Review of alien species on South African offshore islands

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The occurrence of alien species on South African offshore islands is surveyed. Aliens (species not indigenous to the adjacent mainland of the Cape Province or Namibia, or, in the case of certain vertebrates, present by deliberate translocation), have been noted on 21 islands. It is probable that a more thorough search on Robben Island, the islands of Algoa Bay and off the Namibian coast would reveal more species and more islands occupied. Sixteen alien vertebrate species are involved, 19 invertebrates and 50 seedbearing plants. The ecological history of the offshore islands is outlined and it is shown that in most cases arrival of aliens has taken place in the last 100 years, sometimes in the last 25 years. But for nearly all species there is no information available on how long they have been on each island, how they reached it and whether they have a detrimental impact on the rest of its biota. It is recommended that the feral cats Felis catus *on Dassen and Robben islands be exterminated in the interest primarily of seabird conservation. The widespread presence of the skin beetle* Dermestes maculatus *is noted.*

Die teenwoordigheid van vreemde dier- en plantsoorte op die eilande langs die Suid-Afrikaanse kus is ondersoek. Vreemde soorte - wat nie inheems op die nabygeleë vasteland van die Kaapprovinsie of in Namibië is nie, of in die geval van sekere gewerwelde diere deur opsetlike oorplasing aanwesig is - is wel op 21 eilande waargeneem. 'n Deegliker ondersoek op Robbeneiland en die eilande in Algoabaai en langs die Namibkus kan meer soorte en meer eilande wat deur hulle bevolk is aan die lig bring. Sestien vreemde werweldiere, 19 ongewerweldes en 50 bedeksadige plante is ter sprake. Die ekologiese geskiedenis van die eilande langs die kus word uiteengesit en daar word daarop gewys dat die aankoms van die vreemde flora en fauna in die meeste gevalle gedurende die laaste 100 jaar plaasgevind het, soms gedurende die afgelope 25 jaar. Vir die meeste soorte is daar egter geen inligting beskikbaar oor hoe lank hulle reeds op elke eiland aanwesig is nie, hoe hulle dit bereik het en of hulle 'n ongewenste uitwerking op die res van die biota daarvan het nie. Daar word aanbeveel dat die wilde huiskatte Felis catus *op Dassen- en Robben-eiland uitgeroei word, en wel in die eerste plek in belang van seevoëlbewaring. Die wydverspreide aanwesigheid van die velkewer* Dermestes maculatus *is aangeteken.*

Introduction

The aim of this paper is to catalogue what is known of macroscopic alien species on South African offshore islands, to draw attention to any problems they may cause and to suggest remedies. The islands concerned are continental ones which belong to the Republic of South Africa from Hollamsbird in the north, to Bird Island, Algoa Bay, in the east (Fig. 1). Two islands are now joined to the mainland by causeways (Bird (Lambert's Bay) and Marcus) and cognizance of this has been taken in Appendix 1.

Methods

The literature was scanned for references to macroscopic alien animals and plants on offshore islands. Invertebrate material collected by or for RKB on islands and deposited in the South African Museum, Cape Town, was studied by AJP. Data were also sought by correspondence.

Taxa are deemed to be aliens on offshore islands if they are not known to be indigenous to the adjacent mainland coastal areas of the Cape Province or Namibia (South West Africa). Deliberate translocations of indigenous vertebrates are noted where they have occurred and have remained to the present day (1985): only Dyer and Robben islands are affected. Attention is not given to unsuccessful translocations of which details for mammals may be found in Cooper *et al.* (1985). In the cases of invertebrates and plants (other than trees) it is usually not possible to say whether a taxon was deliberately introduced, accidentally introduced or reached an island by natural dispersal from the adjacent mainland once it had become naturalised there.

Biotic surveys of most of the offshore islands of the south-western Cape were made to provide a baseline for future studies of biotic turnover, not of the impact of alien species on island communities. In addition, the data for the islands off the Namibian coast and in Algoa Bay are certainly less complete than they could easily be. For instance, there are no survey data at all for Hollamsbird, North Reef, Pomona, Plumpudding and Sinclair islands off Namibia although it is likely that some alien taxa would easily be found.

Robben Island has proved a problem for this study. It has been continuously inhabited since 1652 (Thom 1952-58, De Villiers 1971) and is now a Prisons reserve which limits the possibilities for *ad hoc* biological surveys. As noted by Cooper *et al.* (1985) and Cooper & Brooke (in press), a full biological survey of Robben Island is very desirable. Meanwhile, we have extracted what data we could from the literature but it must be accepted that the data are less complete than for most large South African islands, not least because the botanical survey on which we primarily rely is 50 years old (Adamson 1934).

Results

Evidence for the presence of alien species on 21 islands was found (Appendix 1) with the largest, Robben, having the greatest number. The taxa concerned (16 vertebrates, 19 invertebrates and 50 seedbearing plants) and the islands on which they have been found are listed in Appendix 2.

Discussion

South African offshore islands were undisturbed by the indigenous inhabitants of the Cape Province and Namibia who

