The use of archaeological and ethnographical information to supplement the historical record of the distribution of large mammalian herbivores in South Africa

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Introduction

The introduction of animal taxa to areas where they do not naturally occur has the potential to damage severely the native fauna and flora. Introductions, both accidental and intentional, to Australia, New Zealand, Marion Island and other oceanic islands provide spectacular examples of this.[1,2] Non-native mammalian herbivores often become invasive in the absence of their natural predators[2] and their impact on vegetation, which may include alterations to plant species composition, structure and diversity, is exaggerated, especially if the vegetation has evolved in the absence of similar herbivores.[3,4] This influence is not limited to the direct consequence for the vegetation and there may be a cascade effect on ecosystem functioning through, for example, a decline in the amount of available forage for indigenous herbivores,[3] a reduction in the breeding efficiency of birds that rely on the vegetation,[5,6] and a negative effect on carbon storage by transforming stands of dense vegetative cover to open savanna-like systems.[7] Nor are these outcomes restricted to non-native herbivores; the re-introduction of a species, such as the elephant (*Loxodonta africana*), to areas from which it has been absent for many years may have similar consequences.[8–11] Additional problems associated with the uncontrolled movement of large mammals include the transmission of disease, such as brucellosis in the United States,[3] and a threat to the genetic integrity of a species through hybridization.[12] It is thus clear that deliberate introductions of herbivores to areas where they do not naturally occur may not be sound conservation practice.

In terms of the IUCN position statement on the translocation of living organisms,[13] however, the introduction of an alien species may be considered if it has clear and well-defined benefits for man or natural communities. Furthermore, the condition of the habitat should be considered and, while no introductions should be allowed in pristine or natural habitats, this may be relaxed for man-made habitats and those modified by man.[13]

The recent growth in private wildlife ranching and ecotourism, especially in semi-arid areas that are considered marginal for traditional agricultural practices, has resulted in an increase in the movement of large mammals and, in some cases, introductions to regions outside their historical distribution.[4] Significantly, in most cases these new ventures are pursued on old farmlands that cannot be regarded as pristine, natural habitats. The National Environmental Management: Biodiversity Act (Act No. 10 of 2004)[§], prohibits the introduction and spread of an alien species to an ecosystem or habitat where it does not naturally occur. The act defines an alien species as one that is not indigenous or is translocated to a place outside of its natural range. The act furthermore provides the legislative framework with which to control the translocation of large mammals.

In an attempt to implement the act, a draft policy on the national norms and standards for the translocation of mammalian herbivores has been promulgated.[14] Both the Biodiversity Act and the draft policy document, however, make reference to recent historical distributions, and use these as a key criterion to control herbivore translocations.[14] The document goes so far as to suggest giving private landowners incentives for stocking indigenous herbivores, proposing that '...those [properties] supporting historically appropriate taxa under natural conditions [will enjoy] the highest status'. While this may appear to be sensible, the questions that we address here are the levels of certainty that we can ascribe to the historical distribution of large mammals in southern Africa, and the length of the history.

Historical distribution information on large herbivores in South Africa: sources and levels of certainty

The quality of available information on the historical distribution of mammals in southern Africa varies with time. A high level of certainty obtains for the distribution of large mammals over the last 100 years (see, for example, refs 15–19). However, between 100 and 500 years ago, when the first European settlers arrived in South Africa, the quality, quantity and completeness of our knowledge decreases rapidly; weaknesses in the early records have been summarized previously.[20] These weaknesses lie not only with interpreting presence records, where a species may have been wrongly identified and localities poorly described, but also in interpreting absence records.[21] Failure to affirm presence cannot be interpreted as a confirmation of absence.[21] Early travellers and natural historians seldom recorded what they did not see and thus absence is often more accurately an absence of data rather than the absence of a species. This may be less of a problem for the large, easily seen species that we deal with here, but the interpretation of absence records is an issue that needs to be considered.

