The introduction of alien mammals into the broader Western and Northern Cape Provinces of South Africa

A facsimile extract from Skead (2011)

Graham Kerley and André Boshoff

Centre for African Conservation Ecology
Nelson Mandela Metropolitan University
PO Box 77000
Port Elizabeth
South Africa

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Introduction

The ongoing debate on the occurrence, desirability and consequences of the introduction of alien (i.e. those species that do not occur in an area naturally) mammals into areas of South Africa (Castley *et al*. 2001, Cousins *et al*. 2010) highlights the need for a robust historical perspective on such introductions. Thus we need to know which species were introduced, when and where this happened, and also why such introductions took place. Alas, for most of South Africa there is a paucity of such information, as both the authorities responsible for the relevant policy and its application, as well as those who undertook these introductions, failed to maintain an accurate record; and the records that do exist are typically buried in obscure archives. As a consequence, we are left with a patchy, frequently romanticised, record of introductions of mammals that is of little help in explaining where and how (e.g. whether a species is free ranging or maintained in farmed system) alien mammals are currently distributed in South Africa. There is, however, one attempt to compile such an historical perspective, this for the broader Western Cape and Northern Cape provinces of South Africa. This material is published as a chapter in a book (Skead 2011) that may not be generally accessible. In an attempt to overcome this limitation, the relevant chapter is provided here, as an extract from the book, together with these introductory comments and the literature cited.

As part of the revision of the original book by C J Skead (Skead 1980) on the historical incidence of the mammals of the then Cape Province, the editors of the revised edition (Skead 2011) compiled an additional chapter, this relating to the historical record of the introduction of alien species into what is now the Western Cape and Northern Cape provinces and parts of the Eastern Cape and North West provinces (see Skead 2011 for the explanation of this and a map), together with some information on the spread and impacts of such alien species. They also provided some material on the selective breeding of colour morphs of indigenous species, pointing out the risks inherent in this domestication of our wildlife.

This compilation on the history of mammal introductions into, and translocations within, the area covered here is by no means exhaustive in terms of the details around these movements of animals. There are clearly numerous gaps in this information, these gaps representing both a limitation to our knowledge, and also a potentially fertile field of research for students of environmental history. Similarly, the consequences and impacts of such introductions have been identified at a general level, but we are sadly lacking in a robust understanding of these impacts. This is a serious issue given that the introduction of alien species has been globally identified as one of the major threats to biodiversity. While our research institutions have been slow to take up this challenge, the responsibility to drive and fund such research must surely fall at the doors of those agencies responsible for protecting our

biodiversity and regulating the introductions of aliens. Following the "user pays" principle, it is clear that those who advocate the introduction and maintenance of alien species should be also responsible for bearing the costs of these species (such as providing the necessary information required to manage such species, or reducing the loss of indigenous species, impacts on vegetation, etc), be this through funding new research or applying appropriately identified conservation actions to mitigate such threats.

Interested readers who may want to obtain broader insights into the historical incidence of the larger mammals in South Africa and Lesotho are referred to the three books in this series (Skead 2007, 2011, Boshoff & Kerley 2013). They collectively deal with nearly 70% of the area of the Republic of South Africa and the Kingdom of Lesotho. The background, contents and an explanation of how to order these publications may be obtained at: http://ace.nmmu.ac.za/home/Historical-Incidence-of-the-Larger-Mammals.

Recommended citation

The extract provided here is a facsimile copy of the chapter in Skead (2011), together with an appropriately edited extract of the reference list from that book. Accordingly, this extract should be cited as part of that book, as follows:

Skead, C.J. 2011. *Historical incidence of the larger land mammals in the broader Western and Northern Cape*. Second Edition (eds: Boshoff, A.F, Kerley, G.I.H. & Lloyd, P.H.), Centre for African Conservation Ecology, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa.

References

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Skead, C.J. 2007. *Historical incidence of the larger land mammals in the broader Eastern Cape*, Second Edition (eds: Boshoff, A.F., Kerley, G.I.H. & Lloyd, P.H.). Centre for African Conservation Ecology, Nelson Mandela Metropolitan University, Port Elizabeth.

Skead, C.J. 2011. *Historical incidence of the larger land mammals in the broader Western and Northern Cape*. (eds: Boshoff, A.F, Kerley, G.I.H. & Lloyd, P.H.) Centre for African Conservation Ecology, Nelson Mandela Metropolitan University, Port Elizabeth.

CHAPTER 6

INTRODUCED (NON-INDIGENOUS) SPECIES: A GROWING THREAT TO BIODIVERSITY

6.1 INTRODUCTION

As is apparent from Chapter 4, the 528 000 km^2 area covered by this book supported a very rich diversity of the naturally occurring larger mammals. To place this in context, this area historically supported 35 species of wild ungulates (hoofed animals, which also include pigs, horses, rhinos and the elephant), while the entire North American continent (over 123 million km^2) supports only 13 such species. This pattern of a wealth of game, however, has changed over the last 350 years through two processes, the loss of naturally occurring species (detailed in Chapter 5) and the introduction of species out of their natural distribution range. This chapter provides a historical perspective for the latter process and explores some of the implications.

The introduction of species

The movement of animals and plants to areas beyond their natural distribution range by humans is a long-recognised process, which has profound implications for the distribution of species, as well for the ecosystems that receive them. This process, referred to as the introduction of species, results in species being recognised as alien to an area (*i.e.* they did not arrive there through natural evolutionary or dispersal process) and such species are referred to as being alien, introduced, extralimital or non-indigenous. The latter term will be used here.

These movements of species can occur inadvertently, as in the accidental introduction of species such as rats or cockroaches that may 'hitchhike' into new areas in ship-borne cargo. Alternatively, species may be intentionally introduced into new areas in order to achieve a particular objective. Such species typically have an economic (for example, domestic species introduced for agricultural purposes or game species introduced for hunting) or a cultural value (for example, squirrels that were introduced into the Cape as a symbol of the culturally familiar environment of the European settlers in this area). An additional and more recent rationale for translocations may be the opportunity of 'biocontrol' provided by a species. In this scenario, a species is introduced into an area in order to provide some biological control of a problem. An example of this that is relevant to this book is the introduction of European pigs by foresters for the control of moths in commercial forestry plantation areas in the Western Cape.

The prospects of species being introduced intentionally into an area reflect, *inter alia*, the nature of the receiving system. This can be understood in terms of the habitat available in the receiving areas, as well as the existence of comparable species naturally occurring in an area. The former aspect relates to the availability of food, such as grazing, and shelter for the introduced species, whereas the latter suggests that there would be very strong motivation for the introduction of species into areas naturally lacking in large mammals, such as New Zealand. This last point indicates that given the wealth of large mammals that existed in the area covered by this book, there would be little motivation to introduce additional species for economic purposes. However, in the light of the fact that most domestic species, such as cattle, horses, sheep, and dogs, originated in Eurasia (comprising Europe and Asia) and not Africa (Diamond 1998), it is not surprising that domestic mammals were in fact the first known animal introductions into the region. The earliest written records reflect the presence of domestic sheep and cattle in the area, and the archaeological record indicates that these were introduced at least two thousand years ago (Plug and Badenhorst 2001). European settlers quickly supplemented these species with other domestic animals such as the horse, the donkey and the domestic pig. This account does not, however, focus on domestic species, besides those that may be considered to have entered the 'wildlife' estate.

For the historical period covered by this book, it is useful to differentiate between two 'waves' of introductions of mammals. The first such wave reflects the introduction of species of largely Eurasian origin, whether inadvertent or not, which do not naturally occur within the continental area of Africa. Such species are therefore alien not only to the area under consideration, but also to the entire continent, and their introductions can be considered to be far more significant in terms of the disruption of natural mammal distribution patterns. This wave is historically the earliest and reflects the opportunities presented by the considerable shipping traffic between the Cape of Good Hope, Europe and Asia (typically for the inadvertent introductions), as well as the capacity

to move species considerable distances, which dictates that these species were typically small (such as the rabbit) or relatively easy to handle. This wave started virtually as soon as the historical record started, and extended into recent times.

The second wave reflects the redistribution of mammals mostly of African origin, and such movements resulted in both the introduction of species from elsewhere in Africa into the area dealt with in this book, or the movement of species that occurred in one part of this region into other parts. These species are typically larger than those introduced in the first wave, and this process was also initiated much later, as it required the development of the sophisticated game management technology needed to capture and transport wild African mammals. The developing game-farming and so-called ecotourism industry was typically the motivation behind most of these introductions (Castley *et al.* 2001a), which really gained momentum in the latter quarter of the 20th century.

The introduction of mammals into or across the area covered in this book will therefore be dealt with under the framework of these two waves, reflecting the Eurasian or African origins of the species, with the latter split into African species that naturally occurred outside the region of the book, and those that occurred within the region, but whose distribution has been altered within it.

Terminology and Eurasian species
It is not surprising that early recorders of the wealth of wildlife that they encountered at the Cape were sometimes at a loss for names for the animals that they observed for the first time. In these cases, it was not uncommon for these early recorders to fall back on the names of analogous species from Europe, with which they were familiar. These cases may lead to some confusion as to the occurrence of these species at the Cape and in its hinterland, but it should be noted that where there is no record of them being introduced, the explanation of the transfer of familiar names, as provided by Sparrman in 1786, and as set out in section 1.3, should be followed.