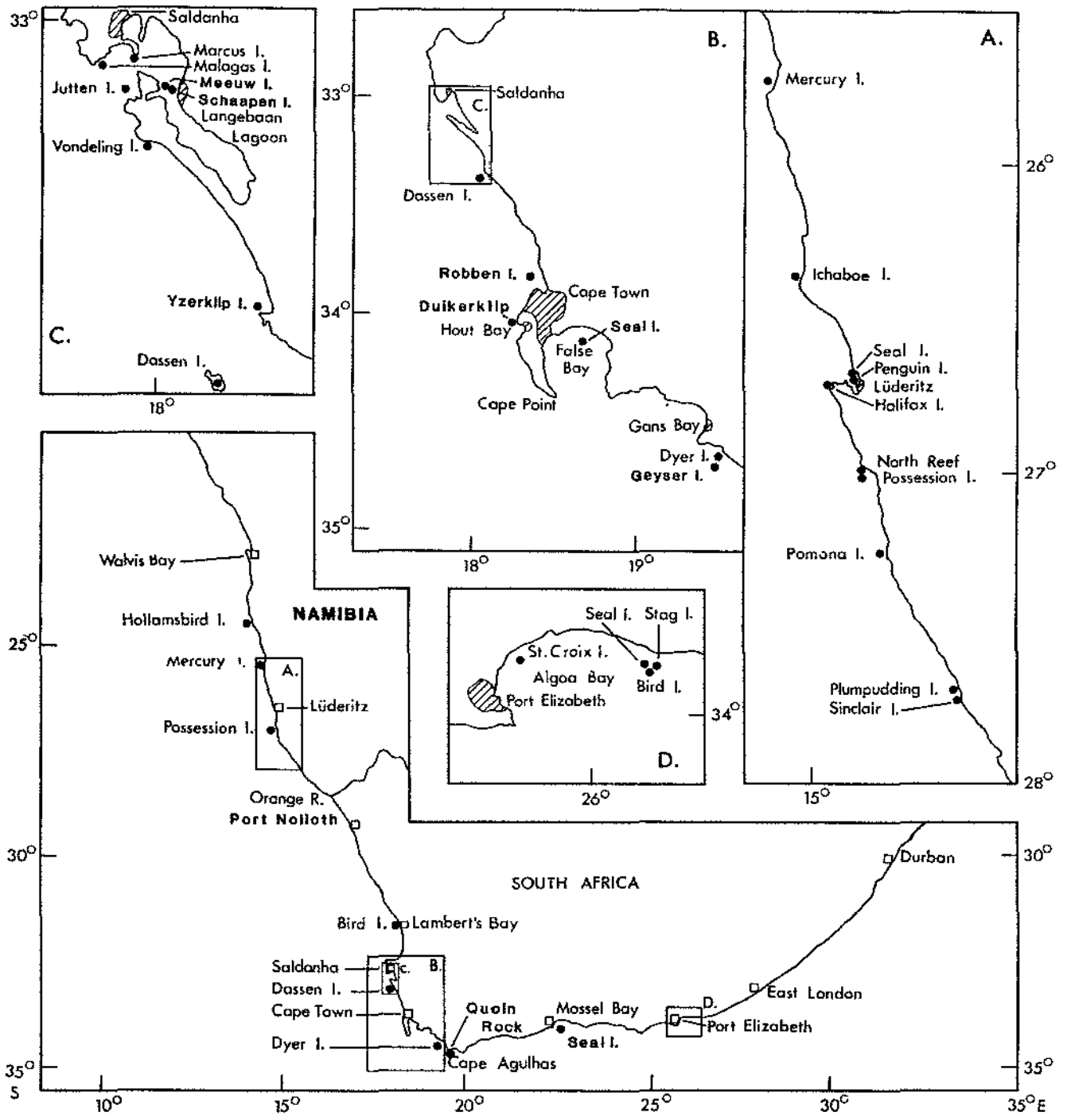

Fig. 1. Map showing most South African owned continental islands.

lacked any form of boat to reach even the nearest islands secured by a strong current through which they could not wade (De Villiers 1971). At Port Nolloth where a long chain of islets and reefs protects the coast and creates lagoon-like conditions, the local Khokhoi used logs to reach the islets to hunt Cape fur seals *Arctocephalus pusillus* (Backhouse 1844) but this seems to be the only place, other than perhaps Meeuw and Schaapen islands in Saldanha Bay, where oceanographic conditions permitted such a crude means of transport to offshore islands to function. From 1600 onwards, European sailors increasingly exploited offshore islands, sometimes drastically (Raven-Hart 1967). Starting in 1845 the accumulated guano of centuries was removed for sale to farmers in the Cape Colony and Europe and from about 1850 crude soils began to form from dust and rubbish on the smaller islands (Brooke & Crowe 1982, Cooper & Brooke 1982). This permitted plants and animals which could get there either by their own dispersal mechanisms or by accidental or deliberate human introduction to establish themselves.

At least four islands were naturally vegetated, Schaapen and Meeuw in Saldanha Bay, Dassen and Robben just north of Cape Town. This situation has persisted since the end of the last glaciation raised the sea to its present level and created islands out of the high points of the former coastal plain. Intrinsically, these islands could have maintained the fauna and flora that was then isolated, subject to the usual stochastic events that imperil populations on small islands (Brooke & Crowe 1982). This situation was nearest to being achieved on the very sheltered Schaapen Island with its size greater than that of the adjacent Meeuw (Appendix 1). Dassen and Robben islands are low lying and during storms windblown spume covers parts of them. They were frequented by colonies of

Cape fur seals and large breeding colonies of several species of seabirds (Thom 1952-58, Brooke 1983) whose excreta enriched their sandy soils with, *inter alia*, an excess of ammonia. Thus on Dassen and Robben islands floras developed that were tolerant of large quantities of ammonia and salt in the environment, e.g. *Mesembryanthemum crystallinum, Prenia pallens* and an orange crustose lichen (Brooke & Crowe 1982)

As Cooper & Brooke (1982) pointed out, no conceivable management programme could restore any South African offshore island to its pristine pre-1600 condition. We know very little of what species were present on even the largest islands, Dassen and Robben for which some data may be found in Brooke (1983), Raven-Hart (1967) and Thom (1952-58), let alone the smaller ones for which the evidence is very scanty, cf. Shaughnessy (1984) on Seal Island (False Bay). We consider, following Cooper & Brooke (1982, in press) and Cooper *et al.* (1985), that the principal management problem is that presented by feral cats *Felis catus* on Dassen Island, cf. Berruti (this volume). In the mid-1970s the Sea Fisheries Research Institute guano staff had reduced the population to a very low level. To enable Peter Apps to carry out his studies (Apps 1981, 1983) cat hunting was stopped in 1979. As a result, the feral cat population rose rapidly and by 1983 Cooper *et al.* (1985) estimated that over 2 000 birds a year were being killed by them for food. Their prey included many jackass penguins *Spheniscus demersus,* a species accepted as of special concern by the International Union for Conservation of Nature and Natural Resources (Collar & Stuart 1985) and as vulnerable in South African local terms (Brooke 1984). However, Berruti (this volume) estimates that *c.* 600 birds a year were being killed by cats in 1985. Whatever the true figure, the pressure on the threatened jackass penguin population should be abated and, if possible, stopped.

