

Potential distributions of the medium- to large-sized mammals in the Cape Floristic Region, based on historical accounts and habitat requirements

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Conservation planning in the Cape Floristic Region, a recognized world plant diversity hotspot, required systematic (i.e. presence/absence) information on the estimated distributions of the medium- to large-sized mammals. A pragmatic approach for obtaining distribution estimates, for the period prior to arrival of European settlers, was employed. Distribution estimates were based on a combination of a literature survey (with emphasis on early texts) and the ecological requirements of species, and were mapped within each of 102 Broad Habitat Units delineated according to key biophysical parameters. The estimated distributions of 42 species are provided in the form of maps; these are accompanied by brief notes on historical and current occurrences. The distributions, which can be used to guide conservation decisions, should be considered as testable hypotheses.

Key words: Cape Floristic Region, distributions, mammals, habitats.

INTRODUCTION

Information required for conserving biological diversity includes, amongst others, the natural distribution ranges and ecological requirements of species (McNeely *et al.* 1990). Distributional data are important for interpreting ecological and evolutionary processes, and for providing tools for conservation planners and managers (Lawton *et al.* 1994; Hawksworth & Kalin-Arroyo 1995). Furthermore, the study of biotic distribution, diversity and endemism requires the identification of pattern before an understanding of the underlying causal processes can be obtained (Nelson & Platnick 1981). The strategic placement of protected areas is necessary to capture maximum biological diversity but this can only be done by conservation planners on the basis of solid inventory data on biological diversity, i.e. distribution and abundance of species in time and space.

The Cape Floristic Region (CFR) of South Africa, a region of exceptional plant diversity and one of the world's six floral kingdoms (Goldblatt 1978; Cowling & Holmes 1992), encompasses three of southern Africa's centres of plant endemism (Cowling & Hilton-Taylor 1997). This globally recognized biodiversity 'hotspot' (Myers 1990), covering some 90 000 km², is currently the focus of a strategic conservation planning exercise

(Cowling *et al.* 1998). The implementation of this exercise in the spatially extensive CFR accords with recent emphasis on the need for conservation biology principles to be applied to large spatial scales (May 1994). The distribution of the mammals of the CFR is considered to be a key component of the conservation planning exercise in this region.

The focus of the present study is on the medium- to large-sized mammals because their distributions are probably better known, or can be better estimated, than those of the small-sized mammals in the CFR.

Given an inadequate understanding, and lack of detailed information, on the distributions of the larger mammals of the CFR, a pragmatic approach is required to obtain data, at the appropriate scale and coverage, for achieving the overall objectives of the planning exercise. This approach is described in detail by Boshoff *et al.* (2001). The present paper presents the detailed outcomes of the distribution component of that study, together with notes on the species' historical and present occurrence.

APPROACH & METHODS

The information on distributions is presented at the level of the 102 secondary Broad Habitat Units

(BHUs) which are the biodiversity entities for the conservation planning component of the CFR project (Fig. 1a, b). These BHUs were delineated according to a number of biological and environmental characteristics, including vegetation type, geology, mean annual rainfall, rainfall seasonality, modal altitude and ruggedness (Cowling & Heijnen 2001).

The 42 indigenous terrestrial mammal species included in this study are those with a mass greater than c. 2 kg (cf. Chew 1978), that are most prominent on the landscape and which are relatively easily recognizable. Two species that fall into this category, namely the hippopotamus (*Hippopotamus amphibius*) and the Cape clawless otter (*Aonyx capensis*), have been excluded here since they occur almost exclusively in aquatic habitats and their associated riparian areas; the riparian habitat was not mapped as a separate habitat unit by Cowling & Heijnen (2001).

The present study reconstructs the species' distributions in the period prior to arrival of European settlers, in what is now known as the CFR, in the mid 17th century. They thus represent a situation where the patterns and processes exhibited by the mammals of the region were presumably still intact. In fact, the distributions are provided for the entire planning domain for the CFR conservation planning project (see Cowling & Heijnen 2001).

Zoological and explorer's records from 17th, 18th and 19th centuries have been well reviewed by Du Plessis (1969), Skead (1980, 1987) and Rookmaaker (1989). Whereas these reviews were useful in determining the general presence or absence of most species in all or parts of the CFR, they proved to be frustratingly vague in terms of the exact areas and habitats occupied by the various species. This resulted mainly from the fact that most early hunters and naturalists only recorded occurrences along well-travelled, or passable, routes, and few travelled at night, thereby missing the nocturnal species. Other problems arose with interpreting the early, published accounts with regard to the accurate identification of some species (see Skead 1980).