6.2 INTRODUCTIONS FROM EURASIA AND NORTH AMERICA

Brown or Norway rat (*Rattus norvegicus*)

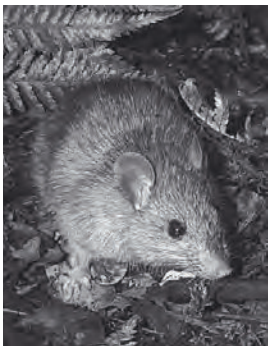
There are no records to indicate the date of introduction of the brown or Norway rat, and all indications are that this occurred inadvertently, either with cargo brought to present-day Cape Town or during shipwrecks along the coast. Given its natural distribution range in Asia and its willingness to travel in cargo, and also the (relatively) high volume of ship traffic between Asia and Europe, its introduction may have occurred soon after this shipping route was opened. This animal is typically commensal with man; Smithers (1983) reported that the brown rat had restricted its distribution to ports within the region under consideration.

House rat (*Rattus rattus*)

This species is also known as the 'black' or 'ship' rat, the latter name reflecting its willingness to board ships. This is also shown in its long history of expanding its range beyond its natural distribution in tropical Asia. Again, there are no records of its introduction into the area in question, but given its affinity for shipping, and its more aggressive range expansion globally, it may have arrived before the brown rat. Crawford and Dyer (2000) report that this species was "abundant" on Robben Island in 1614 and 1620. The house rat is also more widespread in the region under consideration than the brown rat, and it has moved extensively inland. However, it is apparently restricted to the moister areas (rainfall > 500 mm per year, Smithers 1983). An interesting early historical record of house rats refers to those that were apparently included in wagonloads of food that originated in Kimberley in 1892 (Smithers 1983).

House mouse (*Mus musculus*)

As for the rat species, there are no clear historical records of the first observations of the house mouse into the area covered by this book, as early recorders generally referred to these small rodents generically as 'rats' or 'mice'. This species originates in the Russian steppe region, but has now achieved a worldwide distribution and the house mouse is typically commensal with man. It is likely that animals were introduced with early cargoes or shipwrecks and this species can now be found throughout the area dealt with in this book (Smithers 1983).



The similarity in appearance of the (from left above, clockwise) brown or Norway rat, house rat and house mouse makes it unlikely that early observers, who were not trained in mammal taxonomy, would have been able to distinguish between these three species.

Photos: Photolibrary Group Ltd, Educational Museum of Egyptian Fauna and Creative Commons.org

Grey squirrel (*Sciurus carolinensis*)

The grey squirrel is a native of eastern North America, although the population in South Africa was sourced from Britain. This was a deliberate introduction, attributed to Cecil John Rhodes, but the date of the introduction cannot be established more precisely than between 1890 and the early 20th century (Smithers 1983). The original introduction site was Groote Schuur Estate in Cape Town, and the species was able to expand its range due to the availability of oak trees, pine plantations and fruit orchards. By 1920 this species had crossed the Cape Flats to the Paarl and Stellenbosch districts, and populations became established at Suider Paarl, Simondium, Groot Drakenstein, Pniel and Jonkershoek. It reached the Franschoek area and the Hottentots Holland Mountains by 1930 (Haagner 1920, in Smithers 1983). By 1933 it had reached Elgin (Davis 1950). A historical survey carried out in 1980 showed that these range expansions continued, with records for Firgrove and Faure (1930), Muldersvlei (1941) and Kuils River (1943) (Millar 1980). The process was also facilitated by further human intervention (Smithers 1983), with squirrels being moved to Swellendam (seven squirrels being moved from Paarl) in 1957, and Ceres in 1978 (two animals from Stellenbosch).

The grey squirrel was not always well received and in 1920 FitzSimons (1920,4:56) reported that it was "now on the vermin list, and threepence per head bounty is paid by the Cape Provincial Government." This presumably reflects concerns about crop damage in fruit orchards. In addition, its presence in an area is a function of the availability of suitable habitat, such as pine plantations. These can be removed to make way for other landuses, leading to a local collapse of the squirrel population.

Grey squirrel *Photo: Darren Bradnick Creative Commons.org*

European rabbit (*Oryctolagus cuniculus*)

The European rabbit is a good example of a domestic species that was able to enter the wildlife estate by going feral. It has been widely introduced throughout the world, largely to provide meat, with unintended negative consequences on the vegetation and local herbivores, as seen in Australia

(Cowan and Tyndale-Biscoe 1997). The fact that rabbits were not released on the mainland, as documented below, demonstrates a level of prescience by the Council of Seventeen (the governing body of the Dutch East India Company) that has been lacking in later wildlife policy. Their concerns about the potential impact of introduced species led to rabbits only being introduced to offshore islands, and the story therefore follows these individual populations.

The introduction of rabbits to Robben Island

Although the original idea of introducing rabbits to Robben Island in Table Bay does not appear in the actual journal of Jan van Riebeeck (a document written by a duty scribe and not by Van Riebeeck himself), Leibbrandt (1,1900:28) records a letter dated 13 May 1652 from Van Riebeeck to his headquarters in Amsterdam advocating the introduction of "…some rabbits to breed from in the downs so suitable for them". Thus, within a month of setting foot on soil at the Cape, he had the undoubted intention of releasing rabbits on the mainland, *i.e.* the Cape Peninsula.

The incongruity of this idea in a country teeming with game, something which drew comment from the crews of almost every passing ship, was heightened by Van Riebeeck's own references, in the same letter, to the great number of game animals and wildfowl which could be snared for the sake of their skins. Referring to birds (Leibbrandt 1,1900:28), he adds: "A bird-cage (trap) might be invented in which to catch numbers of geese, ducks and other waterfowl, in abundance here, would require for this purpose some tame ducks and geese from Batavia…". Presumably the Batavian birds were to be used as decoys. Yet, he still felt the need for rabbits.

Nevertheless, two years were to pass before the first consignment of rabbits was placed on Robben Island. On 3 April 1654, Van Riebeeck instructed Corporal Marcus Robbeljaert (stationed on the island and after whom Marcus Island in Saldanha Bay was to be named) (Leibbrandt 1,1900:244): "You also receive nine rabbits ['konijnen' in the Dutch text, thus proving that rock-rabbits or dassies were not meant] in a hutch. You are to open it in the sheep pen and let the animals run about as they like. In the hutches they will not breed, but we trust that they will thrive better in the sandhills. You are, however, to observe where they burrow that we may always find them".

These first rabbits did not thrive. Eight months later (Thom 1,1952:274), on 5 December 1654, "Marcus Robbeljaert wrote to inform us that there now remained 58 sheep, and that he had found eight rock-rabbits (*i.e.* rock hyraxes or dassies *Procavia capensis*, which had been taken there in 1601 and later) and only one rabbit still alive".

Nothing more on rabbits appears in the Van Riebeeck journals until a report on 17 October 1656 (nearly two years later) indicates the arrival of a new consignment from overseas (Thom 2,1954:67). "The rabbits arrived safely and were placed among the dunes where we had made shallow holes for them. Nothing had been seen for a long time of the other rabbits sent there two years ago; it was supposed that they had died or been eaten by snakes". This fear of snakes was no idle one for Van Riebeeck was constantly urging and ordering the islanders to exterminate the snakes, which he took to be poisonous, and which he felt would hamper the increase of the rabbit population, presumably by their taking the young.

Leibbrandt's historical account now reveals a startling fact, for which today's South Africans may well have cause to be thankful, and also one which shows the very justifiable fears of the Council in Amsterdam, to whom Van Riebeeck was responsible. In his letter, dated 5 March 1657, to the Council, Van Riebeeck writes: 'We obtained seven rabbits with the '*Princess Royael*, the male of which unfortunately died, so that the females placed on Robben Island cannot breed. It will therefore be necessary to send us some more, especially more than one male. They will no doubt thrive very well there".

Then comes the enlightening passage (here italicised) (Leibbrandt 2:297): "*According to your orders we keep none here on the continent lest they damage the garden and crops*". Had Van Riebeeck but known it, the Company in Holland was probably saving South Africa the fate suffered by Australia with its rabbit plague, unless our indigenous predators at the Cape would have kept the rabbits in check. Yet, why should they have done so? Hares, Van Riebeeck himself said, were abundant there; animals which live and sleep above ground whereas rabbits go to earth in burrows. Australia had its dingoes to match our jackals, although perhaps we have more carnivores overall.

On 16 July 1657, four months later, only three rabbits were left on the island, one white one, one grey one, and a black one. "They are extremely ruttish" said the journal (Thom 2,1954:133), "It is a pity that there is no male, for soon the island will be full of them". However, no male was to be placed there for another eight months, or a year after the does had been put there, until 16 March 1658 when two buck rabbits were sent over together with another doe and three young rabbits whose gender is not revealed (Thom 2,1954:242).

A month later, on 7 April 1658, another buck rabbit was sent to the island for breeding purposes, and a report from there said that it had arrived safely and was running with the others (Thom 2,1954:256). "They are all still alive, except the little white one which has been missing for some

days…It has very likely been eaten by ravens ['…dat het van de raven sal gegeten wesen' in the Dutch text] of which the dunes are full…").