We recommend, following Cooper *et al.* (1985) and Cooper & Brooke (in press), that feral cats on Dassen Island be exterminated. This will lead to a temporary rise in the population of European rabbits *Oryctolagus cuniculus* and consequent increased pressure on the vegetation. However, starvation will probably soon intervene to reduce rabbit numbers and it does not seem likely that the size of the probably indigenous angulated tortoise *Chersine angulata* population will be seriously diminished by the consequences of removing feral cats.

We also recommend, following Cooper & Brooke (in press), that control of feral cats be undertaken and maintained on Robben Island in the interest of conserving the remaining seabird colonies (Kriel *et al.* 1980, Brooke 1983) and the recently re-established jackass penguin colony (Shelton *et al.* 1984, Cooper 1985). It will be noted from Appendix 1 that the former population of feral cats was exterminated in the middle of this century (Cooper *et al.* 1985) but that a new one has arisen. Continued vigilance is necessary to ensure that feral cats do not destroy the impoverished seabird colonies that remain on Robben Island.

The most widely distributed alien vertebrate on South African offshore islands is the European rabbit, deliberately introduced in all cases. Their activities, chiefly burrowing and browsing, do not seem to be inimical to most seabirds though they may prevent the development of woody vegetation on which crowned cormorants *Phalacrocorax coronatus* would breed (Gillham 1963). There is no evidence that they cause erosion on the relatively flat islands they inhabit. But as Gillham (1963) pointed out, floral communities are markedly altered and impoverished by their browsing. It is very likely that, if European rabbits were exterminated, a number of indigenous plant species would re-establish themselves on the larger islands, particularly Jutten, Schaapen and Dassen islands.

The most widely distributed alien invertebrate is the carrion-eating skin beetle *Dermestes maculatus,* already recorded on 12 islands (Appendix 2), although whether carried there or arriving by natural dispersion is unknown. It is a faster consumer of carrion than indigenous beetles (Prins 1984) and therefore ensures a faster recycling of the nutrients contained in the many carcasses of birds and seals that litter offshore islands. In addition, its larvae are preyed upon by many indigenous invertebrate predators and even on occasion by kelp gulls *Larus dominicanus* (AJP pers. obs.).

Three botanical families have provided the most widely dispersed plants among the islands (Appendix 2): *Emex australis* in the Polygonaceae, *Chenopodium murale* in the Chenopodiaceae and *Senecio vulgaris* and *Sonchus oleraceus* in the Asteraceae. It is apparent from Appendix 1 that diversity of alien species, particularly plants, is usually higher on manned islands, presumably due to more frequent transport of propagules and greater disturbance leading to more opportunities for such aliens. There is little evidence that alien plants have adverse effects on the indigenous biota already markedly affected by disturbance caused by rabbit browsing, seabird nesting, seals dragging themselves about and storms. However, the rooikrans *Acacia cyclops* is likely to spread on any island on which it is established, smothering other species as it does so. Manatoka *Myoporum serratum* is apparently invasive only on Robben Island (Cooper 1985, RKB pers. obs.).

The environment on the islands is relatively extreme compared to the continental mainland and few species are capable of successful establishment. As noted by Gillham (1963), many of the successful plants on offshore islands are weeds with ranges recently vastly increased by human activity. The absence of honey bees *Apis mellifera* from all islands except Robben means that only plants which are not dependent on honey bees as pollinators are capable of establishing populations as opposed to individuals which may grow and flower but, unfertilised, produce no offspring.

It is clear from the foregoing that there is a need to make more thorough surveys for aliens on offshore islands, particularly Robben Island, those off the Namibian coast and in Algoa Bay, a point also made by Cooper & Brooke (in press). This should be followed by ecological studies to see which alien species have an adverse impact on indigenous species or modify island ecosystems towards the interests of aliens or whether our belief that they do not usually present problems on offshore islands is valid.

Acknowledgements

We are obliged to R.P. Wilson then of the FitzPatrick Institute for making a collection of invertebrates on some Namibian islands in February 1980; to H.A. van der Heyde for making a survey of invertebrates on some Namibian islands in November 1978; to B.M. Randall of the University of Port Elizabeth for making a collection of invertebrates on St Croix Island in May 1985; to Dr D. Koutnik of the Bolus Herbarium and to I.A.W. Macdonald of the FitzPatrick Institute for advice on alien plant taxa and their names, cf. Macdonald (1983); to A. Berruti of the Sea Fisheries Research Institute for data on Bird (Lambert's Bay) and Robben islands; to Sgt N.H. Pietersen of the Prison Service for data on introductions of mammals and birds to Robben Island.

References

ADAMSON, R.S. 1934. The vegetation and flora of Robben Island. *Trans. R. Soc. S. Afr.* 22: 279-296.

APPS, P.J. 1981. Behavioural ecology of the feral house cat (*Felis catus* Linnaeus) on Dassen Island. M.Sc. Thesis, Univ. of Pretoria.