A review of the recent (20th century) literature revealed that noteworthy surveys, namely those by Hewitt (1931), Shortridge (1942), Bateman (1961), Lloyd & Millar (1983), Stuart (1981, 1985) and Stuart *et al.* (1985), are incomplete in terms of species and/or area covered and tend to use political boundaries rather than ecological zones as the

basic mapping units. The scale of the distribution maps in the standard account of the mammals in the southern African subregion (Skinner & Smithers 1990) allows only generalized ranges (or extents of occurrence – see Gaston 1991) to be determined. Similarly, distributions of threatened mammal species are illustrated on a broad regional basis (Smithers 1986).

Museum specimens and records provide useful point data but are biased in that they only provide 'presence' data, i.e. they do not represent the results of systematic data collection throughout the CFR, and they do not take into account the possible migratory or nomadic patterns of some species (see discussions in Slotow & Hamer 2000 and Van Jaarsveld *et al.* 1998).

To address the above issues, in the determination of potential species' distributions, in terms of BHUs, the following information was obtained:

1. evidence that a species occurred, or could potentially occur, in all, or in a specific part, of the CFR, according to the early and recent literature;
2. the presence/absence of each species in each BHU, according to our understanding of their ecological requirements, including a review of published habitat requirements (in the CFR and elsewhere in their range), our personal field knowledge, and the respective habitat characteristics of each BHU (mainly dominant plant species and vegetation structure, grass component, soil nutrients, geology, topography, modal altitude, mean rainfall, rainfall seasonality). As part of this exercise, wildlife scientists with knowledge of mammals in the CFR were consulted.

The approach described above, which involves a simple model based on the estimated range of each species and its association with mappable environmental features, and expressed as a series of polygons, is broadly similar to that used in other studies (e.g. Butterfield *et al.* 1994).

The taxonomy and English common names follow Skinner & Smithers (1990). Species which are considered to be marginal in the CFR are listed separately.

RESULTS

Distributions

The estimated distributions are illustrated in Figs 2–43. Three distribution categories are used:
a. BHUs with the potential to sustain significant

of Cape Town, during the second half of the 18th century (Thunberg 1795). Large populations were recorded in the Mossel Bay area. It has been suggested that in the past elephants made periodic use of the Karoo, moving between the thicket of the Eastern Cape and the savanna of the Orange River (Vernon 1990); although it has not been documented, a similar situation could have occurred in the CFR. The elephant was probably a permanent component of the fauna of the CFR only in the valleys of the Gouritz and Gamtoos rivers and in the areas of thicket vegetation in the east.

Present occurrence

Elephants could potentially survive in the lowland areas; they would avoid the drier northern areas. The greatest potential for occurrence is in the eastern parts. This species is virtually extinct as a resident in the region. A few aboriginal individuals remain in the forested areas to the north and east of Knysna.

Black rhinoceros, *Diceros bicornis bicornis* (Fig. 22)

Historical occurrence

The black rhinoceros apparently occurred throughout most of the CFR (Du Plessis 1969; Skead 1980; Rookmaaker 1989).

Present occurrence

Potentially, this species could survive in the lowland areas; it would avoid dense forests. There are no free-ranging populations within the CFR, the closest being the extralimital *D. b. michaeli* in the Karoo National Park and *D. b. bicornis* in the Eastern Cape thicket.

Cape mountain zebra, *Equus zebra zebra* (Fig. 23)

Historical occurrence

Unfortunately, there is much confusion in the early literature between the historical occurrence of *E. zebra zebra* and the extinct quagga *E. quagga* (Skead 1980; Rookmaaker 1989). Both species are known to have occurred in the area of the CFR. However, both Du Plessis (1969) and Skead (1980) conclude that the Cape mountain zebra occurred widely in the mountainous areas of the 'Cape Province', from east of the Zuurberg range in the east to the mountains in the southwestern part of the province. Records of mountain zebra from Namaqualand were probably of Hartmann's mountain zebra, *E. z. hartmannae*.

Present occurrence

The species can potentially survive in the montane parts and adjacent lowlands; it tends to be absent from densely vegetated areas. Only two aboriginal populations survive in the CFR; that in Gamka Mountain Provincial Nature Reserve, and that in Kammanassie Provincial Nature Reserve, both in the Little Karoo. Populations have been reintroduced to a number of national parks, provincial and private nature reserves in the CFR.