Prior to the arrival of the first European settlers, there are no written records, so that other sources of information on the distribution of large herbivores such as faunal remains and cave and rock paintings and engravings may be used. The interpretation of archaeological faunal remains, such as bones, can be problematic.[20] A relatively comprehensive survey of macromammal presence at archaeological sites in southern Africa, conducted by Plug and Badenhorst,[21] revealed that information from only 226 sites across South Africa was suitable for analysis, with four provinces (Eastern Cape, Northern Cape, Gauteng and Mpumalanga) providing fewer than 15 sites each. Furthermore, the representation of large herbivores in these deposits was generally low (as few as six species at some sites in the Eastern Cape).[21] It must be noted, however, that the sites used in this study (as well as many other sites with faunal remains present) were located in areas of archaeological activity and these may not accurately reflect past animal distributions.[21] In addition, bones are often heavily fragmented, making identification to species or class difficult.[22]

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Religious/kinship taboos and the transportation of materials may also affect the presence of animal remains at archaeological sites. To confirm the presence of a species at an archaeological site, remains should be sufficiently numerous to eliminate the possibility of a chance incorporation.[20] For example, red lechwe (*Kobus leche*) have been recorded only in the Okavango swamps (Botswana) and Caprivi Strip (Namibia).[17] Their abundance in archaeological samples in the North West province of South Africa suggests, however, that their distribution was far wider in the past, possibly when conditions were more suitable during the wetter early Holocene (which began 11 800 years ago).[23–26] Furthermore, the entire species assemblage at a site should be considered in relation to past environmental conditions to ensure that the faunal evidence was not merely incorporated from other regions through trade or long-distance travel.[22] When these requirements are met, it is possible to draw firm conclusions regarding the past distribution of particular herbivores.

Rock paintings and engravings are another possible source of information on historical distribution that, like the bone record, must be interpreted with care. They may not reflect the faunal composition of the area as hunter-gatherer artists may have depicted animals they encountered during long-distance travels and those of particular spiritual significance.[27] In addition, certain animals such as eland (*Tragelaphus oryx*) were held in greater esteem as symbols of rites of passage and rain-making, and so were more commonly illustrated than other species.[27,28] Conversely, in the Northern Cape and Karoo the ubiquitous springbok (*Antidorcas marsupialis*), which formed in vast herds, is poorly represented in rock paintings and engravings.[27] However, the diversity (not frequency or abundance) of animal species depicted by hunter-gatherers in paintings and engravings is likely to reflect the artists' daily experiences in their respective environments.[27]

While certain animal paintings and engravings appear anomalous under current climatic conditions, they may provide an indication of past distribution and previous environmental circumstances.[27] For example, the present distribution of the hippopotamus (*Hippopotamus amphibius*) excludes most of Namibia, central and southern Botswana and most of South Africa, being resident only in northeastern KwaZulu-Natal.[17] Yet the species is recorded in engravings (approximately 3200–2500 years ago) near Carnarvon in the Northern Cape province[27] and was associated with perennial rivers and water bodies in other parts of the country.[19] This may reflect the more favourable climate of the post 3500 BP period,[29] when parts of the Cape and the interior received higher summer rainfall than today.[30] The change in distribution of hippopotamus since the engravings were made is probably a consequence of human predation. Hunting has been postulated as contributing to the Late Pleistocene extinctions of megaherbivores (animals that exceed 1000 kg) in the Americas, Europe and Australia.[31–33] Middle Stone Age (250 000 to 70 000 years ago)[34] people in southern Africa hunted mainly eland and other medium-sized herbivores, and avoided elephants and rhinoceroses (*Ceratotherium simum* and *Diceros bicornis*).[35] Archaeological and anthropological evidence suggests, however, that Later Stone Age man could have hunted large herbivores (as large as buffalo, *Syncerus caffer*, and hippopotamus) as far back as 30 000 years ago in southern Africa.[36,37]

Thus, the written historical record, which stretches back about 500 years, may be supplemented in some cases with evidence from the archaeological/sedimentary record and from rock paintings and engravings. The levels of certainty that can be ascribed to this record decrease sharply after the first one hundred years and all forms of distribution information must be interpreted with care.

