

Alien animals in South Africa – composition, introduction history, origins and distribution patterns

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Background: There is no comprehensive inventory and analysis of the composition, distribution, origin and rate of introduction of the alien fauna of South Africa.

Objectives: To provide such an analysis to facilitate effective ecological management, and compile a comprehensive inventory of introduced animal species across major habitats.

Methods: All available databases and references were used to compile the inventory, forming the basis of subsequent analyses. A graduated map was produced to identify concentrations of alien species.

Results: Of the 571 alien animal species analysed, insects comprised the largest component (53%, 300 species), followed by molluscs (9%, 51 species), annelids (8%, 48 species), arachnids (7%, 41 species), vertebrates (7%, 41 species) and crustaceans (6%, 36 species). Vertebrate introductions (88%) were largely intentional, whereas 84% of invertebrate introductions were unintentional.

Conclusions: Almost all marine and most terrestrial alien species were accidentally introduced, whereas freshwater introductions were almost entirely intentional. Some 13% had not spread significantly, 16% had spread significantly and 71% had become fully invasive. Vertebrate introductions virtually ceased after the 1950s, but rate of introduction of invertebrates remained linear. The overall rate of species accumulation was fairly low until 1880, but accelerated sharply thereafter. Most terrestrial alien species originated from Europe (28.6%) and Asia (25.0%) and the lowest proportion (6.1%) from Africa. Freshwater introductions largely originated from the Americas, with few from Africa. The most invaded areas were around Cape Town, (up to 162 introduced species/half-degree grid cell), followed by Gauteng and Durban.

Introduction

The distribution patterns and impacts of the approximately 750 tree and 8000 herbaceous plant species that have invaded over 10 million hectares of land in South Africa (Department of Environmental Affairs and Tourism [DEAT] 2006) have been extensively documented (Henderson 2001; Joubert 2009; Macdonald, Kruger & Ferrar 1986; Macdonald et al. 2003; Richardson & Van Wilgen 2004; Wilson et al. 2014). Much less has been published on the introduced fauna, although previous reviews have listed alien animals within some specific habitats or regions or within specific taxonomic groups. These include listings of the introduced fauna of South African aquatic ecosystems (De Moor & Bruton 1988) and South African National Parks (Spear et al. 2011) and several reviews documenting progressively increasing numbers of introductions into the marine environment (Griffiths et al. 1992; Griffiths, Robinson & Mead 2009; Mead et al. 2011a, 2011b; Robinson et al. 2016). Introduction pathways for South African vertebrates, invertebrates and plants have been compared and temporal patterns of invasion via the defined pathways examined (Faulkner et al. 2016). In taxonomic terms, the alien vertebrates have received a fair amount of research interest (Brooke, Lloyd & De Villiers 1986), with various reviews devoted to introduced mammals (Skead 2011), birds (Dean 2000), reptiles (van Wilgen et al. 2010) and fishes (De Moor & Bruton 1988; Ellender & Weyl 2014; Griffiths, Day & Picker 2015). Less attention has been devoted to invertebrate groups, but there have been some attempts to list the introduced species within specific taxa such as terrestrial molluscs (Herbert 2010) and earthworms (Plisko 2010), or functional groups such as biological control agents (Klein 2011). Reviews of the pests of cultivated plants (Annecke & Moran 1982; Prinsloo & Uys 2015; Visser 2009) also incorporate many species that are introduced. However, until recently no attempt had been made to produce an inventory of the entire regional alien fauna. The first such listing appeared in the semi-popular book by Picker and Griffiths (2011). The draft *National Environmental Management Biodiversity Act: Alien and Invasive species list* (Republic of South Africa 2014, Notice 3: National Lists of

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Invasive Species, lists 3–10) also provides incomplete listings of various groups of faunal invasives, which in fact also include numerous species that have not yet invaded any part of South Africa. For example, *list 5* of the Invasive List (*Notice 3*) mentions 35 alien reptile species – none which has been recorded as an established alien, but fails to list the single species which is an established invader (Brahminy blind snake, *Ramphotyphlops braminus*)!