Burchell's zebra, *Equus burchelli* (Fig. 24)

The quagga, *Equus quagga* (now extinct: Smithers 1986), is generally considered to have been a subspecies of Burchell's zebra, *E. burchelli* (see Skinner & Smithers 1990). Since *E. quagga* is an ecotype, *E. burchelli* is included in this account.

Historical occurrence

There is much confusion in the early literature between the historical occurrence of the Cape mountain zebra, *E. zebra zebra*, and the quagga/Burchell's zebra in the former Cape Province (Skead 1980; Rookmaaker 1989). Both species are known to have occurred in the area of the CFR. However, the quagga/Burchell's zebra apparently occurred throughout the lowland areas of the CFR (Du Plessis 1969; Rookmaaker 1989, and the references therein), whereas the Cape mountain zebra was apparently restricted to the harder substrates confined mainly to montane habitats. The last surviving quagga died in a European zoo in 1883.

Present occurrence

Burchell's zebra could potentially occur in the lowlands; it avoids densely vegetated areas. No original populations exist. The species is present in the form of a number of introductions to private game farms and private nature reserves. It was reintroduced into Addo Elephant National Park in 1997.

Bushpig, *Potamochoerus porcus* (Fig. 25)

Historical occurrence

Early records are often insufficiently clear to differentiate between *Potamochoerus porcus* (bushpig) and *Phacochoerus aethiopicus* (warthog) (Skead 1980). The bushpig was, however, recorded in the Swellendam and Outeniqualand regions (Rookmaaker 1989). According to Du Plessis (1969), it occurred eastwards from about Knysna, with its range extending into the immediate hinterland.

Although there are clear records of bushpig in the forested areas of the southern Cape, historical

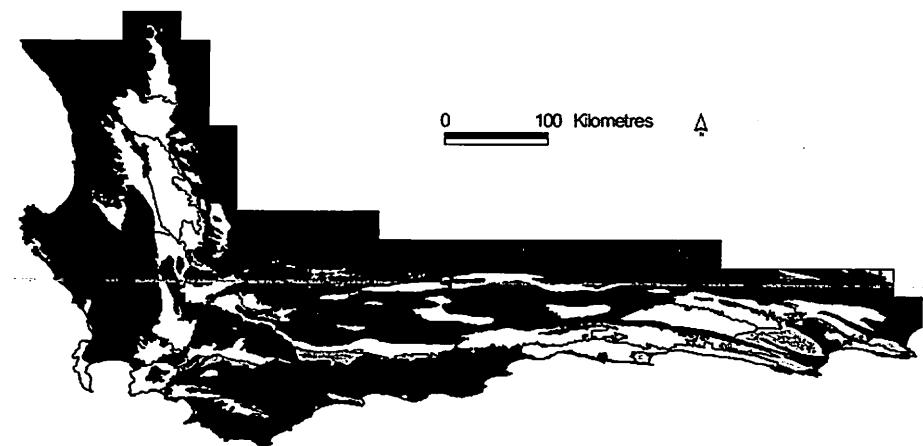


Fig. 22. The potential distribution of the black rhinoceros in the Cape Floristic Region, according to Broad Habitat Unit. Shading conventions as in Fig. 2.

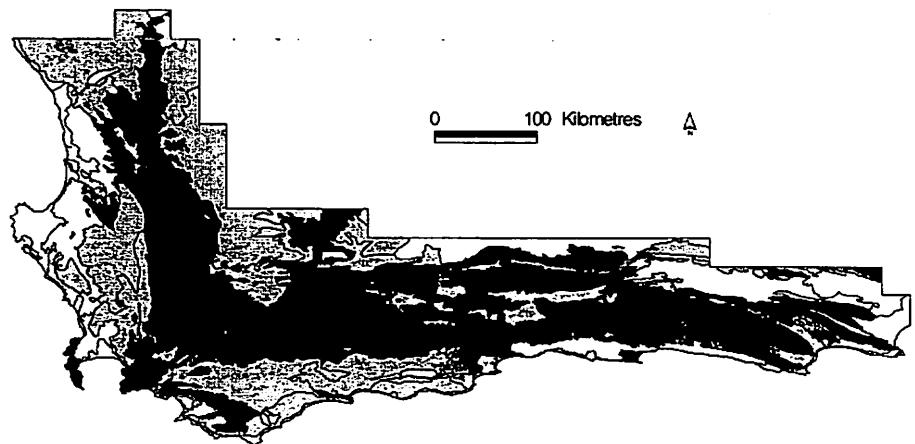


Fig. 23. The potential distribution of the Cape mountain zebra in the Cape Floristic Region, according to Broad Habitat Unit. Shading conventions as in Fig. 2.