In May 1658 a sad note crept into Van Riebeeck's journal (Thom 2,1954:269). "No rabbits have been seen. The white buck is dead, also the doe of the young rabbits sent last time, and the small white one; while the black-and-grey one is still alive. The last buck sent is worthless as it allows itself to be bitten by the others, which chase it about. The black buck is quite good but it seems to have forgotten the does".

However, the tide was about to turn. On 16 June 1658, Robben Island reported that "The white doe produced three young rabbits; they are as swift as the wind. We believe the mother is again with young, also the large grey one which I at first told Your Honour was a buck. The young rabbits which you sent last time are roaming the island". Fears were now beginning to be expressed that the rabbits would attack the island's vegetable garden with its sweet potatoes and greens (Thom 2,1954:284) and "…nothing will keep them out".

From now on Van Riebeeck's journal gives satisfactory accounts of the rabbits' well-being, and in January 1659, the Hague copy of the journal noted "…the presence of 50 rabbits on the island" (Thom 3,1958:2). The early fears of a rabbit failure now turned to fears of a rabbit population explosion. On 14 March 1659, five years after the initial placement of rabbits, Van Riebeeck's journal (Thom 3,1958:30) notes that "There is such an abundance everywhere that it will be difficult to exterminate the creatures; within two or three years they will overrun the island, since they increase most remarkably". Despite this cry of alarm, the fear of the depredations by snakes creeps into the report (Thom 3,1958:309), for, instead of being glad to have these predators under the circumstances, the incongruous remark is passed on 4 January 1661: "All over, rabbits were met with in their hundreds…and would do even better if there were not so many snakes and adders on the island, though the men kill some every day, and have thus reduced the numbers considerably".

Such was the rabbit position when Jan van Riebeeck's period of duty at the Cape ran to its close. To show the extent to which his Amsterdam instructions had impressed him, we find Van Riebeeck, after telling of the rabbits on Robben Island, leaving instructions for his successor, Commander Z Wagenaer, on 5 May 1662 (Leibbrandt 3,1900:254): "A few are still here [*i.e.* on the mainland] in hutches, from the increase of which you will be able to refresh the friends that call here, as we have done. But, above all, they are not to be let out of their hutches, or planted here on the continent, as our Lords Masters have expressly forbidden it, as they would spoil the gardens here".

A fascinating postscript to the history of rabbits on Robben Island lies in the recent survey work by De Villiers *et al.* (2010). They showed that in 2009 this population exceeded 24 000 individuals! Van Riebeeck could hardly have anticipated the success of his efforts, given the early travails suffered by these rabbits.

The question facing the management authority (Robben Island Museum) of what is now a World Heritage Site is how to reconcile this historically significant population of rabbits with other priorities, which include conservation. The Robben Island Environmental Management Plan rightly calls for their removal (Fortuin 2002), and efforts are being made to implement this. Ironically, it seems that these rabbits are as hard to remove (Kieser 2010) as Van Riebeeck found them to be to establish, and the final words on this population remain to be written.

European rabbit *Photo: Creative Commons.org*

The introduction of rabbits to other offshore islands

No satisfactory 'first dates' for the introduction of European rabbits to Dassen Island and the neighbouring islets in Saldanha Bay have been found, but the following items give some indication of when they were already known there.

Dassen Island

That Jan van Riebeeck had his eye on Dassen Island for rabbit production, an idea at first rejected by him, comes on 5 March 1657 (Leibbrandt 2,1900:298) when he writes: "Dassen Island, however, on account of the stench of the dead seals, is unfit for them". That he changed his mind about this ridiculous objection is shown in his instructions left to Commander Z Wagenaer, his successor, when, on 5 May 1662, he suggests (Leibbrandt 3:254): "Some may be placed on Dassen Island, however, that large quantities may be reared there". In 1668 a report from Jacob

Granaat (Leibbrandt 1901:256) says of the rabbits on Dassen Island: "The rabbits brought by us there, were likewise prospering well, and it was probable that in a comparatively brief period they would increase in fair number". From this we can adjudge that the rabbits were introduced to Dassen Island somewhere between 1662 and 1668.

That the introduction was successful is shown by OF Mentzel, a German chronicler of events at the Cape in the 18th century, who also reveals their fate (Mentzel 3,1787:232). "Rabbits were imported to the Cape from Europe, and Dassen Island was stocked with them, but the oil-refiners who were formerly sent there every year have thinned them out considerably. On the mainland I did not see a single one, the birds of prey having probably exterminated them" . Thunberg, the travelling botanist, certainly saw rabbits there on 22 September 1773, the island being called by him 'Taxel Island' (Thunberg 2:8, undated).

Skaapeiland (also known as Schapen, or Schaapen, Island), Saldanha Bay

This small islet's rabbits were first mentioned in 1781 when Francois le Vaillant (1,1790:45) "… found a prodigious number of rabbits in the small isle of Schapen Eylan : it became our warren, and was an excellent resource for our seamen".

Heinrich Lichtenstein (1,1812:54) also knew them there, in 1803. "European rabbits are also to be found, the descendants of some brought here and which have increased exceedingly".

Paravicini di Capelli (in De Kock 1965:26) stated that he shot 30 rabbits on Schapen Island on 20 May 1804, an indication of how many the island must have held.

Cooper and Brooke (1982) record that the original stock was extinct prior to 1953, when the island was restocked with albino white domesticated rabbits, which were observed in 1982. In 2010 these albino rabbits were confirmed as still present (B. Dyer, Oceans and Coastal Management, Cape Town, pers. comm. July 2010).

Other islands, Saldanha Bay

Of the other islands in and near Saldanha Bay, no early records have yet been found. Jutten, Marcus, Meeu and Vondeling islands had rabbits in 1970, but not Malgas Island (Superintendent of the Government Guano Islands, *in litt.* 15 October 1970). Meeu Island's rabbits were described as "very plentiful" in 1904 by WL Sclater, the Director of the South African Museum (1904:77-88).

Cooper and Brooke (1982) show that these populations suffered a variety of fortunes over time. Rabbits were eradicated from Malgas Island in 1977, when the last three individuals were killed. The Meeu Island population had also gone extinct by that year. The Marcus Island population was gone by 1982, and only Jutten and Vondeling islands in Saldanha Bay had extant populations in 1982. The Vondeling Island population was extinct by early 1993, whereas the Jutten Island population was still surviving in 2010 (B. Dyer, Oceans and Coastal Management, Cape Town, pers. comm. July 2010).

An island in the Keurbooms River, Plettenberg Bay, Knysna district

Edgar L Layard (1861:57), after mentioning the successful introduction of rabbits to Robben Island in Table Bay by Jan van Riebeeck, went on to say: "In 1859 we transmitted a few pair [*sic*] which were placed on an island in the Keurboom's River which falls into Plettenberg Bay. We thus note the date of its introduction to that part of the colony". The population is now extinct, but there is no record of the timing of this, beyond Cooper and Brooke's (1982:73) statement that these were "probably extinct before 1865".

That the experiment failed is obvious, but it would be interesting to know why an island in the Keurbooms River was selected, a site which, with the inefficient and infrequent land communications of that time, must have seemed remote to the citizens of Cape Town. Its choice seems strangely incongruous.

In view of Layard's connection with the South African Museum at that time, an appeal to the then Director, Dr TH Barry, for possible records or reports on the 1859 event, brought a reply from Mr Roger Summers, hon. archaeologist at the museum (*in litt.* 6 February 1974) who brought a fresh line of thought to the problem: "I believe that the only practicable method of transport would have been by sea. At that time there was a naval survey vessel HMS *Castor*, based on Simonstown, surveying the coast of East Africa. Layard made a trip on this ship in 1856/57 and so could well have asked the captain to put the rabbits ashore at some convenient place on the south coast, although even so the choice of a very low-lying islet in the Keurbooms River seems extremely odd".

The feasibility of a Royal Naval vessel being used for such a project was put to Commander RT Tripp, RN (retd) of the South African Naval Hydrological Service. His reply (*in litt.* 25 April 1974) confirmed that it was "quite feasible for the Survey ship *Castor* to have released rabbits there in order to ensure having a plentiful supply of fresh meat in the future, while the survey progressed".

In his letter, Commander Tripp referred to an island in the Keurboom's River shown on Trig. Survey Sheet 3423 AB (1:50 000) of 1967. This island is 2.5 ha in extent, an elongated oval 1030 m long and 250 m at its widest. Its greatest height

is 18 feet [5.5 m] above mean sea level. The northernmost point is only 20 m below the national road bridge spanning the Keurbooms River and its southernmost point is 2 km from the river mouth, which enters the sea through a long lagoon behind sandbanks.

Whatever the motive for this introduction, it is indeed fortunate that these rabbits did not appear to access the mainland, where the prospects of an Australian-style invasion may have loomed. We cannot determine whether it was floods, food shortages or local predators that led to the demise of this population, but we should be grateful for this outcome.

Feral pig/wild boar (*Sus scrofa*)

Domestic pigs become relevant to this account when they enter the wildlife estate; in such circumstances free-ranging domestic pigs are referred to as feral pigs. In the Western Cape, previously established feral pig populations were supplemented with wild boars, the ancestral species of the domestic pig. Thus, yet another Eurasian species has been added to the list of introduced species. The wild boar occurs naturally in densely vegetated habitats across northern Eurasia.