APPS, P.J. 1983. Aspects of the ecology of feral cats on Dassen Island, South Africa. *S. Afr. J. Zool.* 18: 393-399.
BACKHOUSE, J. 1844. A narrative of a visit to Mauritius and South Africa. Hamilton Adams, London.
BETHAM, R.M. 1929. Some observations on the nesting of birds in the vicinity of Cape Town. *Ibis* ser. 12, vol. 5: 71-104.
BROOKE, R.K. 1983. On the 17th century avifauna of Robben Island, South Africa. *Cormorant* 11: 15-20.
BROOKE, R.K. 1984. South African red data book - birds. *S. Afr. Natl Sci. Progr. Rep.* 97, 213 pp.
BROOKE, R.K. & CROWE, T.M. 1982. Variation in species richness among offshore islands of the southwestern Cape. *S. Afr. J. Zool.* 17: 49-58.
BROOKE, R.K. & LOUTIT, R. 1984. Marine cormorants using moored boats as nest sites in southern African west coast harbours. *Cormorant* 12: 55-59.
CHAPMAN, N.G & CHAPMAN, D.I. 1980. The distribution of fallow deer: a worldwide review. *Mammal Rev.* 10: 61-138.
COLLAR, N.J. & STUART, S.N. 1985. Threatened birds of Africa and related islands. International Council for Bird Preservation and International Union for Conservation of Nature and Natural Resources, Cambridge.
COOPER, J. 1976. Primary moult, mass and breeding cycles of the European starling on Dassen Island. *Safring News* 5(2): 7.
COOPER, J. 1977. Food, breeding and coat colour of feral cats on Dassen Island. *Zool. Afr.* 12: 250-252.
COOPER, J. 1985. New breeding locality data for southern African seabirds: jackass penguin *Spheniscus demersus*. *Cormorant* 13: 81.
COOPER, J. & BROOKE, R.K. 1982. Past and present distribution of the feral European rabbit *Oryctolagus cuniculus* on southern African offshore islands. *S. Afr. J. Wildl. Res.* 12: 71-75.
COOPER, J. & BROOKE, R.K. in press. Alien plants and animals on South African continental and oceanic islands: species richness, ecological impacts and management. In: The ecology and management of biological invasions in southern Africa. Eds I.A.W. Macdonald, F.J. Kruger & A.A. Ferrar. Oxford University Press, Cape Town.
COOPER, J., HOCKEY, P.A.R. & BROOKE, R.K. 1985. Introduced mammals on South and South West African islands: history, effects on birds and control. In: Proceedings of the symposium on birds and man, Johannesburg 1983. Ed. L.J. Bunning, Witwatersrand Bird Club, Johannesburg. pp. 179-203.
COURTENAY-LATIMER, M. & GIBSON-HILL, C.A. 1946. A preliminary note on the Bird island group in Algoa Bay. *Ostrich* 17: 75-86.
CUTHBERT, K.C. 1972. The ecology of Skaapeiland. Zoo. Hons Proj., Univ. Cape Town.
DE VILLIERS, S.A. 1971. Robben Island. C. Struik, Cape Town.
EVERY, B. 1972. House sparrows on Bird Island, Algoa Bay. *Ostrich* 43: 131.
GILLHAM, M.E. 1960. South African guano islands from N.W. to S.E. field notes. Copy of MS in FitzPatrick Institute Library.
GILLHAM, M.E. 1963. Some interactions of plants, rabbits and seabirds on South African islands. *J. Ecol.* 51: 275-294.
HEWITT, J. 1920. Notes on the fauna of St. Croix Island. *S. Afr. J. Nat. Hist.* 2: 98-112.
KEARTON, C. 1930. The island of penguins. Longmans, Green & Co, London.
KRIEL, F., CRAWFORD, R.J.M. & SHELTON, P.A. 1980. Seabirds breeding at Robben Island between 1949 and 1980. *Cormorant* 8: 87-96.
LAYARD, E.L. 1867. The birds of South Africa. J.C. Juta, Cape Town.
LIVERSIDGE, R., BROEKHUYSEN, G.J. & THESEN, A.R. 1958. The birds of Langebaan Lagoon. *Ostrich* 29: 95-106.
MACDONALD, I.A.W. 1983. Invasive alien plants in southern Africa. FitzPatrick Institute, University of Cape Town.
McGILL, E.A. 1970. The E. Cape Bird Club's visit to St. Croix Island. *Bee-eater* 21(3): 1-4.
McGILL, L. 1972. Bird Island. *Afr. Wildl.* 26: 66-68.
McLACHLAN, A. 1974. Notes on the fauna and flora of St. Croix Island. *East Cape Nat.* 52: 10-11.
McLACHLAN, G.R. 1949. The geology of Dassen Island. *Trans. Proc. Geol. Soc. S. Afr.* 52: 377-384.
McLACHLAN, H. & McLACHLAN, A. 1974. Notes on the fauna and flora of St. Croix Island. *East Cape Nat.* 51: 20-22.
NANKIVELL, J.W. 1934. Robben Island. *S. Afr. Geogr. J.* 17: 29-34.
PATERSON, H.E. 1960. Diptera (Brachycera, Muscidae): Muscinae and Lipsinae. *S. Afr. Anim. Life* 7: 397-401.
PINCHIN, R. 1871. The bird islands. *Cape Monthly Mag.* ser. 2, vol. 2: 354-357.
PRINS. A.J. 1984. Morphological and biological notes on some South African arthropods associated with decaying organic matter part 3 the families Dermestidae, Cantharidae, Melyridae, Tenebrionidae, and Scarabaeidae (Coleoptera). *Ann. S. Afr. Mus.* 94: 203-304.
RAND, R.W. 1963. The biology of guano-producing seabirds. 4. Composition of colonies on the Cape islands. *Div. Sea Fish. S. Afr. Invest. Rep.* 43: 1-32.
RANDALL, B.M. & RANDALL, R.M. 1984. Land and shore birds at St Croix Island *Bokmakierie* 36: 51-55.
RAVEN-HART, R. 1967. Before van Riebeeck. C. Struik, Cape Town.
SCHMIDT, R.K. 1970. Birds of our islands. *Cape Bird Club Newsl.* 94: 1.
SHAUGHNESSY, P.D. 1984. Historical population levels of seals and seabirds off southern Africa, with special reference to Seal Island, False Bay. *Sea Fish. Res. Inst. S. Afr. Invest. Rep.* 127: 1-61.
SHELTON, P.A., CRAWFORD, R.J.M., COOPER, J. & BROOKE, R.K. 1984. Distribution, population size and conservation of the jackass penguin *Spheniscus demersus*. *S. Afr. J. Mar. Sci.* 2: 217-257.
SIEGFRIED, W.R. 1971. Chukar partridge on Robben Island. *Ostrich* 42: 156.
SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province, vol. 1. Cape Provincial Department of Nature and Environmental Conservation, Cape Town.
THOM, H.B. 1952-58. Journal of Jan van Riebeeck, 3 vols. A.A. Balkema, Cape Town.
TRIMEN, R. 1882. In: Report of the Trustees of the South-African Museum for the year 1881. Cape Colonial Govt G.65-'82: 10.
VAN BRUGGEN, A.C. 1970. Non-marine Mollusca. *S. Afr. Anim. Life* 14: 446-476.
WINTERBOTTOM, J.M. 1966. Birds of our islands. *Cape Bird Club Newsl.* 81: 2.
WINTERBOTTOM, J.M. & LIVERSIDGE, R. 1954. The European starling in the south west Cape. *Ostrich* 25: 89-96.
ZUMPT, F. 1956. Diptera (Brachycera): Calliphoridae. *S. Afr. Anim. Life* 6: 427-440.