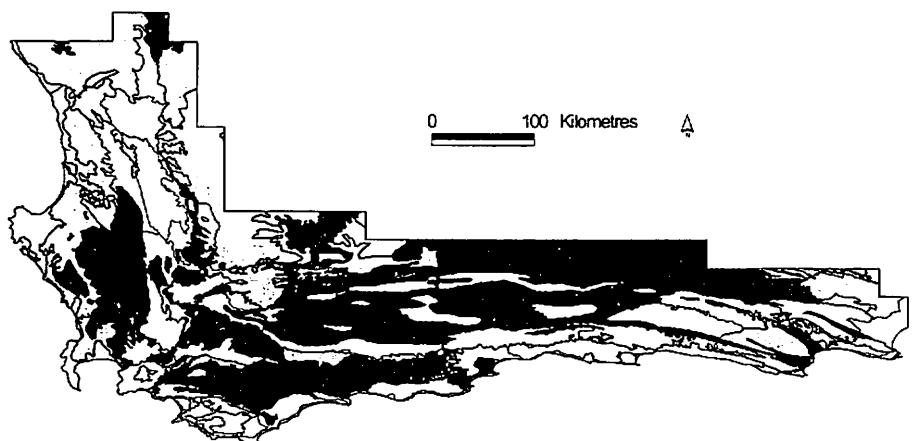


Fig. 24. The potential distribution of the Burchell's zebra in the Cape Floristic Region, according to Broad Habitat Unit. Shading conventions as in Fig. 2.

Southern Africa, (eds) R.M. Cowling, D.M. Richardson & S.M. Pierce, pp. 43–61. Cambridge University Press, Cambridge.

COWLING, R.M. & HOLMES, P.M. 1992. Flora and vegetation. In: *The Ecology of Fynbos: Nutrients, Fire and Biodiversity*, (ed.) R.M. Cowling, pp 23–61. Oxford University Press, Cape Town.

COWLING, R.M., PRESSEY, R.L., HEIJNIS, C., RICHARDSON, D.M. & LOMBARD, A.T. 1998. Systematic conservation planning for the CAPE project. Conceptual approach and protocol for the terrestrial biodiversity component. Report 9803, Institute for Plant Conservation, University of Cape Town, Cape Town.

DU PLESSIS, S.F. 1969. The past and present geographical distribution of the Perissodactyla and Artiodactyla in southern Africa. M.Sc. thesis, University of Pretoria, Pretoria.

EBEDES, H., VERNON, C. & GRUNDLING, I. 1991. Past, present and future distribution of elephants in southern Africa. Paper presented at the Elephant Symposium, Berg-en-Dal, Kruger National Park.

GASTON, K.J. 1994. How large is a species' geographic range? *Oikos* 61: 434–438.

GOLDBLATT, P. 1978. An analysis of the flora of southern Africa: its characteristics, relationships and origins. *Annals of the Missouri Botanical Garden* 65: 369–436.

HAWKSWORTH, D.L. & KALIN-ARROYO, M.T. 1995. Magnitude and distribution of biodiversity. In: *Global Biodiversity Assessment*, (ed.) V.H. Heywood, pp. 107–191. Cambridge University Press, Cambridge.

HEWITT, J. 1931. *A Guide to the Vertebrate Fauna of the Eastern Cape Province*, Trustees, Albany Museum, Grahamstown.

KLEIN, R.G. 1974. On the taxonomic status, distribution and ecology of the blue antelope *Hippotragus leucophaeus* (Pallas, 1766). *Annals of the South African Museum* 65: 99–143.

LAWSON, A.B. 1982. Notes on the mammals of the Gamka Mountain Reserve, Cape Province. *Bontebok* 2: 1–8.

LAWTON, J.H., NEE, S., LETCHER, A.J. & HARVEY, P.H. 1994. Animal distributions: patterns and processes. In: *Large-scale Ecology and Conservation Biology*, (eds) P.J. Edwards, R.M. May & N.R. Webb, pp. 41–58. Blackwell Science, London.