Historical distribution information on large herbivores in South Africa: duration

Although not explicitly stated in the draft policy document, historical distribution is taken to apply to the last 500 years, for which there is some written record. The wisdom of enforcing such a chronological cut-off, which is a product of the European colonization of South Africa rather than a biologically meaningful period, must be questioned, particularly if it is to be used as a tool to control herbivore translocations in an evolutionary context. Often animals are moved to re-create 'natural' ecosystems that are fully functional, *sensu* Donlan *et al.*[38] The converse of this argument has been used to criticize the introduction of giraffe to game reserves in the Eastern Cape. Here, it has been suggested that the vegetation evolved in the absence of such a megaherbivore.[4] The ideal of returning systems to a more natural condition is held by South African National Parks: according to the National Parks Act (Act No. 57 of 1976), '...the area which constitutes the park shall ... be retained in its natural state.' If a key goal is to return land to a more natural state, or to the state in which the area evolved, then we must surely look back further than 500 years. The careful incorporation of evidence from faunal remains and rock art and engravings enables an extension of the historical record for some species and some regions and this poses the question of how long the historical record should be.

Clearly, the period covered by the historical record should not include major climate and habitat change. In a comprehensive investigation of the palaeoclimatogy of the Drakensberg region of the Eastern Cape province — using archaeological, geomorphological, isotopic and palynological evidence — Lewis[39] demonstrated that the modern climate has been relatively stable for the last 3200 years but with identifiable runoff/precipitation oscillations. Although a regional study, the climatic changes reported[39] are in step with documented events around the world, so that a 3200 year cut-off is probably widely applicable to much of South Africa.[33] However, we suggest that each region be considered on a case-by-case basis as the climate of some parts of the country has been more variable than others, with clear evidence of dramatic climate change 800 years ago.[40,41] In addition, cognizance should be taken of increases in the human population and development of farming practices in certain regions as early as 1500–2000 years ago, as this would have affected habitat change.[42] This is particularly relevant in view of the proposed relaxation of restrictions on the movement of herbivores to habitats that have been modified by man.[13] Donlan *et al.*[38] recognize that habitats in North America have not remained static over geological time. However, significant climatic changes (for instance, average temperatures more than 5°C lower than at present) have not happened over the past 13 000 years.[38] Consequently, these authors suggest that re-wilding North America with extant megafauna from around the world that are similar (ecologically and evolutionarily) to the Pleistocene fauna of the continent, would re-instate the dynamic evolutionary processes (such as predator–prey relationships) that were at work during this time, and also provide a bold conservation alternative for some of Africa and Asia's large mammals.[38] Although this may be possible for North America, past climatic data for southern Africa suggest a much more variable

climate over the last 13 000 years.[30,39]

In summary, our knowledge of the distribution of large herbivorous mammals in South Africa is most robust for the last 100 years and perhaps the last 500 years for certain (typically larger) species. In order to re-create natural, functioning ecosystems, however, we need to extend the historical record further back in time. To do this, we have to rely on evidence provided by faunal remains and ethnography (rock art and engravings), which are both prone to various forms of bias.[35] We suggest that while historical distribution is undoubtedly important and may be useful in some cases, depending on the species and the region, it will not be for many species. In such cases, decisions should be made based on biologically more robust and meaningful information. Comprehensive guidelines for the control of the movement of animals can be found in the IUCN position statement on the translocation of living organisms.[13] We recommend that, for South Africa, greater emphasis should be placed on factors that are perhaps more biologically meaningful, such as the availability of suitable habitat, the potential for the species to damage the environment, pose a genetic risk through hybridization and to spread disease,[13] especially in the case of species for which information on historical distribution is poor.

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