M.C., Possingham H.P. & Martin T.G. (2011). Optimal timing for managed relocation of species faced with climate change. *Nat. Clim. Change*, **1**, 261-265.

Milliken T. & Shaw J. (2012). The South Africa–Vietnam rhino horn trade nexus. TRAFFIC, Johannesberg, South Africa. pp 136.

Mulero-Pázmány M., Stolper R., Van Essen L., Negro J.J. & Sassen T. (2014). Remotely piloted aircraft systems as a rhinoceros anti-poaching tool in Africa. *PLoS ONE*, **9**, E83873.

Muntifering J.R., Linklater W., Clark S.G., *et al.* (2015). Harnessing values to save the rhinoceros: insights from Namibia. *Oryx*, **51**, 98-105.

Nicholas G.P. & Wylie A. (2009). Archaeological finds: legacies of appropriation, modes of response. Pages 11-54 in J.O. Young, C.G. Brunk editors. *The ethics of cultural appropriation*. Wiley-Blackwell, Oxford, UK.

Ogden J. (2011). International Studbook for the White Rhinoceros *Ceratotherium simum* (Burchell 1817). Page 329. *Disney's Animal Kingdom*. Bay Lake, Florida, FL.

Owen-Smith N. (1981). The white rhino overpopulation problem and a proposed solution. Pages 129-141 in P.A. Jewell editor. *Problems in management of locally abundant wild mammals*. Academic Press, New York.

Pienaar D. (1994). Social organization and behaviour of the white rhinoceros. *Proceedings of a symposium on "Rhinos as game ranch animals."* Onderstepoort, South Africa.

Plotz R.D. (2014). *The interspecific relationships of black rhinoceros (Diceros bicornis) in Hluhluwe-iMfolozi Park*. Ph.D. thesis, School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand.

Ripple W.J., Newsome T.M., Wolf C., *et al.* (2015). Collapse of the world's largest herbivores. *Sci. Adv.* **1**, e1400103.

Ripple W.J., Chapron G., Lopez-Bao J., *et al.* (2016). Saving the world's terrestrial megafauna. *BioScience* **biw092**.

Rochat K. & Steele N. (1968). Operation Rhodesian Rhino: the translocation of Square-lipped rhinoceroses from the Umfolozi Game Reserve in the Republic of South Africa to the Parks and Nature Reserves of Rhodesia. *Lammergeyer*, **8**, 15-23.

Rodríguez J., Taber A., Daszak P., *et al.* (2007). Globalization of conservation: a view from the South. *Science*, **317**, 755.

SANParks. (2015). *Annual report 2014/2015*. Page 156. South African National Parks, Pretoria, South Africa.

Sherriffs P. (2006). Black rhino range expansion project. *Pachyderm*, **41**, 105-106.

Sherriffs P. (2007). Update on the Black Rhino Range Expansion Project: local community receives black rhinos. *Pachyderm*, **41**, 116-117.

Sherriffs P. (2010). South Africa: the black rhino range expansion project. *The Horn*, **2010**, 28.

Shrader A., Owen-Smith N. & Ogutu J. (2006). How a mega-grazer copes with the dry season: food and nutrient intake rates by white rhinoceros in the wild. *Funct. Ecol.*, **20**, 376-384.

Slater K. & Knights K. (2011). Recommendations for elephant management at Pongolo private game reserve, South Africa. https://www.opwall.com/wp-content/uploads/2011-Pongola-Elephant-Management-Report.pdf. Pongola Elephant Management Report. Accessed 26 May, 2016.

Smith R.J., Verissimo D., Leader-Williams N., Cowling R.M. & Knight A.T. (2009). Let the locals lead. *Nature*, **462**, 280-281.

Snyder N.F.R., Derrickson S.R., Beissinger S.R., *et al.* (1996). Limitations of captive breeding in endangered species recovery. *Conserv. Biol.*, **10**, 338-348.

Spencer H.G. & Zuk M. (2016). For host's sake: the pluses of parasite preservation. *TREE*, **31**, 341-343.

Stringer A.P. & Linklater W. (2014). Everything in moderation: principles of parasite control for wildlife conservation. *BioScience*, **64**, 932-937.

Stringer A. & Linklater W. (2015). Host density drives macroparasite abundance across populations of a critically endangered megaherbivore. *Oecologia*, **179**, 201-207.

Talukdar B.K., Emslie R.H., Bist S.S., *et al.* (2008). *Rhinoceros unicornis. IUCN Red List of Threatened Species* http://www.iucnredlistorg (visited May 17, 2016). IUCN, Gland, Switzerland.

van Strien N.J., Manullang B., Secionov I.W., *et al.* (2008a). *Dicerorhinus sumatrensis. IUCN Red List of Threatened Species*. http://www.iucnredlistorg (visited May 17, 2016). IUCN, Gland, Switzerland.

van Strien N.J., Manullang B., Secionov I.W., *et al.* (2008b). *Rhinoceros sondaicus. IUCN Red List of Threatened Species*. http://www.iucnredlistorg (visited May 17, 2016). IUCN, Gland, Switzerland.

Waldram M.S., Bond W.J. & Stock W.D. (2008). Ecological engineering by a mega-grazer: white rhino impacts on a South African savanna. *Ecosystems*, **11**, 101-112.

Woinarski J.C.Z., Burbidge A.A. & Harrison P.L. (2014). *The action plan for Australian mammals 2012*. CSIRO Publishing, Melbourne, Australia.

Woinarski J.C., Garnett S.T., Legge S.M. & Lindenmayer D.B. (2016). The contribution of policy, law, management,

research, and advocacy failings to the recent extinctions of three Australian vertebrate species. *Conserv. Biol*, **31**, 13–23.
WWF-BRREP Bulletin. (2009). *BRREP heads into phase 3 and phase 2 evaluation*. Page 11. WWF and EKZNW, Durban, South Africa.
WWF-South Africa. (Undated). Black rhino range expansion project http://www.wwf.org.za/what_we_do/rhino_programme/black_rhino/. Accessed 26 December, 2016.
Zumpt F. (1964). Parasites of the white and the black rhinoceroses. *Lammergeyer*, **3**, 59-70.