LLOYD, P.H. & MILLAR, J.C.G. 1983. A questionnaire survey (1969–1974) of some of the larger mammals of the Cape Province. *Bontebok* 3: 1–49.

MACDONALD, I.A.W. 1982. The influence of short-term climate fluctuations on the distribution of savanna organisms in southern Africa. M.Sc. thesis. University of Natal, Pietermaritzburg.

MACDONALD, I.A.W. 1992. Vertebrate populations as indicators of change in southern Africa. *Transactions of the Royal Society of South Africa* 48: 87–122.

MASON, D.R. 1982. Studies on the biology and ecology of the warthog *Phacochoerus aethiopicus sundevallii*. Lönnberg, 1908. D.Sc. thesis, University of Pretoria, Pretoria.

MAY, R.M. 1994. The effects of spatial scale on ecological questions and answers. In: *Large-scale Ecology and Conservation Biology*, (eds) P.J. Edwards, R.M. May & N.R. Webb, pp. 1–17. Blackwell Science, London.

MCNEELY, J.A., MILLER, K.R., REID, W.V., MITTERMEIER, R.A. & WERNER, T.B. 1990. *Conserving the World's Biological Diversity*. IUCN, Gland, Switzerland.

MOORE, J.M. & PICKER, M.D. 1991. Heuweltjies (earth mounds) in the Clanwilliam district, Cape Province, South Africa: 4 000 year old termite nests. *Oecologia* 86: 424–432.

MYERS, N. 1990. The biodiversity challenge: expanded hot-spots analysis. *The Environmentalist* 10: 243–255.

NELSON, G. & PLATNICK, N.I. 1981. *Systematics in Biogeography: Cladistics Vicariance*. Columbia University Press, New York.

NORTON, P.M. 1986. Ecology and conservation of the leopard in the mountains of the Cape Province. Unpubl. Report, Cape Department of Nature & Environmental Conservation, Cape Town.

NOVELLIE, P.A. & KNIGHT, M. 1994. Repatriation and translocation of ungulates into South African national parks: an assessment of past attempts. *Koedoe* 37: 115–119.

ROOKMAAKER, L.C. 1989. *The Zoological Exploration of Southern Africa 1650–1790*. A.A. Balkema, Rotterdam.

SCLATER, W.L. 1877. Additions to the Societies Menagerie. *Proceedings of the Zoological Society (London)*: 532–553.

SCOTT, H.A. 1989. Factors affecting the distribution of small antelope on the De Hoop Nature Reserve, southern Cape. *Bontebok* 7: 7–15.

SHORTRIDGE, G.C. 1934. *The Mammals of South West Africa*, Vols 1 & 2. Heinemann, London.

SHORTRIDGE, G.C. 1942. Field notes on the first and second expeditions of the Cape Museums mammal survey of the Cape Province and descriptions of some new subgenera and species. *Annals of the South African Museum* 36: 27–100.

SKEAD, C.J. 1980. *Historical Mammal Incidence in the Cape Province: Vol. 1 – The Western and Northern Cape*. Department of Nature and Environmental Conservation, Cape Town.

SKEAD, C.J. 1987. *Historical Mammal Incidence in the Cape Province: Vol. 2 – The Eastern Half of the Cape Province, including the Ciskei, Transkei and East Griqualand*. Department of Nature & Environmental Conservation, Cape Town.

SKINNER, J.D. & SMITHERS, R.H.N. 1990. *The Mammals of the Southern African Subregion*, University of Pretoria, Pretoria.

SLOTOW, R. & HAMER, M. 2000. Biodiversity research in South Africa: comments on current trends and methods. *South African Journal of Science* 96: 222–224.

SMITHERS, R.H.N. 1986. South African Red Data Book – Terrestrial Mammals. *South African National Science Programmes Report No. 125*.

SPARRMAN, A. 1786. *A Voyage to the Cape of Good Hope. Towards the Antarctic Polar Circle, and Round the World; but Chiefly into the Country of the Hottentots and Caffres, from the Year 1772 to 1776*, Vols 1 & 2. Robinson, London.

STUART, C.T. 1981. Notes on the mammalian carnivores of the Cape Province, South Africa. *Bontebok* 1: 1–58.

STUART, C.T. 1985. The status of two endangered carnivores occurring in the Cape Province, South Africa, *Felis serval* and *Lutra maculicollis*. *Biological Conservation* 32: 375–382.

STUART, C.T., MACDONALD, I.A.W. & MILLS, M.G.L.