Appendix 1

South African owned offshore islands, their coordinates, area, minimum distance from mainland and annotated list of alien species recorded on them

MERCURY I. 25°43'S, 14°50'E; 3 ha; 800 m; not manned.
Lucilia sericata South African Museum, Cape Town, (= SAM) material
Attagenus sp. SAM material
Dermestes maculatus SAM material
Gnathoncus cornutus SAM material

ICHABOE I. 26°17'S, 14°56'E; 6,5 ha; 1,3 km; manned.
Porcellio scaber SAM material
Periplaneta sp. H.A. v.d. Heyde, PFIAO unpubl. data
Musca domestica H.A. v.d. Heyde, PFIAO unpubl. data
Cafius xantholoma SAM material
Dermestes maculatus Prins 1984
Technomyrmex albipes SAM material

SEAL I. 26°36'S, 15°09'E; 44 ha; 1 km; not manned.
Lucilia sericata SAM material

PENGUIN I. 26°37'S, 15°09'E; 36 ha; 900 m; not manned.
Lucilia sericata SAM material
Dermestes maculatus SAM material

HALIFAX I. 26°40'S, 15°05'E; 8 ha; 146 m; not manned.
Lucilia sericata SAM material

POSSESSION I. 27°01'S, 15°12'E; 90 ha; 2,7 km; manned.
Oryctolagus cuniculus Cooper & Brooke 1982, partially dependent on kitchen scraps.
Alien invertebrates are almost certainly present since the island is manned but no search has been made for them.

BIRD I. 32°05'S, 18°18'E; 3 ha; 180 m; not manned.
Joined by a causeway to the mainland since at least 1959 (Cooper *et al.* 1985) which has apparently had little effect on its biota (Brooke & Crowe 1982, Cooper *et al.* 1985).
Rattus rattus var. *frugivorus* Cooper *et al.* 1985, present since at least 1966.
Labidura riparia SAM material, Brooke & Crowe 1982 (= B & C 82)
Dermestes maculatus B & C 82, Prins 1984
Chenopodium murale B & C 82
Malva parviflora Gillham 1963 but not present in the late 1970s when the collections on which Brooke & Crowe (1982) reported were made.

MALGAS I. 33°03'S, 17°55'E; 9 ha; 800 m; manned.
Oryctolagus cuniculus Cooper & Brooke 1982, extinct by 1977.
Passer domesticus Schmidt 1970, not breeding after the 1964 record (Brooke & Crowe 1982 and unpubl. PFIAO data).
Porcellio scaber SAM material, B & C 82
Musca domestica ditto
Dermestes maculatus B & C 82, Prins 1984
Atriplex semibaccata Gillham 1963; B & C 82
Chenopodium murale ditto
Lavatera arborea ditto
Malva parviflora ditto
Senecio vulgaris ditto
Myoporum serratum B & C 82

MARCUS I. 33°02'S, 17°58'E; 11 ha; 1,2 km; usually manned.
No longer an island since the causeway was completed in 1976 (Cooper *et al.* 1985). Only records made before the effects of the causeway seemed manifest are included.
Oryctolagus cuniculus Cooper & Brooke 1982, extinct *c.* 1970.
Sturnus vulgaris B & C 82
Pholcus sp. SAM material, B & C 82
Porcellio scaber ditto
Lucilia sericata ditto
Musca domestica ditto
Adonia variegata ditto
Soronia grisea ditto
Dermestes maculatus B & C 82, Prins 1984
Hordeum murinum Gillham 1963, B & C 82
Atriplex semibaccata ditto
Chenopodium murale ditto
Lavatera arborea ditto
Malva parviflora ditto
Sonchus oleraceus ditto
Senecio vulgaris ditto
Bromus gussonei B & C 82
Poa annua B & C 82
Emex australis B & C 82
Solanum nigrum B & C 82
Myoporum serratum B & C 82
Erodium moschatum Gillham 1963, not present in the late 1970s (Brooke & Crowe 1982).
Note the increase in the number of alien plant species between 1960 when Gillham collected (Gillham 1963) and 1979/80 when S.J. Milton and RKB collected the flora (Brooke & Crowe 1982). A visit on 4 August 1985 by RKB and T.M. Crowe revealed an even richer flora with more alien species.

SCHAAPEN I. 33°06'S, 18°01'E; 41 ha; 500 m; not manned.
Oryctolagus cuniculus Liversidge *et al.* 1958, Gillham 1963, Cooper & Brooke 1982, present since at least 1781.
Adonia variegata SAM material, B & C 82
Euborellia annulipes ditto
Theba pisana Cuthbert 1972, ditto
Chenopodium murale Gillham 1963
Spergula arvensis Gillham 1963
Malva parviflora Gillham 1963
Urtica urens Gillham 1963, Cuthbert 1972, B & C 82
Acacia saligna Cuthbert 1972
A. cyclops Gillham 1963, B & C 82
Emex australis ditto
Myoporum serratum ditto

MEEUW I. 33°05'S, 18°00'E: 7 ha; 140 m; not manned.
Oryctolagus cuniculus Liversidge *et al.* 1958, Gillham 1963, Cooper & Brooke 1982, extinct in 1976.
Emex australis Gillham 1963
Fumaria muralis Gillham 1963
Erodium moschatum Gillham 1963
Silybum marianum Gillham 1963
Malva parviflora Gillham 1963
Urtica urens Gillham 1963, B & C 82
Sonchus oleraceus Gillham 1963, B & C 82
Bromus gussonei B & C 82
Atriplex semibaccata B & C 82
Chenopodium murale B & C 82
Acacia cyclops B & C 82
Malva verticellata B & C 82
Senecio vulgaris B & C 82

