



Alien species in South Africa's national parks

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Invasive alien species (IAS) are one of the major threats to biodiversity in protected areas and pose a significant management challenge (see Allen, Brown & Stohlgren 2009; Pyšek, Jarošík & Kučera 2002). One of the first steps towards managing IAS in protected areas is establishing which alien species are present, followed by ongoing surveillance and prevention efforts to combat new introductions (Foxcroft *et al.* 2009). Information on the identity and traits of alien species is needed for conducting risk assessments and prioritising species for control, as well as for monitoring management effectiveness in preventing new introductions (McGeoch *et al.* 2010). It also provides a first step towards monitoring the extent of occurrence of alien species in national parks.

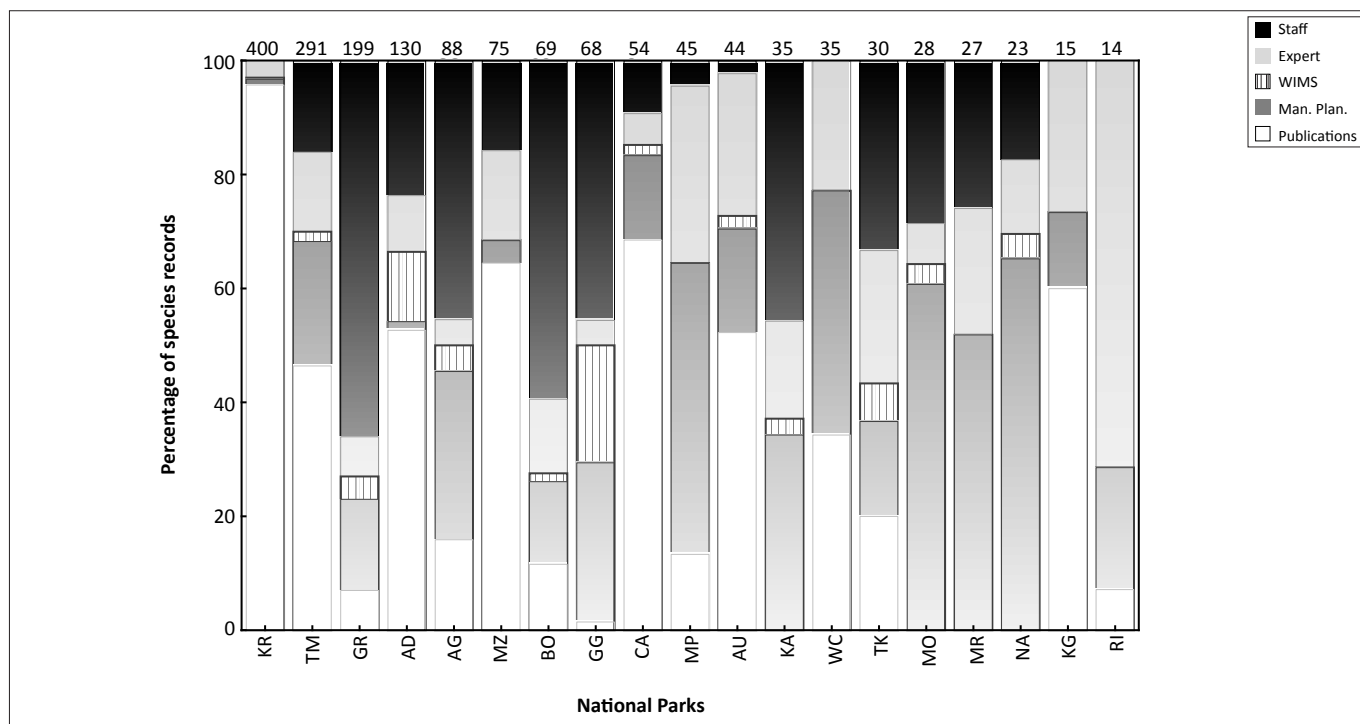
The online checklist that accompanies this summary provides a taxonomic list of alien plant and animal species for South Africa's 19 national parks (including marine protected areas). An online index with common names is also provided. The checklist is intended to serve, (1) as a baseline against which future improvements in knowledge of the alien fauna and flora in South African National Parks (SANParks) may be compared and (2) for future monitoring of the success of alien species prevention and control (Foxcroft 2009; McGeoch *et al.* 2011).