The locations of introduction sites or records of feral pigs/wild boars in the South-western Cape, and sites where populations are extinct, and where they persist, are shown on Figure 6.1.

Feral pig populations in the Waterval, Kluitjieskraal and Highlands Forest Reserves (plantations), that had been established at some earlier time, were supplemented with additional pigs by the Forestry Department in 1926, 1927, and 1945, respectively (Botha 1989). Similarly, pig populations were established on the Franschhoek (1937), Lebanon (1938), Swellendam (1944), Garcia (1947), Nuweberg (1947) and Jonkershoek (1950) plantations (Botha 1989). These animals were introduced for the purposes of biological control of the pine emperor moth *Imbrasia cytheria*, which was considered a problem in these plantations. The Kluitjieskraal feral pig population was supplemented with four wild boars of Austrian origin that were provided by the Groote Schuur Zoo in 1930, and again with a further six in 1935 (Hignett 2006). This supplementation was apparently aimed at producing a pig "that would be more successful in destroying the pine tree emperor moth" (Hignett 2006:22). Whatever the success of that aspect, it is clear that the many of the descendents of these pigs closely resemble wild boars in their ancestral distribution range.

Smithers (1983) documented a feral population of pigs in the Piketberg region in 1973, while

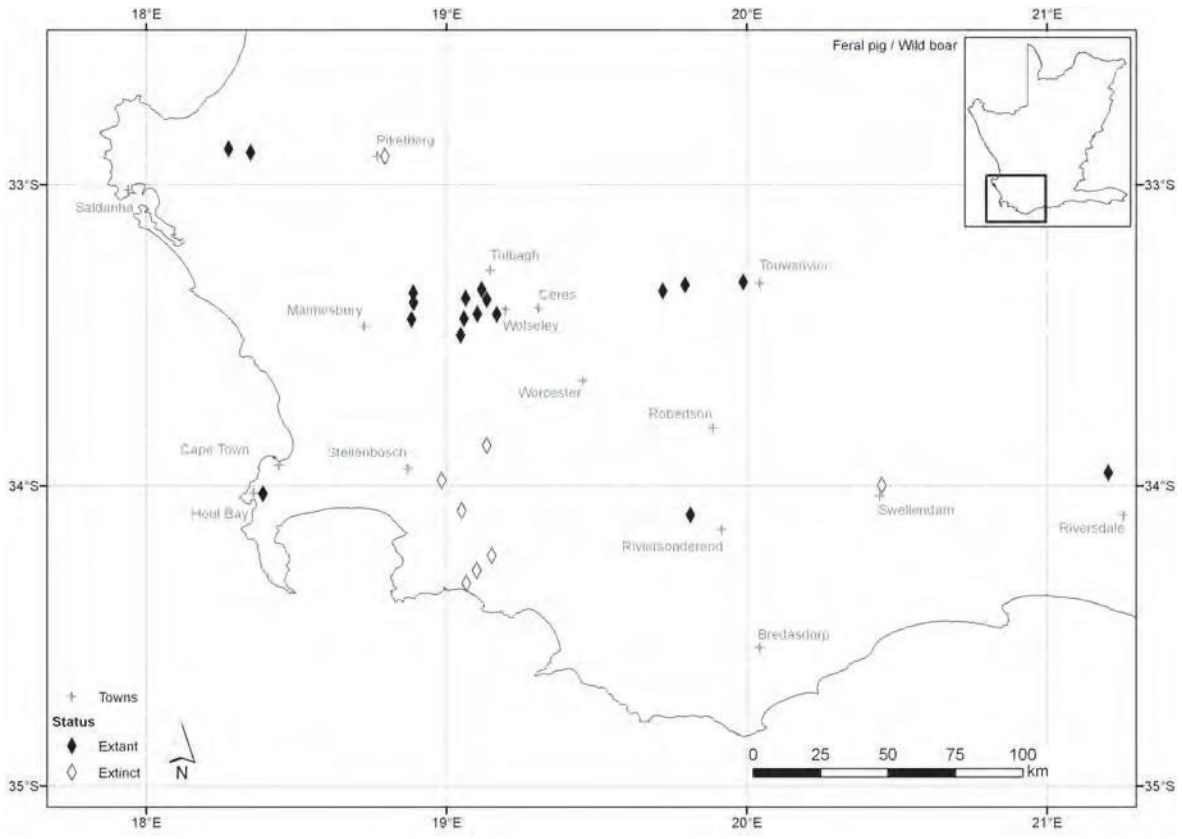


Figure 6.1 *Locations of introduction sites or records of feral pigs/wild boars in the South-western Cape. Sites where populations are extinct, and where they persist, are shown. Monitoring the existing populations, and their impacts on the environment, is key to managing this potentially invasive species.*

Feral pigs/wild boars *Photo: Wikimedia Commons*

Botha (1989) recorded pigs at Kersefontein (near Velddrif), Ganskraal (Riviersonderend), Bok River (between Ceres and Touws River) farms and Franschhoek, Garcia (Riversdale), Kluitjieskraal and Waterval Forest Reserves (Wolseley / Tulbagh). Hignett (2006) confirmed that the populations at Kersefontein, Kluitjieskraal and Waterval were extant and identified additional populations at Langrietvlei (adjacent to Kersefontein) and at Kloovenberg in the Riebeeck Valley, as well as "at Voelvlei Dam, Elandsberg and Krantzkop Private Nature Reserves, on the farm Kadema (near Kluitjieskraal) and Porseleinberg (south of Kasteelberg Mountain)" (Hignett 2006:23). The Garcia population near Riversdale persists (Karen Kirkman, pers. comm. 18 July 2010), whereas the Lebanon, Swellendam, Highlands, Nuweberg and Jonkershoek populations were extinct by 1989 (Botha 1989).

A wild boar-like feral pig was observed and shot in the Hout Bay area in 2005 (Hignett 2006), raising the prospect that this species may be established in the Table Mountain National Park. Is this another case of escapees from that famously porous Groote Schuur Zoo, compromising what is now a globally important conservation icon?

Wild boars have been shown to alter indigenous plant communities through their well-known rooting activities, and there are concerns around their impact on tortoises. Wild boars also bring about economic damage, particularly of vineyards (Hignett 2006). These impacts have, however, not been formally studied. Ironically, these pigs' role in the control of moth larvae in plantations is no longer required (Botha 1989), but they have not been removed by the Forestry Department. This suggests a lamentable lack of responsibility.

Fallow deer (*Dama dama*)

The fallow deer is a native of the Mediterranean Basin, extending eastwards to Iran. It has been widely introduced globally for meat production as well as for display animals, and it now occurs on all continents except Antarctica (Chapman and Chapman 1980).

Although popularly believed to have been introduced to the Cape by Cecil John Rhodes in 1897 (when he released some animals onto the Groote Schuur Estate on Table Mountain), fallow deer records for Newlands House in Cape Town date back to 1869 (Chapman and Chapman 1980). The date of the introduction of the species into the Cape has however been lost, but at least Rhodes can no longer be considered guilty of this introduction.

Records show that subsequent to the sale of Newlands House, the entire population of fallow deer was sold to a farmer in the Somerset West district, and it has since been widely dispersed into the area covered by this book (Chapman and Chapman 1980; Figure 6.2). By about 1970, Chapman and Chapman (1980) provided records for the fallow deer in 32 of the 113 districts of the then Cape Province.

Fallow deer *Photo: Jiri Bohdal*

Two notable populations include those on Table Mountain, and Robben Island. The Table Mountain population (presumably escapees from the Groote Schuur Estate) now presents a problem for the managers of the Table Mountain National Park, illustrating the risks of maintaining animal collections in the vicinity of important conservation areas. The Robben Island population was established with three individuals from Groote Schuur in 1963 (Chapman and Chapman 1980), and has recently (2010) been featured in the news, as the population was impacting on the vegetation of the island. The current environmental management plan for Robben Island calls for the complete removal of this species (Fortuin 2002).

Fallow deer distribution has continued to expand since the survey work in the 1970s (Chapman and Chapman 1980), although the relevant authorities have few good records of its current status and distribution. A survey of the opportunities to hunt fallow deers, as advertised in *Magnum* magazine and on South African websites during 2010 (G Kerley and M Landman, unpublished report, 2010), as well as feedback from experienced wildlife managers familiar with the area (Kerley *et al*. 2010), indicates that there are now few districts within the area covered by this book that do not support fallow deer (Figure 6.2). Their apparent absence from the more arid areas such as Bushmanland and Namaqualand probably reflects an ecological limit rather than any success by the conservation authorities to manage the spread of this invasive species.