JUTTEN I. 33°05'S, 17°57'E; 46 ha; 800 m; manned.
Oryctolagus cuniculus Cooper & Brooke 1982
Sturnus vulgaris B & C 82
Passer domesticus B & C 82
Porcellio scaber SAM material, B & C 82
Lucilia sericata ditto
Musca domestica ditto
Adonia variegata ditto
Anobium punctatum ditto
Dermestes maculatus B & C 82, Prins 1984
Hordeum murinum Gillham 1963
Stellaria media Gillham 1963
Atriplex semibaccata Gillham 1963, B & C 82
Emex australis ditto
Senecio vulgaris ditto
Urtica urens ditto
Lavatera arborea ditto
Malva parviflora ditto
Sonchus oleraceus ditto
Chenopodium murale B & C 82
Argemone mexicana B & C 82
Myoporum serratum B & C 82
Acacia cyclops B & C 82
Nicotiana glauca B & C 82
Note the increase in the number of alien plant species in the last 25 years.

VONDELING I. 33°09'S, 17°59'E; 21 ha; 800 m; not manned.
Oryctolagus cuniculus Cooper & Brooke 1982
Sturnus vulgaris B & C 82
Porcellio scaber SAM material, B & C 82
Atriplex semibaccata B & C 82
Urtica urens B & C 82
Malva parviflora B & C 82
Vondeling has not been manned since 1963: hence the relatively small number of alien species now present due to reduced human traffic in the last 20 years.

DASSEN I. 33°25'S, 18°05'E; 222 ha; 9 km; manned.
Oryctolagus cuniculus Skead 1980, Cooper & Brooke 1982, the original introduction from Holland having been made in the 1660s.
Mus musculus Kearton 1930, B & C 82, Cooper *et al.* 1985
Felis catus Cooper 1977, Apps 1981, 1983, Cooper *et al.* 1985; Berruti this volume, introduced *c.* 1890.
Numida meleagris A. Berruti pers. comm. 1985, not present in September 1979 (Brooke & Crowe 1982).

Sturnus vulgaris Cooper 1976, B & C 82
Passer domesticus B & C 82
Porcellio scaber SAM material, B & C 82
Lucilia sericata Zumpt 1956, SAM material, B & C 82
Musca domestica Paterson 1960, SAM material, B & C 82
Fannia canicularis SAM material, B & C 82
Dermestes maculatus ditto
D. peruvianus ditto
Soronia grisea ditto
Theba pisana van Bruggen 1970, SAM material, B & C 82
Malva nicaensis B & C 82, probably what McLachlan (1949) recorded *sub nom. M. parviflora.*
Senecio vulgaris McLachlan 1949, B & C 82
Hordeum murinum B & C 82
Phalaris minor B & C 82
Poa annua B & C 82
Stellaria media B & C 82
Anagallis arvensis B & C 82
Chenopodium murale B & C 82
Emex australis B & C 82
Erodium moschatum B & C 82
Urtica urens B & C 82
Cotula cornucopifolia B & C 82
Nicotiana glauca B & C 82
Myoporum serratum B & C 82
Sonchus oleraceus B & C 82

ROBBEN I. 33°49′S, 18°22′E; 507 ha; 6,7 km; manned.
Oryctolagus cuniculus Adamson 1934, Nankivell 1934, Skead 1980, Cooper & Brooke 1982, first successfully introduced 1656/58.
Rattus sp. Skead 1980, Cooper *et al.* 1985, first reported in 1620 (Raven-Hart 1967).
Mus ?musculus Cooper *et al.* 1985, present in 1886 (De Villiers 1971).
Taurotragus oryx Cooper *et al.* 1985, introduced *c.* 1950.
Antidorcas marsupialis ditto; second introduction in May 1975 (N.H. Pietersen *in litt.* Oct. 1985).
Ramphicerus campestris introduced in September 1973 (N.H. Pietersen *in litt.*).
Cervus dama introduced in 1963 (Chapman & Chapman 1980), now the subject of control measures (Cooper & Brooke in press).
Felis catus Trimen 1882, Nankivell 1934, Cooper *et al.* 1985, extinct as feral animals in mid 20th century but a new feral stock has arisen (A. Berruti pers. comm. 1985).
Struthio camelus introduced in March 1968 (N.H. Pietersen *in litt.*) though the Eastern Province Herald for 5 June 1967 gives that month or May 1967 as the date of introduction.
Francolinus capensis introduced in the 1850s (Layard 1867) but shot out or died out before 1930; reintroduced in the last 25 years.
Alectoris chukar Siegfried 1971, specimens coll. A. Berruti det. RKB 1983 now in the Durban Museum.
Pavo cristatus introduced in 1968 (N.H. Pietersen *in litt.*).
Numida meleagris Layard 1867, probably introduced in the 1850s.
Sturnus vulgaris Betham 1929, Winterbottom 1966, present since at least 1907 (Winterbottom & Liversidge 1954).
Passer domesticus A. Berruti pers. comm. 1985, probably a recent arrival since it was not listed by Winterbottom (1966).
No search has been made for alien invertebrates though they are sure to be present. We have not found published references to them other than De Villiers's (1971) comment on abundant human fleas and lice in the infirmary in the middle of the 19th century. There is an official research site for work on *Apis mellifera capensis* established in 1963.