The aims of this paper are to analyse the most comprehensive available listing of alien animal species of South Africa, that in Picker and Griffiths (2011), in terms of invaded habitat, taxonomic composition of the fauna, proportions of intentionally and unintentionally introduced species, invasion status, historical rate of accumulation of species, geographical origins of the fauna and spatial distribution across the region. These analyses provide baselines against which to measure future rates and patterns of faunal invasion in the region and also allow for comparisons of invasion rates and patterns between the various taxa and across the different habitats examined, as well as between South Africa and other regions. The species listing provided in the Appendix also documents which species have (or have not) in fact been reported in the region and can provide a basis for updated legislation, be used to compare listing from other regions, etc.

Methods

This analysis is based entirely on the listing of 571 alien species given in Picker and Griffiths (2011). Species documented after 2011 are excluded, as are translocated species and cryptogenic marine species (as listed by Mead et al. 2011a, 2011b). Data from the Appendix of Picker and Griffiths (2011) were used for the analysis of taxonomic composition, geographical origin and species richness of the South Africa alien fauna. All 571 species listed in the Appendix of Picker and Griffiths (2011) were also used for the analysis of modes of introduction and for the species accumulation curves. The original sources of data from which the listing in Picker and Griffiths (2011) were derived included various earlier reviews (Annecke & Moran 1982; Coates 1970; Herbert 2010; Heyns 1971; Klein 2011; Mead et al. 2011b; Millar 1994; Plisko 2010; Visser 2009) and scattered taxonomic papers as cited under the individual species entries in Picker and Griffiths (2011). In cases where only a subset of the data could be used (viz. Figures 2 and 3), the number of species used and source of data are given in the figure legends.

When examining the invasion status of species, we followed the framework proposed by Blackburn et al. (2011) and applied these categories to the 220 species featured in Picker and Griffiths (2011) for which we deemed the distribution sufficiently well known to be evaluated. Species were considered to have remained restricted to the site of entry (Category C3) if their distribution was mapped as a point entry (or two points in the case of multiple known sites of introduction, e.g. to two harbours). Species were considered to have ‘spread significantly’ (Category D) if they had expanded < 100 km from site of entry and to be fully invasive

(Category E) if they had spread > 100 km or occupied numerous sites (e.g. several widespread cities). In analysing geographical origin of the alien fauna, we used the seven-continent model. Where the native range of a species spanned two continents, each continent was scored 0.5 for that species, and where the home range spanned three continents, each received a score of 0.33. This accounts for the fractional scores shown in terms of numbers of species originating from the various continents. Assigning a full score to a species that occurs naturally on two continents would effectively bias the scores, as it would assume that the species had been introduced twice, once from each source continent and thus give it a double weighting. For parsimony, the fractional scores assume each species has been introduced from a single continent within its natural range.

When defining the mode of introduction as either intentional or unintentional, we consider species to be unintentional introductions only if they arrived inadvertently into the region, typically through association with crops, on ships’ hulls and ballast water, etc. Species are considered as intentional introductions both if purposely introduced directly into the wild, for example, as ornamentals, biological control agents or targets for hunting or fishing, or if introduced intentionally into captivity/aquaculture, from where they subsequently escaped and established in the wild. The mode of introduction was assessed for species in the Appendix of Picker and Griffiths (2011) using original sources of data as listed above.

Dates of introduction were bracketed by decade. While dates of introduction of vertebrates are generally quite accurately known, the date of discovery for the more cryptic invertebrates commonly postdates the true date of introduction, sometimes by decades. Species accumulation curves were plotted separately in Excel 2013 for invertebrates, for vertebrates and for all taxa combined. The slopes of the fitted curve for all taxa combined were calculated separately for the period 1750–1880, which was a period of limited colonisation, and for the period 1880–2000, which was a period of greater international trade initiated by the discovery of diamonds in Kimberley (1871) and gold in the Witwatersrand (1884), the Anglo-Boer wars (1880–1881; 1899–1902) and by immigration of Indian labourers in 1860 for the growing sugarcane industry in KwaZulu-Natal (Christopher 1994). The 1880–2000 curve was extrapolated in Excel 2013.