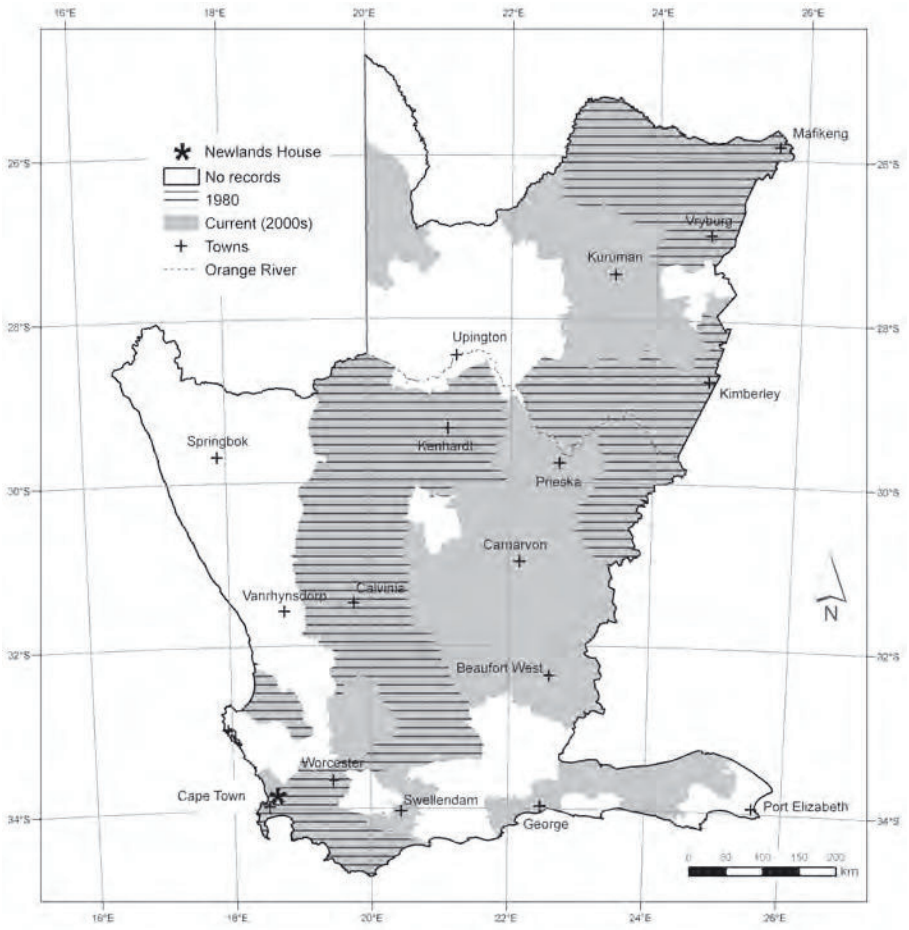


Figure 6.2. *The distribution (at a district level) of the fallow deer shows that from the original introduction location at Newlands House in Cape Town, it had spread to a number of districts by 1980 (horizontal bars – Chapman and Chapman 1980), and since then its range (shaded area) has expanded even further (according to current records).*

Red deer (*Cervus elaphus*)

The red deer occurs naturally across Eurasia and North America, it is variously known as the red deer, elk, or wapiti, and there is an outlier population in the Atlas Mountains of north Africa. It appears to have been relatively recently introduced into zoos in the area dealt with in this book (Smithers 1983), but Lloyd and Millar (1983) showed that in the period 1969-1974 red deers were recorded on farms in the Bredasdorp, Caledon, Piquetberg (Piketberg) and Swellendam divisions of the former Cape Province.

Red deer *Photo: Mehmet Karatay/Creative Commons.org*

Himalayan tahr (*Hemitragus jemlahicus*)

The Himalayan tahr probably has the highest public profile of the Eurasian species to be introduced to the area dealt with in this book, reflecting the recent controversy over its presence in the Table Mountain National Park. As its name indicates, this species is native to the Himalayas, and its introduction resulted from the escape of two animals from the Groote Schuur Zoological Estate on the slopes of Devil's Peak in 1936, and the subsequent establishment of a population on Table Mountain (McKinnon 1971). These animals thrived and by 1972 Lloyd (1975) reported an estimated total of 330 tahrs, which by then were to be found on Devils Peak, the northern and southern faces of Table Mountain and as far south-west as the Twelve Apostles above Camps Bay.

Himalayan tahr *Photo: General Public Use*

As a result of concerns over the impact of tahrs on the indigenous fynbos vegetation, the then Department of Nature and Environmental Conservation of the former Cape Provincal Administration proposed a control programme, to be implemented by the then managers of Table Mountain; namely the Municipality of Cape Town, under which more than 600 tahrs were removed between 1975 and 1981 (Smithers 1983). In 1998, South African National Parks became the management authority for Table Mountain and the programme of removal continued, such that by 2010 tahr sightings had become infrequent enough to merit news status (Gosling 2010).

Sometime in the 1980s a further population of the tahr was established in the Asbestos Mountains in the Northern Cape, north of the Orange River, but it subsequently became extinct (Kerley *et al.* 2010).

American bison (*Bison bison)*

The American bison is unusual among the animal imports from outside of Africa, as it originates on the North American continent, occurring historically in grassland and woodland habitats from northern Mexico to Canada. A tiny bison population was established on the farm Ratelfontein (formerly the property of the famous heart surgeon Dr Christiaan Barnard) in the Richmond area of the central Karoo during the 1990s (Kerley *et al.* 2010).

American bison *Photo: Ron Niebrugge wildnatureimages.com*

Feral cat (*Felis catus*)

The domestic cat has typically been introduced as a pet virtually everywhere that humans live. It is considered here as it has a propensity to adopt a free-living lifestyle, as a so-called feral cat, and then function within natural ecosystems. Reflecting the paucity of historical records, Van Aarde *et al.* (1981:168) state that "it can be assumed that the transportation of domestic cats to South Africa coincided with the early exploration and settlement of the subcontinent by Europeans during the middle of the seventeenth century." Van Aarde *et al.* (1981) showed that the feral cat population in Cape Town had genetic affinities with such populations in Amsterdam and Rotterdam in the Netherlands, and Bristol in southern England, thereby reflecting the influences of these cities in the development of Cape Town.

Feral cats have become established across the area covered by this book, largely in association with humans. Populations have also been established on offshore islands such as Dassen Island (Apps 1983) and Robben Island (De Villiers *et al.* 2010). The Dassen Island cat population was extinct by 2008 (B. Dyer, Oceans and Coastal Management, Cape Town, pers. comm. July 2010), whereas the Robben Island population was still present in 2009 (De Villiers *et al.* 2010), despite substantial variations in numbers over time that included at least one local extinction event (in "the mid-20th century" - Crawford and Dyer 2000:15). Management has been sporadic, and has included

the removal of 107 cats from the island in 1989/99 (Crawford and Dyer 2000). Current management plans call for the removal of the Robben Island cat population (Fortuin 2002).

Feral cat *Photo: Marianne Roberts*

Other species from outside Africa

A number of other species from outside Africa have also been introduced into the area covered by this book, largely in the late 20th century. These introductions are typically onto game farms, and the animals are managed for their hunting value, and are considered captive populations. The records of these introductions are vague, and the best one can do is document their presence, and even this is probably not comprehensive. From Eurasia we now have Indian black buck *Antilope cervicapra*, axis deer *Axis axis*, hog deer *Axis porcinus*, sambar deer *Rusa unicolor*, water buffalo *Bubalus bubalis* and mouflon sheep *Ovis aries orientalis* (Kerley *et al.* 2010).

A clear message from the history of introductions presented for other species (see above) and their impacts (see below), is that any introduced species has the prospect of becoming widespread and creating problems in its new habitat. One can therefore only speculate on the long term costs to society, and to the receiving ecosystems, of these introductions.

6.3 INTRODUCTIONS FROM ELSEWHERE WITHIN AFRICA

The temptation to introduce species from elsewhere into Africa into the area covered by this book has been too strong, especially in the latter half of the 20th century. These introductions, which have been poorly documented, have apparently been driven by the hunting industry (Castley *et al.* 2001a). There also seems to be no abatement of this pressure. As a consequence, African species such as addax *Addax nasomaculatus*, barbary sheep *Ammotragus lervia*, Nubian ibex *Capra ibex nubiana*, Nile lechwe *Kobus megaceros*, red lechwe *K. leche*, puku *K. vardonii*, Defassa waterbuck (*K. ellipsiprymnus defassa*, Arabian oryx *Oryx leucoryx*, scimitar-horned oryx *O. dammah*, sitatunga *Tragelaphus spekii*, Livingstone's eland *T. oryx livingstonii*, nyala *T. angasii*, forest buffalo *Syncerus caffer nanus*, Lichtensteins hartebeest *Alcelaphus lichtensteinii*, suni *Neotragus moschatus*, and red duiker *Cephalophus natalensis* (Kerley *et al.* 2010) now occur in an area which previously was special in terms of its natural large mammal communities.

6.4 INTRODUCTIONS FROM WITHIN THE AREA COVERED BY THE BOOK

Once the technology to move large mammals was developed, the game industry was able to indulge in the grand scale expansion of species' distributions within the area covered by this book. Unfortunately, this has been poorly documented. Although

The blue wildebeest (top) and impala (above) are just two of the many species that have been widely introduced into areas outside their natural distribution ranges within the area covered by this book.
Photos: André Boshoff (top) and Graham Kerley

we have some information as to which species have been successfully moved, we have less information as to how many of these translocations have failed, or what the economic and ecological consequences of the failed translocations have been.