Pinus pinaster RKB pers. obs. 1985
Ammophila arenaria Adamson 1934
Avena sativa Adamson 1934
Bromus diandrus Adamson 1934
B. japonicus Adamson 1934
Hordeum murinum Adamson 1934; Gillham 1960
Phalaris minor Adamson 1934
Poa annua Adamson 1934
Agave americana Adamson 1934, Gillham 1960
Urtica urens Adamson 1934
Emex australis Adamson 1934, Gillham 1960
Atriplex sp., *semibaccata?* Adamson 1934
Chenopodium album Adamson 1934
C. murale Adamson 1934, Gillham 1960
Salsola kali Adamson 1934
Polycarpon teraphyllum Adamson 1934
Spergularia media Adamson 1934
S. rubra Adamson 1934
Acacia cyclops Adamson 1934, Gillham 1960, Cooper 1985
A. saligna Adamson 1934
Medicago hispida Adamson 1934
Erodium moschatum Adamson 1934
Oxalis corniculata Adamson 1934
Euphorbia peplus Adamson 1934
Ricinus communis Adamson 1934
Schinus mollis Adamson 1934
Lavatera arborea Adamson 1934
Malva parviflora Adamson 1934. Gillham 1960
Eucalyptus lehmanni ditto
E. punctatus Gillham 1960
Leptospermum laevigatum Adamson 1934
Anagallis arvensis Adamson 1934
Nerium oleander Adamson 1934
Nicotiana glauca Adamson 1934
Solanum nigrum Adamson 1934
Myoporum serratum Adamson 1934, Brooke & Loutit 1984, Cooper 1985
Plantago coronopus Adamson 1934
Sonchus oleraceus Adamson 1934
Gillham (1960) only botanised the areas occupied by seabird breeding sites, not the whole island. Adamson (1934) who botanised the whole island, even gardens, distinguished the habitats in which he found plants. Aliens which he recorded only in cultivated areas have not been adverted to unless later work suggests that they have escaped into at least semi-natural areas.

SEAL I. 34°08′S, 18°35′E; 2 ha; 6 km; not manned.
Porcellio scaber SAM material, B & C 82
Dermestes maculatus ditto
Euborellia annulipes ditto

DYER I. 34°41′S, 19°25′E; 20 ha; 7 km; manned.
Passer domesticus B & C 82
Chersine angulata B & C 82, introduced as pets or for food.
Pholcus sp. SAM material, B & C 82
Porcellio scaber ditto
Lucilia sericata ditto
Musca domestica ditto
Adonia variegata ditto
Dermestes maculatus B & C 82, Prins 1984
D. peruvianus SAM material, B & C 82
Euborellia annulipes ditto
Emex australis B & C 82
Chenopodium murale B & C 82
Portulaca oleracea B & C 82
Raphanus raphinistrum B & C 82
Lavatera arborea Rand 1963, B & C 82
Malva parviflora B & C 82
Senecio vulgaris B & C 82
Sonchus oleraceus B & C 82

GEYSER I. 34°42′S, 19°25′E; 3 ha; 8 km; not manned.
Dermestes maculatus SAM material, B & C 82

ST CROIX I. 33°48′S, 25°46′E; 2,5 ha; 3,9 km; not manned.
Oryctolagus cuniculus Cooper & Brooke 1982, extinct since 1915 if ever present.
Mus musculus Hewitt 1920, McLachlan 1974, Cooper *et al.* 1985.
This population maintained itself on a predator-free island after the first suite of buildings was destroyed, though they moved back into buildings when new ones were erected.
Passer domesticus Randall & Randall 1984.
No alien invertebrates were reported by Hewitt (1920) though the following species were collected by B.M. Randall on 10 May 1985 and are now in the collections of the South African Museum:-

Lucilia sericata
Musca domestica
Anthrenus verbasci
Periplaneta sp.
Chenopodium album Gillham 1963, McLachlan & McLachlan 1974
Malva parviflora ditto
Sonchus oleraceus ditto
Chenopodium murale Gillham 1963
Atriplex muelleri Gillham 1963
Solanum nigrum Gillham 1963
Cotula anthemoides Gillham 1963
Senecio vulgaris Gillham 1963
There appears to have been a real decrease in the number of alien plant species between 1960 when Gillham collected (Gillham 1963) and 1973/4 when H. McLachlan studied the flora (McLachlan & McLachlan 1974). McGill (1970) found that on 1 June 1970 the only plant species was "Wild Spinach" growing in the roof gutters of the abandoned house by the jetty. The reduction in plant species diversity corresponds well with the increase in numbers of breeding jackass penguins *Spheniscus demersus* between 1950 and 1970 shown in Appendix 1 of Shelton *et al.* (1984) and also with the departure of the guano staff.

SEAL I. 33°50'S, 26°17'E; 0.6 ha; 8 km; not manned.
Oryctolagus cuniculus Cooper & Brooke 1982, extinct *c.* 1975.

BIRD I. 33°51'S, 26°17'E; 19 ha; 8,4 km; manned.
Oryctolagus cuniculus McGill 1972, Cooper & Brooke 1982
Mus ?musculus Rand 1963, Cooper *et al.* 1985
Passer domesticus Every 1972
Lucilia sericata E.A. McGill *in litt.* 1971 to C.J. Skead in PFIAO files.
Musca domestica ditto
Dermestes maculatus ditto
Chenopodium album or *murale* Pinchin 1871, Rand 1963, E.A. McGill *in litt.* 1971 to C.J. Skead in PFIAO files
Anagallis arvensis E.A. McGill *in litt.* as above
Malva parviflora Courtenay-Latimer & Gibson-Hill 1946
Pinchin (1871) comments on the presence of unspecified weeds, doubtless mostly aliens, in the garden.

Appendix 2

Alien taxa found on South African owned offshore islands and the islands on which they have been recorded

MAMMALIA
Antidorcas marsupialis springbok: Robben I.
Cervus dama fallow deer: Robben I.
Felis catus feral cat: Dassen, Robben Is.
Mus musculus house mouse: Bird? (Algoa Bay), Dassen, Robben, St Croix Is.
Oryctolagus cuniculus European rabbit: Bird (Algoa Bay), Dassen, Jutten, Malgas, Marcus, Meeuw, Possession, Robben, Schaapen, Seal (Algoa Bay), Vondeling Is.
Ramphicerus campestris steenbok: Robben I.
Rattus rattus house rat: Bird (Lambert's Bay), Robben? Is.
Taurotragus oryx eland: Robben I.

AVES
Alectoris chukar chukar partridge: Robben I.
Francolinus capensis Cape francolin: Robben I.
Numida meleagris helmeted guineafowl: Dassen, Robben Is.
Passer domesticus house sparrow: Bird (Algoa Bay), Dassen, Dyer, Jutten, Malgas, Robben, St Croix Is.
Pavo cristatus peacock: Robben I.
Struthio camelus ostrich: Robben I.
Sturnus vulgaris European starling: Dassen, Jutten, Marcus, Robben, Vondeling Is.