A graduated map showing the species richness of the alien fauna per half-degree square in South Africa was generated from Picker and Griffiths (2011), using those 242 species for which adequate distributional data were presented. Hardcopies of individual distribution maps for each of these species were scanned and superimposed over a visual half-degree grid map of matched scale to generate a visual half-degree grid map showing the number of alien species in each grid cell. Marine species were included in cells bordering the coastline, meaning that cells falling over both land and sea contain both terrestrial and marine species. From this visual grid, a half-degree cover was constructed for South Africa, and the species count data were transferred

from the Excel grid to the grid feature class in ArcGIS 10.3.1. The grid was then symbolised using the 'Graduated Colour' symbology option with seven classes. This was subsequently converted to greyscale in Corel Photo-Paint X3.

Results

Composition of the fauna

Of the 571 alien animal species analysed, the largest taxonomic component comprised the Insecta (300 species; 53% of the fauna), followed by Mollusca (51; 9%), Annelida (48; 8%), Arachnida (41; 7%) and Crustacea (36; 6%). These five groups together comprised 83% of the total introduced fauna (Table 1 and Appendix 1). Vertebrates (sum of Mammalia, Aves, Reptilia and Pisces, there being no alien Amphibia in this region [Measey et al. 2017]) were represented by just 41 species and only accounted for 7% of the alien fauna. Of the species listed, 452 (79%) were terrestrial, 79 (14%) marine and only 40 (7%) freshwater (Table 1 and Appendix 1).

The taxonomic composition of the introduced fauna varied dramatically across the different habitats. All marine introductions were invertebrates, with typically diverse marine groups, such as Ascidiacea, Crustacea, Annelida, Mollusca and Cnidaria, each well represented (11%–29% of the marine fauna). By far, the most important group in freshwater systems was Pisces (43% of the fauna), followed by Mollusca (20%) and then Crustacea (12%). The terrestrial fauna was dominated by Insecta (65%), followed by Arachnida, Annelida and Mollusca (7%–9% each).

Mode of introduction

The modes of introduction of 571 species could be determined. Of these species 41 were vertebrates, of which

36 (88%) were intentional introductions and only five unintentional (three rodents, one bird and one reptile). By contrast, the 530 invertebrate species comprised 91 (17%) intentional introductions, 82 (16%) of which were introduced as biological control agents, and 439 (83%) unintentional introductions (Table 2).

When the mode of introduction was separated by habitat (Figure 1), other interesting patterns emerged. The marine fauna comprised almost exclusively accidentally introduced species, the two exceptions being oysters intentionally introduced as aquaculture species but which subsequently escaped from captivity and established feral populations. The terrestrial component comprised about 20% intentional introductions, the majority of which were biological control agents. The freshwater fauna was dominated by fishes or crustaceans that were released intentionally as fishery targets, forage species or as biological control agents, or were intentionally introduced into captivity as ornamentals or aquaculture species, but subsequently escaped to establish feral populations (see Marr et al. 2017 for a proposed risk assessment procedure for future fish introductions).

Establishment category

Of the 240 species assessed (Table 3), only 13% remained restricted to their site of origin (Category C3), 16% had spread significantly (Category D) and 71% were fully invasive at multiple sites (Category E). These proportions varied considerably between taxa and systems. Site-restricted forms

TABLE 1: Taxonomic composition of the introduced fauna of South Africa, listed by major habitat type.

Group	Terrestrial	Marine	Freshwater	Total
Mammalia	13	0	0	13
Aves	9	0	1	10
Reptilia	1	0	0	1
Pisces	0	0	17	17
Ascidiacea	0	9	0	9
Echinodermata	0	2	0	2
Insecta	294	3	3	300
Myriopoda	9	0	0	9
Pycnogonida	0	1	0	1
Arachnida	40	0	1	41
Crustacea	8	23	5	36
Nematoda	5	0	0	5
Annelida	39	9	0	48
Mollusca	32	11	8	51
Brachiopoda	0	1	0	1
Bryozoa	0	6	0	6
Platyhelminthes	2	0	4	6
Cnidaria	0	13	1	14
Porifera	0	1	0	1
Total	452	79	40	571

Source: Species counts from all 571 species listed in the Appendix of Picker and Griffiths (2011)

TABLE 2: Mode of introduction of 571 alien animal species to South Africa, listed by major taxonomic group.