Inspection of the list of species recorded historically within the area covered by this book and whose distribution is known (Kerley *et al.* 2010) to have been changed through introductions to new localities in this area (Table 6.1) shows that many of these ungulates have had their natural distribution ranges expanded by such introductions. In such cases these species now represent non-indigenous populations in areas in which they did not occur historically. Notable exceptions include the hippopotamus and the elephant. The carnivores have not suffered this extensive distribution re-arrangement, probably because most carnivore species were historically widespread anyway, and the large predators require very large areas of habitat, making it more difficult to establish new populations.

There are examples of translocations within the area covered by this book that are of some historical interest, by virtue of the availability of such records or the larger significance of the location. These include the West Coast National Park and Robben Island, and available information on these is summarised on pages 482 and 483.

Introductions can have major negative impacts, particularly in terms of ecological, pathogenic and genetic consequences.

Table 6.1 List of the ungulate species recorded historically within the area covered by this book and whose distribution is known to have been artificially changed through introductions to new locations within this area.

Species	Common name
Ceratotherium simum	White rhinoceros
Equus zebra zebra	Cape mountain zebra
Equus zebra hartmannae	Hartmann's mountain zebra
Equus quagga burchellii	Burchell's (plains) zebra
Phacochoerus africanus	Common warthog
Giraffa camelopardalis	Giraffe
Syncerus caffer	African buffalo
Tragelaphus strepsiceros	Greater kudu
Tragelaphus scriptus	Bushbuck
Connochaetes gnou	Black wildebeest
Connochaetes taurinus	Blue wildebeest
Damaliscus pygargus pygargus	Bontebok
Damaliscus pygargus phillipsi	Blesbok
Damaliscus lunatus	Tsessebe
Hippotragus equinus	Roan
Oryx gazella	Gemsbok
Redunca arundinum	Southern reedbuck
Redunca fulvorufula	Mountain reedbuck
Pelea capreolus	Grey rhebok
Antidorcas marsupialis	Springbok
Aepyceros melampus	Impala
Oreotragus oreotragus	Klipspringer

Aberrant forms and the domestication of our wildlife heritage

Man, along with magpies and bower birds, has always had a fascination for the rare or bizarre, and such objects are frequently coveted and collected. This has unfortunate consequences when it extends to our wildlife, as it leads to an increase in the value of unusually coloured specimens. Landowners therefore selectively encourage and maintain aberrant colour variations of wildlife on their properties.

The various springbok colour forms are probably the best known example of these colour variations, as this species occurs as the so-called common (*i.e.* white belly, chocolate flank, fawn back and white dorsal gland), the red or copper, the white or the black colour morph or form. The copper form lacks the white belly. The white form is not an albino but represents a case of leucism (the condition of reduced pigmentation in animals), as it often has a fawn tinge and the nostrils and eyes are pigmented. The black form is actually a chocolate colour, except for the white blaze.

The common form was historically overwhelmingly abundant, presumably reflecting its adaptive advantages. The white form was the only other form recorded historically, but in such low frequencies as to be an object of veneration and was protected by hunting taboos by the /Xam people (Roche 2005). Early European settlers adopted the opposite approach, exhibiting an unseeming lust to kill white springboks (Roche 2005). The black colour form is a recent phenomenon, as it was first recorded in the 1950s when a population was established on a single farm in the Murraysberg district (Skead 2007). This colour form therefore appears to have arisen as a mutation within this population, and has been built up in numbers by inbreeding. Both these unusual colour forms have now been bred up to high numbers, forming a substantial portion of the global population of this species. There is unfortunately limited scientific understanding of the genetic mechanisms determining these colour forms. A recent study by Hetem *et al*. (2009) showed that black springboks are able to maintain body temperatures more effectively under cold conditions but suffered under hot conditions, while white springboks did well under hot conditions but not under cold conditions; the common springbok represents an effective compromise to deal with the full range of temperatures. It is likely that the latter's coat pattern reflects the combined advantages of thermoregulatory and predator-avoidance adaptations.

A number of other ungulate species also occur as artificially-maintained colour forms, and are actively encouraged by selective breeding. As a consequence we now have the 'white' blesbok *Damaliscus pygargus phillipsi*, the 'golden' oryx (gemsbok) *Oryx gazella*, the 'golden' gnu *Connochaetes gnou*, as well as the 'black', 'midnight' and 'saddled' impala *Aepyceros melampus*. Other aberrant forms include a 'curly-haired' blesbok, in which the normally sleek appearance of this species is changed to a rough, shaggy one. This list can only grow as wildlife breeders learn to generate aberrant forms more effectively through inbreeding.

Two carnivores are also vulnerable to selective breeding. White lions *Panthera leo* are famous for having originated in the Timbavati area near Kruger National Park (Smithers 1983), but are now bred at will. These animals have no value in terms of lion conservation, as they represent a dilution of the normal buff-coloured lion gene pool and are maintained solely by inbreeding. The observed leucism is a result of the expression of the recessive gene known as "chinchilla", and maintaining inbred populations of white lions artificially increases the frequency of this mutated gene in the lion gene pool.

The cheetah has two known aberrant forms, the 'woolly' and 'king' cheetahs. The 'woolly' cheetah had denser, woollier fur, shorter limbs and fulvous rather than black markings. Only a single specimen has been recorded and this was captured in the Beaufort West district in the central Karoo in 1877 (see section 4.2.23), and held in the London Zoo for a number of years until

Continued
it died (Smithers 1983). The 'king' cheetah, with its marking reminiscent of a tabby cat, was historically recorded in Zimbabwe in 1927, when it was mistakenly given species status as *Acinonyx rex* (Smithers 1983). It was subsequently realised that the king cheetah is simply a colour form of the cheetah *Acinonyx jubatus*. In 1981 two 'king' cheetahs were bred in captivity from closely related, normally coloured parents (Smithers 1983). The fact that the 'king' colour form was exposed by inbreeding has done little to dampen the enthusiasm for breeding them.

None of these ungulate or carnivore colour forms are recognised as separate species. Hence attempts to elevate them to such status by game farmers are no more than marketing strategies under the cloak of pseudo-science.

This increase in the abundance of what are simply unusually coloured individuals is clearly artificial selection and is recognised as domestication. One can only speculate as to the consequences of all this inbreeding for the genetic fitness of all these animals. If these odd colour forms had adaptive value they would have been encountered in the historical record. This suggests that this domestication is undoing the adaptive value found in these species. Sadly, the wildlife industry fails to recognise this and often mistakenly labels such action as conservation, whereas in fact the genetic integrity of the species is being undermined in a rash frenzy of colour manipulation.

Our wildlife heritage is now facing this new threat and it would be sad if those species that survived the pressure of overhunting in earlier years were to succumb to domestication, owing to man's fascination with the bizarre.

The various colour forms (top: white, black and normal coloured springbok, above left: white blesbok, above right: white lion) are all artificially maintained (and often deliberately promoted) by high levels of inbreeding, which is widely recognised to reduce the evolutionary viability of populations.

Photos: (top, clockwise) Brenda de Witt, Greatstock/Barcroft Media and Juan Garcia

Introduced species in the West Coast National Park

The high conservation status of the West Coast National Park has led to some attention being paid to the history of introductions of species that did not occur naturally on properties that were eventually incorporated into this park, which was proclaimed in 1985. This information (per JG Castley, *in litt*. March 2010) can be summarised as follows:

- The gemsbok was introduced in 1972, sourced from Okahanja and Kalkveld in Namibia.
- The kudu was introduced in 1972, sourced from Kalkveld in Namibia.
- The black wildebeest was introduced in 1968, sourced from De Hoop Nature Reserve to the east of Bredasdorp (note that this would have been a secondary translocation as De Hoop is also not in the natural range of this species), and again in 1969, sourced from Harrismith in the Free State.
- The blue wildebeest was introduced in 1969, sourced from KwaZulu-Natal.
- The blesbok was introduced in 1968 and 1969, sourced from Caledon (another secondary translocation).
- An attempt to introduce the bontebok from the then Cape Point Nature Reserve in 1969 failed as both animals died, but this species was successfully introduced in 1977, sourced from De Hoop Nature Reserve.
- The mountain reedbuck was introduced, from Cradock, in 1976.
- The impala was introduced from KwaZulu-Natal, in 1969.

The history of this area highlights a further point, as many of the historically occurring species that were reintroduced (*i.e.* species that occurred there naturally but had been extirpated) into what is now the West Coast National Park were not available locally. As a consequence, individuals representing different ecotypes had to be sourced further afield. Thus, the present eland population is derived from individuals from De Hoop Nature Reserve (originally derived from both Kalahari and Drakensberg stock), Kimberley, Otjiwarongo (in Namibia) and Caledon. Similarly, red hartebeests were brought in from Kalkveld (in Namibia) and Vaalbos National Park (JG Castley, *in litt*. March 2010). Thus, even populations of species that occurred historically in the area are now the products of extensive translocations, and not genetically representative of the original local populations (*i.e.* ecotypes). We have no idea of the evolutionary or ecological implications of these within-species translocations.