The checklist was compiled using a range of information sources, including scientific publications, reference books, the Working for Water Information System (WIMS), the Birds in Reserves Project database (<http://birp.adu.org.za/>), SANParks Invasive Species Control Unit biocontrol database, park management, lower level and operational plans, Kimberley SANParks Herbarium (KSAN) records, species listed for monitoring with handheld computers loaded with *CyberTracker* software (<http://www.cybertracker.org>; hereafter referred to as *CyberTracker* data) and communication from specialists and SANParks staff. Sources for literature searches included content pages of *Koedoe* (initially the research journal of SANParks, published since 1958; see <http://www.koedoe.co.za>) and ISI Web of Science and Google Scholar searches using the names of national parks and the search terms 'alien', 'introduced' and 'exotic'. *CyberTracker* data (256 records) were obtained for the Addo Elephant, Agulhas, Augrabies Falls, Camdeboo, Golden Gate Highlands, Kalahari Gemsbok, Karoo, Mapungubwe, Marakele, Mokala, Mountain Zebra, Namaqua and Richtersveld National Parks (currently held at the Geographic Information System Laboratory at Skukuza). Thirty-three records were obtained from the KSAN for nine parks.

In addition to contributions from the authors, data were obtained from seven specialists (on plants, mammals, the Harlequin ladybird, Painted reed frog and invertebrates). Data were also obtained from at least 20 *in situ* national parks staff in 15 of the national parks, largely via email. Plant species names were checked for validity using <http://www.theplantlist.org> and animal names were checked using a number of databases, including <http://www.gbif.org/>, <http://www.biolib.cz>, <http://www.itis.gov/> and <http://www.fishwise.co.za>. Taxonomy was assigned according to the Angiosperm Phylogeny Group (2003, 2009) for plants and multiple sources for animals.

Alien species here refer to species that occur outside their historical distribution ranges. Literature and online database searches were conducted to determine indigenous ranges of species and to designate species as alien. The alien species listed include, (1) domestic and livestock animals (see Campos *et al.* 2007 for predation by cats and dogs), (2) extralimital species, that is species that are indigenous to South Africa but that have been introduced into national parks outside their historical ranges (see Spear & Chown 2009a, 2009b for ungulates and their impacts), (3) bird species that have expanded their geographic ranges in response to human modified habitats, for example Hadedda ibis, *Bostrychia hagedash* (Macdonald, Richardson & Powrie 1986) and (4) biological control agents released to control invasive alien plants.

A substantial number of records (54%) were obtained from sources other than primary literature, such as from databases, specialists, park management plans, park management staff and rangers (Figure 1). Alien plants, freshwater fish, marine organisms and snails are the best studied taxa



AD, Addo Elephant; AG, Agulhas; AU, Auwabies Falls; BO, Bontebok; CA, Camdeboo; GG, Golden Gate Highlands; GR, Garden Route; KA, Karoo; KG, Kalahari Gemsbok; KR, Kruger; MO, Mokala; MP, Mapungubwe; MR, Marakele; MZ, Mountain Zebra; NA, Namaqua; RI, Richtersveld; TK, Tankwa Karoo; TM, Table Mountain; WC, West Coast.

FIGURE 1: Percentage of species records from different data sources, namely peer-reviewed publications and reference books (publication), park management plans and lower level alien and rehabilitation plans (man. plan.), Working for Water Information Management System (WIMS), ex-situ specialists and SANParks herbarium (experts), and SANParks *in situ* staff and *CyberTracker* data (staff).

in national parks (based on the number of publications) and some national parks have been relatively well studied compared with others (Table 1; Online checklist). Plants contribute most to alien species richness in national parks and a similar dominance of alien species lists by plants has been shown globally (Delivering Alien Invasive Species Inventory for Europe 2009; McGeoch *et al.* 2010).

There are particular taxa that are considered most likely to be under-represented on these lists (see Table 2 for representation of taxonomic groups). Commensal species (species benefiting from human habitation and food) associated with buildings

and dwellings in national parks are one such group, such as cockroaches (these are reported for Kruger National Park but not for other national parks) and mice and rats (*Mus musculus* and *Rattus rattus* are reported for only three national parks) (Online checklist). Domestic animals (e.g. cats, *Felis catus* and dogs, *Canis familiaris*) and livestock are also likely to be in the vicinity of most national parks and, if they are not resident in national parks, may be transient visitors. National parks that are surrounded by game farms are also likely to be subject to extralimital and alien game species intrusions (Spear & Chown 2009a) and these mammal species may be missing from lists for some national parks.

TABLE 1: Number of alien species records per national park for different taxa, as collated from peer-reviewed publications.