REPTILIA
Chersine angulata angulated tortoise: Dyer I.

ARACHNIDA
Pholcus sp.: Marcus, Dyer Is.

ISOPODA
Porcellio scaber: Dassen, Dyer, Ichaboe, Jutten, Malgas, Marcus, Seal (False Bay), Vondeling Is.

HYMENOPTERA
Technomyrmex albipes Formicidae: Ichaboe I.

DIPTERA
Fannia canicularis Fanniidae: Dassen I.
Lucilia sericata Calliphoridae: Bird (Algoa Bay), Dassen, Dyer, Halifax, Jutten, Marcus, Mercury, Penguin, Seal (Lüderitz), St Croix Is.
Musca domestica Muscidae: Bird (Algoa Bay), Dassen, Dyer, Ichaboe, Jutten, Malgas, Marcus, St Croix Is.

COLEOPTERA
Adonia variegata Coccinellidae: Dyer, Jutten, Marcus, Schaapen Is.
Anobium punctatum Anobiidae: Jutten I.
Anthrenus verbasci Dermestidae: St Croix I.
Attagenus sp. Dermestidae: Mercury I.
Cafius xantholoma Staphylinidae: Ichaboe I.
Dermestes maculatus Dermestidae: Bird (Lambert's Bay), Bird (Algoa Bay), Dassen, Dyer, Geyser, Ichaboe, Jutten, Malgas, Marcus, Mercury, Penguin, Seal (False Bay) Is.
D. peruvianus: Dassen, Dyer Is.
Gnathoncus cornutus Tenebrionidae: Mercury I.
Soronia grisea Nitidulidae: Dassen, Marcus Is.

DERMAPTERA
Euborellia annulipes: Dyer, Schaapen, Seal (False Bay) Is.
Labidura riparia: Bird (Lambert's Bay), St Croix Is.

BLATTARIA
Periplaneta sp. Ichaboe, St Croix Is.

PULMONATA
Theba pisana: Dassen, Schaapen Is.

GYMNOSPERMAE
Pinaceae
Pinus pinaster cluster pine: Robben I.

ANGIOSPERMAE
Poaceae
Ammophila arenaria marram grass: Robben I.
Avena sativa oats: Robben I.
Bromus diandrus ripgut brome: Robben I.
B. gussonei: Dyer, Marcus, Meeuw Is.
B. japonicus: Robben I.
Hordeum murinum false barley: Dassen, Jutten, Marcus, Robben Is.
Phalaris minor small canary grass: Dassen, Robben Is.
Poa annua annual bluegrass: Dassen, Marcus, Robben Is.
Agavaceae
Agave americana sisal: Robben I.
Urticaceae
Urtica urens bush stinging nettle: Dassen, Jutten, Meeuw, Robben, Schaapen, Vondeling Is.
Polygonaceae
Emex australis: Dassen, Dyer, Jutten, Malgas, Marcus, Meeuw, Robben, Schaapen, St Croix Is.
Chenopodiaceae
Atriplex muelleri: St Croix I.
A. semibaccata: Jutten, Malgas, Marcus, Meeuw, Robben?, Vondeling Is.
Chenopodium album white goosefoot: Bird? (Algoa Bay), Robben, St Croix Is.
C. murale: Bird (Lambert's Bay), Bird? (Algoa Bay), Dassen, Dyer, Jutten, Malgas, Marcus, Meeuw, Robben, Schaapen, St Croix Is.
Salsola kali Russian tumbleweed: Robben I.
Portulacaceae
Portulaca oleracea common purselane: Dyer I.

Caryophyllaceae
Polycarpon tetraphyllum fourleafed allseed: Robben I.
Spergula arvensis corn spurry: Schaapen I.
Spergularia media: Robben I.
S. rubra: Robben I.
Stellaria media chickweed: Dassen, Jutten Is.
Papaveraceae
Argemone mexicana Mexican poppy: Jutten I.
Fumariaceae
Fumaria muralis: Meeuw I.
Bassicaceae
Raphanus raphanistrum wild radish: Dyer I.
Fabaceae
Acacia cyclops rooikrans: Jutten, Meeuw, Robben, Schaapen Is.
A. saligna Port Jackson willow: Robben I.
Medicago hispida bur clover: Robben I.
Geraniaceae
Erodium moschatum musk heron's bill: Dassen, Marcus, Meeuw, Robben Is.
Oxalidaceae
Oxalis corniculata creeping sorrel: Robben I.
Euphorbiaceae
Euphorbia peplus petty spurge: Robben I.
Ricinus communis castor oil plant: Robben I.
Anacardiaceae
Schinus mollis pepper tree: Robben I.
Malvaceae
Lavatera arborea tree mallow: Dyer, Jutten, Malgas, Marcus, Robben Is.
Malva nicaensis: Dassen I.
M. parviflora small mallow: Bird (Algoa Bay), Dyer, Jutten, Malgas, Marcus, Meeuw, Robben, Schaapen, St Croix, Vondeling Is.
M. verticellata: Meeuw I.
Myrtaceae
Eucalyptus lehmanni spider gum: Robben I.
E. punctatus: Robben I.
Leptospermum laevigatum Australian myrtle: Robben I.
Primulaceae
Anagallis arvensis scarlet pimpernel: Bird (Algoa Bay), Dassen, Robben Is.
Apocyanaceae
Nerium oleander oleander: Robben I.
Solanaceae
Nicotiana glauca wild tobacco: Dassen, Jutten Is.
Solanum nigrum: Marcus, Robben, St Croix Is.
Myoporaceae
Myoporum serratum manatoka: Dassen, Jutten, Malgas, Marcus, Robben, Schaapen Is.
Plantaginaceae
Planatago coronopus: Robben I.
Asteraceae
Cotula anthemoides: St Croix I.
Senecio vulgaris groundsel: Dassen, Dyer, Jutten, Malgas, Marcus, Meeuw, St Croix Is.
Sonchus oleraceus common sow thistle: Dassen, Dyer, Jutten, Marcus, Meeuw, Robben, St Croix Is.
Silybum marianum blessed milkthistle: Schaapen I.