In 2001 it was recognised that many species in the West Coast National Park were inappropriate historically, and the concerns about their impact on the vegetation led to recommendations to remove the blue wildebeests, kudus and bonteboks (Castley *et al.* 2001b). By then the black wildebeest had gone. Nearly a decade later, the mammals in the park still include blue wildebeests, kudus and bonteboks, while the Cape mountain zebra has been introduced (South African National Parks 2010), despite Castley *et al.*'s (2001b) misgivings about the appropriateness of this latter species. As indicated in the account for this species (section 4.2.49), the closest historical record was on the Piketberg, 70 km away from the West Coast National Park. And so the saga continues.

Introduced species on Robben Island

Robben Island is a small area (507 ha) that has assumed a very large significance in South Africa's history as a place of incarceration of political figures. The island is now a World Heritage Site, with a heavy focus of using lessons from the past to remind current generations of how humans should treat other humans. The island also has a long history of introductions of mammals, and given the significance of this island it is worth reviewing them.

Robben Island has been separated from mainland Africa for about 9 000 years (Crawford and Dyer 2000) and Cape fur seals *Arctocephalus pusillus* (hence the name) were the only medium to large-sized mammals present on the island at the start of our historical record. Early seafarers introduced sheep as early as 1608 as a source of food for passing ships (section 4.2.4), and Van Riebeeck followed this tradition, motivated by the absence of predators on the island. Its proximity to the new settlement (it is 6.7 km from Cape Town) and the absence of mammals served as a powerful incentive to introduce other species to the island. Van Riebeeck was quick to succumb to the temptation, introducing the European rabbit and rock hyraxes (dassies) onto the island – the details of this are provided above and in section 4.2.4. Other non-African species that have been introduced onto Robben Island are the domestic cat and the fallow deer, while African species include the blue wildebeest, eland, bontebok, steenbok, and springbok.

- The blue wildebeest was introduced "after World War II". According to Crawford and Dyer (2000:10) this species was "soon shot out".

Robben Island, although a relatively small area, looms large in South African history and is well recognised for its political significance. Importantly, given the long history of the introduction of mammals (none of which are indigenous), the island should also serve as a lesson on the ecological and economic costs of such introductions. *Photo: Alain Proust*

- The bontebok was introduced in 1985, with a further introduction of three males (from the West Coast National Park) in 1999. The population, apparently peaking at about 50 animals in 1999 (Crawford and Dyer 2000), went extinct in 2008 (De Villiers *et al.* 2010).

- The eland was introduced between 1945 and 1955, but failed to flourish, despite a further introduction of two bulls (from the West Coast National Park) in 1999. Population estimates include 11 animals in 1985, four in 1995, three in 1996 (Crawford and Dyer 2000), four in 2002 (Fortuin 2002) and a single animal in 2010 (B. Dyer, Oceans and Coastal Management, Cape Town, pers. comm. July 2010). Given that the Robben Island Environmental Management Plan calls for the removal of the eland on the basis that it is neither indigenous nor sustainable (Fortuin 2002), the removal of this last individual will be the end of the eland story on Robben Island.

- The springbok was also introduced between 1945 and 1955, with further introductions in 1975. Population sizes of up to 80 animals have been recorded (Crawford and Dyer 2000), and the plan is to remove all of these (Fortuin 2002). In 2010 about 5-10 springbok were still on the island (B. Dyer, Oceans and Coastal Management, Cape Town, pers. comm. July 2010).

- The steenbok was unsuccessfully introduced to Robben Island in 1658, the earliest known attempt to translocate wild ungulates in South Africa. The two animals (ewe and lamb) did not survive (Crawford and Dyer 2000). A second, successful introduction occurred in September 1973 and a census in 1998 yielded 253 animals (Crawford and Dyer 2000). The Robben Island Environmental Management Plan (Fortuin 2002) incorrectly identifies the steenbok as occurring naturally on the island and a stated objective is to manage this species sustainably. It seems that this plan has not been properly informed as to the history of the island.

It is clear that Robben Island, in addition to its socio-political value, can also serve as a lesson on the pitfalls of introducing non-indigenous species. It would be very valuable if this lesson could be incorporated into the tourist experience that is staged on the island.

6.5 IMPACTS OF INTRODUCED SPECIES

It is widely recognised that introduced species bring with them a variety of impacts to the receiving ecosystem. Worryingly, these impacts have been identified, along with overhunting, habitat destruction and chains of extinction, as one of the main drivers of the loss of biodiversity through extinction (Caughley 1994). The mechanisms of the impacts of introduced species can be broadly seen as being through habitat alteration, competition, predation, disease and hybridisation. Although poorly studied, there is evidence for all of these processes being brought into play and through which the naturally occurring species and ecosystems in the area covered in this book have been affected. In addition, introduced species have been shown to lead to economic costs (Cousins *et al.* 2010).

Habitat alteration

Despite the broad recognition of the potential impacts of introduced species, there is little known about the impacts of these introduced herbivores in terms of habitat alteration within the area in question. This may reflect the fact that this area is replete with large herbivores, and hence it is difficult to assign impacts of herbivory specifically to introduced species. There are four notable exceptions, each of which is revealing in terms of how introduced species can impact ecosystems.

European rabbit

The introduced European rabbit (see section 6.2) has been widely recognised as altering the vegetation structure and dynamics of the offshore islands to which it has been introduced (Cooper and Brooke 1982). De Villiers *et al.* (2010) point out that on Robben Island this effect is masked by the fact that the vegetation is dominated by introduced (alien) invasive plant species (and therefore not apparently of conservation concern), although they do identify cases of indigenous plant species (such as pipe grass *Ehrharta villosa*), being affected. It is ironic that introduced herbivores can persist in their impacts on indigenous plants because they are able to maintain populations by feeding on introduced plants.

Himalayan tahr

In contrast to the case of the rabbit, Himalayan tahr (see section 6.2) impacts on the vegetation of Table Mountain have raised more immediate concerns. These relate to not only the loss of indigenous plants, but also to observations of accelerated soil erosion (Lloyd 1975). Apparently, tahrs are able to suppress the regenerating fynbos communities in areas responding after fire, these impacts being through non-selective feeding and trampling effects. This "ongoing habitat destruction" (Castley *et al.* 2002:2) was considered sufficient to place the prospects of reintroducing the indigenous klipspringer to Table Mountain at risk. The removal of the Table Mountain tahr population was therefore motivated by these concerns.

Feral pig

The third instance of such impacts is notable because it varies so widely from the way any of the indigenous species affect the system. Feral pigs (see section 6.2), like their Eurasian brethren, have been documented to turn over the upper soil layers and vegetation, particularly in marshy areas, through their well-known rooting activities (Hignett 2006). The scale at which this occurs is much larger than the more focused digging of the indigenous porcupines, and may also have a cascading effect as this rooting behaviour apparently creates opportunities for the establishment of alien invader plants (Hignett 2006).

Giraffe

The giraffe *Giraffa camelopardalis* has been widely translocated in areas south of the Orange River, *i.e.* beyond its historical range. This species is a specialised browser that is able to feed at heights greater than any of the other indigenous browsers, with the exception of elephants *Loxodonta africana*. Like the elephant, the giraffe is a megaherbivore, and its large body size confers especially high resource demands on the landscapes that support it. Hoffman *et al.* (2009) failed to show any impacts of giraffe (among other introduced species) on the vegetation at a site in the Little Karoo. This finding is intriguing as it contrasts with the finding by Jacobs (2008) that introduced giraffes altered the structure of trees in the Eastern Cape. Furthermore, Bond and Loffell (2001) showed that in KwaZulu-Natal introduced giraffes were able to cause the local extinction of *Acacia* species through their feeding impacts. The Hoffman *et al.* (2009) study should therefore be interpreted with caution, and further research is needed to understand the impact of the giraffe, as it serves as an excellent example of a species that brings with it novel feeding impacts when it is introduced.

Competition

Competition, although intuitively sensible, is difficult to demonstrate. The abovementioned concerns about the exclusion of the klipspringer by Himalayan tahr on Table Mountain have not been quantified and it will be vital to monitor the

The giraffe is able to browse above the feeding heights of other species (with the exception of the elephant) and so can be expected to provide specific feeding impacts on plants (particularly trees) in areas to which it has been introduced.

Photo: Evert Jacobs

success of the reintroduction of the indigenous klipspringer in the presence of tahrs. The exclusion of the indigenous bushbuck by introduced nyalas has been demonstrated in KwaZulu-Natal (Coates and Downs 2005), and one can only speculate as to the unintended consequences of the host of introductions of herbivores on the naturally-occurring species in the area dealt with in this book. In the West Coast National Park, Castley *et al.* (2001b) pointed out that the introduced species represented over 40% of the biomass of the herbivores, thereby limiting opportunities for the populations of indigenous species to grow.

Predation

The feral cat (see section 6.2) is the only introduced species that is a predator. Few studies have documented the impact of feral cats in the area dealt with in this book, probably reflecting the abundance of other, apparently more interesting, predators to attract the attention of local ecologists. It is therefore also likely that the impacts of cats on the mainland need to be seen in the context of a predator-rich ecosystem. The situation is however different on the South Africa's offshore islands, which had historically been free of mammalian predators. On Dassen Island, Apps (1983) showed that feral cats preyed on African penguins, Cape cormorants, Cape wagtails, black-backed gulls and terns. Apps (1983) also commented that some species of birds may have been prevented from breeding on Dassen Island, given the fact that cats had been present for over 100 years. Crawford and Dyer (2000:15) identify cats as the "most damaging" of the introduced mammals on Robben Island. They attributed the breeding failure of Hartlaub's gulls and swift terns to cat predation, and also noted that cats consumed large numbers of penguin eggs. Concerns regarding the impacts of cats on the bird fauna have led to their planned removal from the island under the current Robben Island Management Plan (Fortuin 2002).