Park	Plants	Fish	Mammals	Marine organisms	Birds	Reptiles	Snails	Arthropods	Bacteria	Total
KR	348 (2)	1†	2†	-	1†	-	5 (3)	2 (2)	1†	378 (8)
AD	65 (1)	-	-	1(1)	-	1(1)	-	-	-	67 (3)
MZ	49 (2)	-	-	-	-	-	-	-	-	49 (2)
TM	37 (1)	-	-	-	-	-	-	8 (2)	-	45 (3)
CA	37 (1)	-	-	-	-	-	-	-	-	37 (1)
AU	23 (1)	-	-	-	-	-	-	-	-	23 (1)
WC	-	-	4 (1)	7 (3)	-	-	1 (1)	-	-	12 (5)
BO	-	8 (4)	-	-	-	-	-	-	-	8 (4)
KG	9 (1)	-	-	-	-	-	-	-	-	9 (1)
GR	-	1 (2)	-	5 (1)	1 (1)	-	-	2 (1)	-	9 (5)
AG	2 (2)	4 (1)	-	-	-	-	-	-	-	6 (3)
MP	6 (1)	-	-	-	-	-	-	-	-	6 (1)
TK	6 (1)	-	-	-	-	-	-	-	-	6 (1)
GG	-	1 (1)	-	-	-	-	-	-	-	1 (1)
RI	-	-	1 (1)	-	-	-	-	-	-	1 (1)

Note: The number of publications is in brackets.

AD, Addo Elephant; AG, Agulhas; AU, Auwabies Falls; BO, Bontebok; CA, Camdeboo; GG, Golden Gate Highlands; GR, Garden Route; KA, Karoo; KG, Kalahari Gemsbok; KR, Kruger; MO, Mokala; MP, Mapungubwe; MR, Marakele; MZ, Mountain Zebra; NA, Namaqua; RI, Richtersveld; TK, Tankwa Karoo; TM, Table Mountain; WC, West Coast.

†, Paper with a variety of taxa.



TABLE 2: Summary of alien species in South African National Parks (SANParks) by taxonomic group. The number of species per group and number of national parks in which each taxonomic group occurs are shown, as well as the environmental associations of the species.

Group	Terrestrial	Freshwater	Marine	Number of species	Number of SANParks
Plants	655	8	-	663	19
Insects	44	-	-	44	6
Mammals	26	-	-	26	18
Freshwater fish	-	16	-	16	9
Gastropods	15	4	-	19	4
Birds	9	-	-	9	17
Springtails	11	-	-	11	3
Earthworms	4	-	-	4	1
Ascidians	-	-	3	3	2
Soft shelled crustaceans	3	-	-	3	1
Arachnids	3	-	-	3	1
Bivalves	-	-	2	2	3
Fungi	2	-	-	2	2
Millipedes	2	-	-	2	1
Amphibians	-	1	-	1	1
Reptiles	1	-	-	1	1
Sea anemones	-	-	1	1	1
Centipedes	1	-	-	1	1
Barnacles	-	-	1	1	1
Bacteria	1	-	-	1	1
Total	777	29	7	813	-

There are likely to be many more alien invertebrates (e.g. insects, springtails and earthworms) in SANParks than recorded here. The insect taxa currently listed are largely biological control agents, with little record of other alien insects. Insects that may be present but yet unrecorded in some national parks include the European wasp, *Vespula germanica*, the Harlequin ladybug, *Harmonia axyridis* and the Argentine ant, *Linepithema humile*. *Vespula germanica* is found in Table Mountain National Park and could be in other national parks in the Western Cape Province (see Tribe & Richardson 1994), whereas *Harmonia axyridis* has been recorded in the vicinity of Addo Elephant, Bontebok, Mountain Zebra and West Coast National Parks (Lambert Smith pers. comm.). Other groups that are likely to be under-represented on alien species lists for SANParks include grasses (Milton 2004), garden plants (although well studied for the Kruger National Park; Foxcroft, Richardson & Wilson 2008) and marine organisms (Griffiths *et al.* 2010).

As with most alien species lists, those provided here are thus almost certainly incomplete (see Pyšek *et al.* 2008) and may also include inaccuracies as a result of one or more of the following factors, (1) inadequate surveys, inventories and knowledge, (2) taxonomic uncertainty and species misidentification (including cryptogenic species), (3) outdated historical records that may no longer be accurate, (4) unpublished or grey literature information is not always accessible and (5) inadequate information on species historical ranges. Nonetheless, over time and with the planned increase in research, surveillance and monitoring of IAS in national parks (McGeoch *et al.* 2011), the list accuracy and completeness may be incrementally improved. The publication of these baseline lists will also contribute to future assessments of the relative contribution of increased knowledge versus new invasions and extirpations (see Costello & Solow 2003) to the status of, and trends in, alien species in SANParks.

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Supporting information

Additional supporting information may be found in the online version of this article, namely:

- **Online checklist:** Lists of alien plant and animal taxa in South Africa's 19 national parks.
- **Online index:** Lists of animal and plant species and their common names.