Taxon	Number of unintentional introductions	Number of intentional introductions (number biocontrol agents)
Vertebrates		
Mammalia	3	10 (0)
Aves	1	9 (0)
Reptilia	1	0 (0)
Pisces	0	17 (1)
Total	5	36 (0)
Invertebrates		
Ascidiacea	9	0 (0)
Echinodermata	2	0 (0)
Insecta	219	81 (79)
Myriopoda	9	0 (0)
Pycnogonida	1	0 (0)
Arachnida	39	2 (2)
Crustacea	32	4 (0)
Nematoda	4	1 (1)
Annelida	48	0 (0)
Mollusca	48	3 (0)
Brachiopoda	1	0 (0)
Bryozoa	6	0 (0)
Platyhelminthes	6	0 (0)
Cnidaria	14	0 (0)
Porifera	1	0 (0)
Total	439	91 (83)
Total fauna (%)	444 (78)	127 (22)

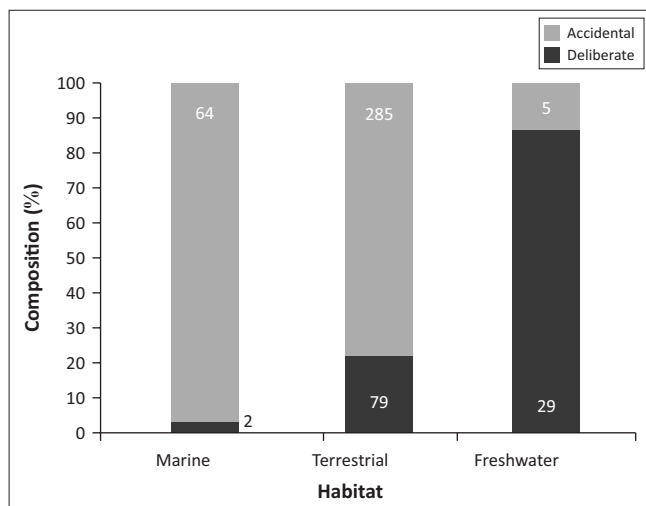
Source: Data from full Appendix of Picker and Griffiths (2011)

Of the intentional introductions, the number introduced as biological control agents are given in brackets.

made up the highest proportions among marine invertebrates (many of which remain confined to the harbours to which they were introduced) and among terrestrial vertebrates. Category D species were most common among vertebrate groups, especially freshwater ones (which often occupy delimited habitats such as dams). Fully invasive species were particularly dominant among the terrestrial and marine invertebrates, both of which are characterised by high mobility (via flight in the case of insects and pelagic larval stages in the case of marine invertebrates).

Date of introduction

Few introduced species were detected prior to the 1880s, although many, including crop pests and marine fouling species, may have been introduced well before that date. Vertebrate introductions, almost all of which were intentional (see above) occurred steadily since that time, but became rare after the 1950s (Figure 2a). By contrast, the rate of introduction of invertebrates has remained virtually linear since the late 1800s, when proper documentation began (Figure 2a). When the rate of detection curve was broken into two components – an early phase of invasion history (1800–1880) and a period of burgeoning international travel and trade (1880–2000) – the fitted curves showed markedly differing slopes, with the more recent period having a much steeper slope (0.65) than the earlier period (0.16). The extrapolated curve maintained the steep