Disease

Introduced rats are synonymous with disease, and bubonic plague or 'black death' is transmitted by infected fleas harboured by rats, the rats serving as a reservoir for the bacteria *Pasteurella pestis* that causes the disease. The first case of plague in southern Africa (in Mozambique) has been linked to a ship which had earlier called in the then plague-ridden Madagascar (Smithers 1983). Davis (1953) confirmed that indigenous rodents exposed to introduced rats were infected with *P. pestis* and were thereby able to serve as an even larger reservoir for this disease.

A further link between disease and introduced species is the association of malignant catarrhal fever with the blue wildebeest, and the risks that this carries for domestic livestock. The virus that causes this disease (a herpes type virus) is endemic to the blue wildebeest, although without any pathogenic effects. Cattle and sheep are however susceptible to the virus, and are vulnerable when kept in proximity with blue wildebeests. The disease attacks the respiratory system and leads to a loss of weight and may cause death, hence there are obvious economic losses associated with the disease. Bison and deer are also vulnerable to the disease.

Hybridisation

The integrity of a species is the outcome of the process of species formation, with isolation of ancestral populations being one of the core requirements of this speciation to occur. It is not surprising then that when the spatial separation between closely related species is removed, hybridisation may occur. One of the direct consequences of the introduction of species into an area that contains naturally occurring, closely related, species may thus be hybridisation of these species. The risk of this is greater the more closely related the taxa are, and would for example be higher at the subspecies level than at the genus or family level. Besides compromising the integrity of a species, hybridisation may lead to reduced fecundity, elevated mortality and loss of market value (Fabricius *et al.* 1989).

Examples of hybridisation in the area covered in this book range from pigs to cats, and include some of the region's iconic ungulates, such as the bontebok. The scale also varies, ranging from isolated accounts to major conservation threats. Thus, feral pigs have been recorded to hybridize with indigenous bushpigs (Krause 1838-40(1973); Smithers 1983), although this appears to be on a limited scale, possibly masked by the lack of studies on the feral pigs. In contrast, the threat posed by domestic cats hybridizing with the African wild cat *Felis silvestris* is substantial and growing (Friedman and Daly 2004). It is increasingly difficult to find pure African wild cats near human settlements (Smithers 1986), reflecting the consequences for the indigenous fauna of domestic cats associated with people.

The two other examples of ungulates that are known to be at risk of hybridisation are ironically species that occur naturally within the area dealt with in this book, but have had their distribution altered by human intervention. These examples are the bontebok x blesbok hybrids and the black wildebeest x blue wildebeest hybrids.

The bontebok *Damaliscus pygargus pygargus*, separated from the blesbok *Damaliscus pygargus phillipsi* at the subspecific level, was historically spatially isolated from the blesbok (compare figures

4.32 and 4.33 in Chapter 4), and assumed significant conservation status. This was based on the fact that it was endemic to the Western Cape (see section 4.2.63) and was nearly exterminated by hunting during the 1800s, with a population nadir of just 121 individuals in 1921 (Pringle 1982). This led to the establishment of the original Bontebok National Park in 1931. The iconic status of the subspecies was confirmed when the then Cape Department of Nature Conservation included the stylised profile of a pair of bonteboks in its coat of arms, and later adopted a bontebok head profile for its logo. Allardice and Gaigher (1979) provided an early warning of the risks of hybridisation with the blesbok, and Smithers (1986) pointed out that hybrid individuals had been widely dispersed in South Africa, including into the then Northern Cape (*i.e.* the area north of the Orange River). He was not confident that this risk to the bontebok could be effectively managed or reversed. Fabricius *et al.* (1989) sampled a number of bontebok and blesbok populations and they were able to reliably identify hybrids using external features. Despite these warnings, authorities and the wildlife industry have not been successful in preventing the ongoing risk of hybridisation, which is identified in the South African Red Data book on mammals as the top ranking threat to the subspecies (Friedman and Daly 2004). The bontebok is now classified as 'Vulnerable' (Friedman and Daly 2004), and it is ironic that an icon that was nearly lost to us through hunting, is now threatened by interbreeding with the much more common blesbok.

The black wildebeest *Connochaetes gnou* is at risk from hybridisation with the blue wildebeest *Connochaetes taurinus* (Fabricius *et al.* 1988), even though these two species did naturally overlap in their distribution range in the area covered in this book (compare figures 4.29 and 4.30 in Chapter 4) and elsewhere (Skinner and Chimimba 2005). Hybridisation is a function of confinement of these two species together in game ranches and nature reserves. Fabricius *et al.* (1988) hypothesised that this leads to the breakdown in the habitat difference of the species, as the black wildebeest is an open habitat species, whereas the blue wildebeest uses woodland habitats. Hybridisation is invariably a case of the larger blue wildebeest bulls dominating mating opportunities.

Both these crosses (bontebok x blesbok and black wildebeest x blue wildebeest) produce fertile offspring (Fabricius *et al.* 1988, 1989), although it is not known whether there is any decline in survival of the hybrid progeny. These fertile hybrids increase the risk of this hybridisation, as it is increasingly difficult to detect second or third generation hybrids in populations. As a consequence, many bontebok and black wildebeest populations can no longer be considered as being purebred, and this problem is exacerbated by the lack of reliable record keeping of game movements by conservation authorities and private game-based ventures.

In addition to the conservation risk to the bontebok and the black wildebeest, this hybridisation leads to a loss of economic value of the progeny. Furthermore, a number of populations of these two species within which hybridisation has been observed have been eradicated in order to reduce this risk (Smith 1983). The trophy hunting industry is also wary of these hybrids and USA-based Safari Club International, for example, warns hunters to learn to distinguish between hybrid and purebred individuals (Anon. 2010).

A blue wildebeest x *black wildebeest hybrid, showing the characteristic downward and then outward curve of the horns, and the general appearance representing a mixture of the features of the parent species.* *Photo: Ezemvelo KZN Wildlife*

The possibilities of the various equids (Burchell's (plains) zebra *Equus burchellii* (*quagga)*, Cape Mountain zebra *Equus zebra zebra* and Hartmann's mountain zebra *Equus zebra hartmannae*) also hybridizing is very real, especially so for the two mountain zebra subspecies, which should therefore always be kept separate. The risks of Burchell's (plains) and mountain zebra hybridising is reduced by the differences in their habitat use (as reflected in their common names), but these differences can be overcome when the two are kept together in small areas. This situation should therefore be guarded against.

Summary

This summary of the impacts of introduced species clearly identifies the risks of such introductions, but also highlights how poor is our understanding of these impacts. One would have hoped that those responsible for managing the situation, namely government authorities and the wildlife industry, would have invested more effort in understanding

the extent and the consequences of such introductions, in terms of their potential or real negative impacts on species conservation and economic development. Instead we are left with a series of glimpses of serious challenges to our biodiversity, economy and health, accompanied by a few inadequate management responses (Cousins *et al.* 2010). One can only speculate how harshly future environmental and social historians will treat our approach to this problem.

6.6 CONCLUDING REMARKS

It is clear that over the last 350 years humans have profoundly altered the composition and distribution of mammals in the area covered by this book, despite the spectacular original community. This has been achieved in part (see also Chapter 5) by the introduction of novel species, including some from beyond the continent of Africa, the redistribution of species within the area, and the increase in aberrant forms through selective breeding. This grand scale meddling with the mammal biodiversity has also been shown to have impacts on the receiving ecosystem, but we have virtually no understanding of this or the economic costs.

What is also apparent is that policy, after the auspicious start of banning rabbits from the mainland in 1654, has obviously had limited impact in managing this process. Unfortunately, we lack a historical perspective of the legislative or policy environment under which all these species were introduced or moved around, although it is apparent that much of this occurred in the latter half of the 20th century. Only time will tell how effective recent government initiatives will be to limit the proliferation of non-indigenous species (Cousins *et al.* 2010), but it is likely that recent declines in the capacity of provincial conservation agencies will undermine these initiatives.

We should also pay attention to the role of formal zoological gardens in the introduction of species. In this regard, it is clear that the Groote Schuur Zoo has historically served as a conduit for a number of species into the wildlife estate over the years, of which some have created significant conservation problems.

This overview of the history of introductions and translocations of mammals shows that these have resulted in the extensive homogenisation (with the faunas of Europe, Asia, America, the rest of Africa, and the area covered by this book – *cf.* Spear and Chown 2008) of what was originally a truly spectacular wildlife fauna. This has been compounded by the decline of many species within their natural ranges, as set out in Chapter 5. The unique value of the larger mammal component of the region's wildlife has thus been lost, and sadly, so have the prospects to compete on global markets for unique ecotourism experiences. That so much natural capital, which developed through aeons of evolution, could be lost in a few short centuries does not reflect well on our stewardship of this region.

[Text by the editors]

Artist: WC Harris (in Harris 1840)

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