References

- Allen, J.A., Brown, C.S. & Stohlgren, T.J., 2009, 'Non-native plant invasions of United States National Parks', *Biological Invasions* 11, 2195–2207. doi:10.1007/s10530-008-9376-1
- Angiosperm Phylogeny Group, 2003, 'An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG III', *Botanical Journal of the Linnean Society* 141, 399–436. doi:10.1046/j.1095-8339.2003.t01-1-00158.x



- Angiosperm Phylogeny Group, 2009, 'An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III', *Botanical Journal of the Linnean Society* 161, 105–121. doi:10.1111/j.1095-8339.2009.00996.x
- Campos, C.B., Esteves, C.F., Ferraz, K.M.P.M.B., Crawshaw Jr, P.G. & Verdade, L.M., 2007, 'Diet of free-ranging cats and dogs in a suburban and rural environment, south-eastern Brazil', *Journal of Zoology* 273, 14–20. doi:10.1111/j.1469-7998.2007.00291.x
- Costello, C.J. & Solow, A.R., 2003, 'On the pattern of discovery of introduced species', *Proceedings of the National Academy of Sciences, United States of America* 100, 3321–3323. doi:10.1073/pnas.0636536100, PMID:12615995, PMCID:152290
- Delivering Alien Invasive Species Inventory for Europe (eds.), 2009, *Handbook of alien species in Europe*, Springer, Dordrecht.
- Foxcroft, L.C., 2009, 'Developing thresholds of potential concern for invasive alien species: hypotheses and concepts', *Koedoe* 51, 1–6. doi:10.4102/koedoe.v51i1.157
- Foxcroft, L.C., Richardson, D.M., Rouget, M. & MacFadyen, S., 2009, 'Patterns of alien plant distribution at multiple spatial scales in a large national park: implications for ecology, management and monitoring', *Diversity and Distributions* 15, 367–378. doi:10.1111/j.1472-4642.2008.00544.x
- Foxcroft, L.C., Richardson, D.M. & Wilson, J.R.U., 2008, 'Ornamental plants as invasive aliens: Problems and solutions in Kruger National Park, South Africa', *Environmental Management* 41, 32–51. doi:10.1007/s00267-007-9027-9, PMID:17943344
- Griffiths, C.L., Robinson, T.B., Lange, L. & Mead, A., 2010, 'Marine biodiversity in South Africa: An evaluation of current states of knowledge', *PLoS ONE* 5, e12008. doi:10.1371/journal.pone.0012008, PMID:20689849, PMCID:2914023
- Macdonald, I.A.W., Richardson, D.M. & Powrie, F.J., 1986, 'Range expansion of the Hadedda ibis *Bostrychia hagedash* in southern Africa', *South African Journal of Zoology* 21, 331–342.
- McGeoch, M.A., Butchart, S.H.M., Spear, D., Marais, E., Kleyhans, E.J., Symes, A. *et al.*, 2010, 'Global indicators of alien species invasion: Threats, biodiversity impact and responses', *Diversity and Distributions* 16, 95–108. doi:10.1111/j.1472-4642.2009.00633.x
- McGeoch, M.A., Dopolo, M., Novellie, P., Hendricks, H., Freitag, S., Ferreira, S. *et al.*, 2011, 'A strategic framework for biodiversity monitoring in SANParks', *Koedoe* 53(2), Art. #991, 10 pages. doi:10.4102/koedoe.v53i2.991
- Milton, S.J., 2004, 'Grasses as invasive alien plants in South Africa', *South African Journal of Science* 100, 69–75.
- Pyšek, P., Jarošík, V. & Kučera, T., 2002, 'Patterns of invasion in temperate nature reserves', *Biological Conservation* 104, 13–24. doi:10.1016/S0006-3207(01)00150-1
- Pyšek, P., Richardson, D.M., Pergl, J., Jarošík, V., Sixtová, Z. & Weber, E., 2008, 'Geographical and taxonomic biases in invasion ecology', *Trends in Ecology and Evolution* 23, 237–244. doi:10.1016/j.tree.2008.02.002
- Spear, D. & Chown, S.L., 2009a, 'The extent and impacts of ungulate translocations: South Africa in a global context', *Biological Conservation* 142, 353–363. doi:10.1016/j.biocon.2008.10.031
- Spear, D. & Chown, S.L., 2009b, 'Non-indigenous ungulates as a threat to biodiversity', *Journal of Zoology* 279, 1–17. doi:10.1111/j.1469-7998.2009.00604.x
- Tribe, G.D. & Richardson, D.M., 1994, 'The European wasp, *Vespula germanica* (Fabricius) (Hymenoptera: Vespidae) in southern Africa and its potential distribution as predicted by ecoclimatic matching', *African Entomology* 2, 1–6.