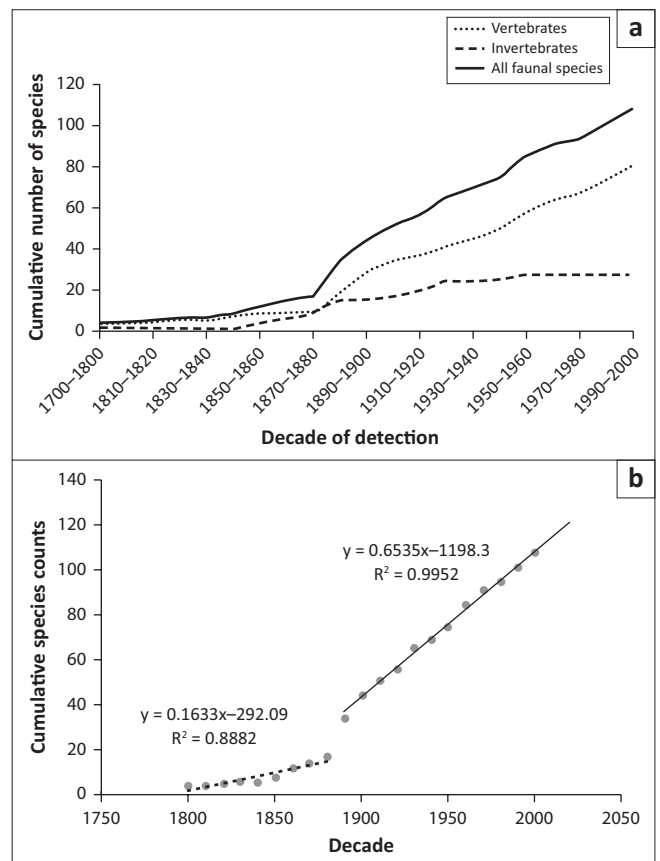
Source: Data based on the 571 species listed in the Appendix of Picker and Griffiths (2011), with biological control agents incorporated into the category of intentional introductions. Numbers in bars refer to species counts; I, intentional; U, unintentional.

FIGURE 1: Modes of introduction of alien fauna of South Africa by major habitat types.

slope and predicts a high future rate of accumulation of alien species (Figure 2b), the great majority of which are likely to be invertebrates.

Geographical origin of the South African alien fauna

For the terrestrial fauna, the majority of species were derived from Europe (28.6%) and Asia (25.0%), with the lowest proportion (6.1%) from other parts of Africa (Figure 3, cf. Faulkner et al. 2017). The component derived from Australia (9.3%) mostly comprised biological control agents. In contrast, the introductions of freshwater alien fauna originated mostly from North America (32.4%), South America (23.5%) and Asia (23.5%). The other continents contributed far fewer species (< 5%) each respectively (Figure 3). The areas of origin of the marine fauna are based on a different set of oceanic,



Source: Dates of first detection based on 27 (66% of the total) vertebrate species and 108 (20.5%) invertebrate species for which reliable data were available from species entries in Picker and Griffiths (2011).

FIGURE 2: Accumulated numbers of alien animal species reported from South Africa since 1800. (a) Vertebrate, invertebrate and combined alien fauna shown separately. (b) Fitted curves for periods prior to and after proliferation of trade and travel between South Africa and other countries (1880).

TABLE 3: Degree of establishment of South Africa invasive fauna. Values are percentages of the defined taxon (number of species in brackets).

Establishment category ^a	Vertebrates (terrestrial)	Vertebrates (freshwater)	Invertebrates (terrestrial)	Invertebrates (freshwater)	Invertebrates (marine)	Total fauna
C3	30 (6)	0 (0)	4 (6)	7 (1)	35 (18)	13 (31)
D	25 (5)	41 (7)	10 (14)	22 (3)	18 (9)	16 (38)
E	45 (9)	59 (10)	86 (118)	71 (10)	47 (24)	71 (171)
Total	9 (20)	7 (17)	58 (138)	5 (14)	21 (51)	100 (240)

Source: Data for 240 species with adequate distribution data, from Picker and Griffiths (2011)

^a, Establishment category after Blackburn et al. (2011) viz.; C3, self-sustaining population around point of origin; D, population extending significant distance from point of origin; E, fully invasive at multiple sites.

rather than continental, bioregions and have previously been plotted by Mead et al. (2011a), so are not re-examined here.

Intensity of faunal invasion across South Africa

The highest densities of introduced animal species (130–162/half-degree grid cell) occurred in the extreme south-western parts of the Western Cape Province, near Cape Town, followed by the highly populated regions around Gauteng and Durban (Figure 4). The southern and eastern coastal regions, as well as the summer rainfall regions in the Northeast, also had fairly high alien animal species richness. The lowest number of alien species (46–57/half-degree grid cell) occurred in the north-western semi-arid interior of the country. Because coastal cells contain both marine

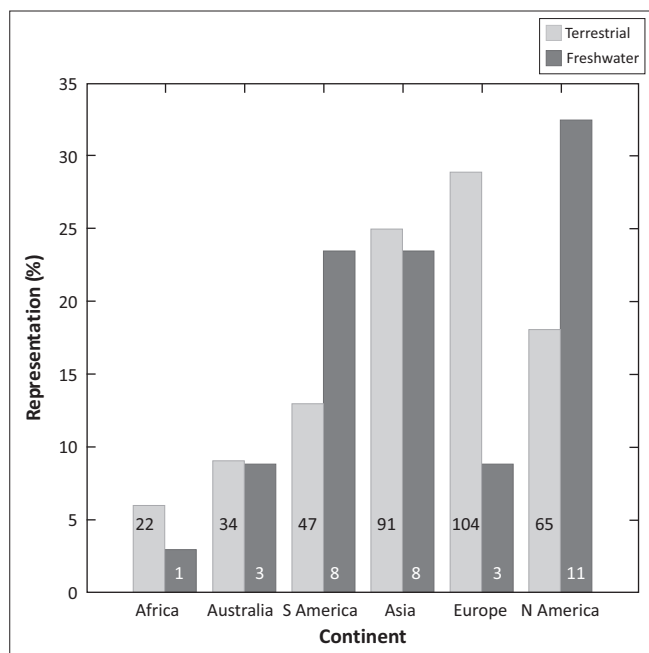
and terrestrial species, this accounts for some increase in the number of species in those cells, but in fact marine species represent a relatively low proportion of the total, except in a few harbour cities, such as Cape Town (42 marine species), Durban (31), Saldanha and Port Elizabeth (both 25) (Mead et al. 2011a).

Discussion

The 571 alien animal species in South African analysed here certainly represent an underestimation of the true number of alien animals present in the region. Newly introduced species are constantly invading the region and several such new invasions are reported each year. In addition, long-established historical invasions are also being revealed as a result of new ecological surveys or taxonomic revisions, for example, Mead et al. (2011a) uncovered several marine invasions that were associated with dry ballast or wooden vessels and had thus probably remained undiscovered for a century or more. Species may of course also be lost from the fauna, if local populations that were recorded as introduced in South Africa in the historical literature become locally extinct. Such losses can be difficult to detect, but see documentation of the recent local extinction of an alien sea urchin by Mabin, Wilson and Robinson (2015).

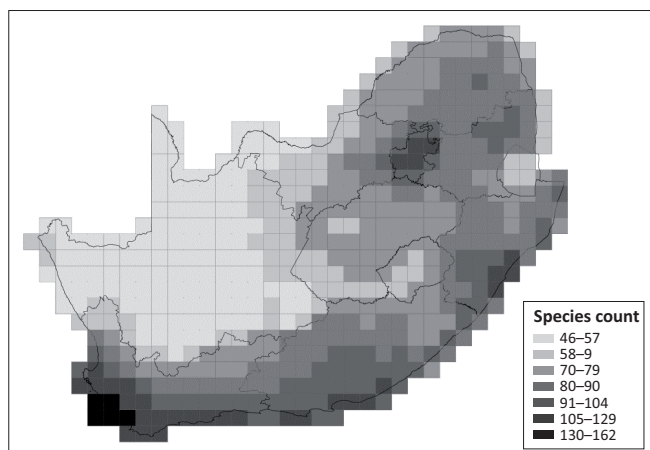
While the number of alien vertebrates (41; 7% of all alien species) is considered to be relatively well documented (Picker and Griffiths 2011), the tally of alien invertebrates is certainly a considerable underestimation linked to South Africa's relatively low 'country development status' (McGeoch et al. 2010), which results in resource limitation constraining the state of knowledge of biological invasions. This is best illustrated by comparing the inventory presented here with that produced by the DAISIE Project (Delivering Alien Invasive Species Inventories for Europe), one of the most comprehensive and detailed inventories of any alien fauna. The DAISIE Project records 2740 terrestrial invertebrate species in Europe compared to only 441 species for South Africa (DAISIE 2008). A similar situation exists in the marine environment. Although the number of recorded alien animals in the South African marine environment has increased dramatically in recent years, from 22 species reported by Griffiths et al. (2009) to 79 species recorded here, this is still far less than the 986 alien marine species recorded for Europe (Hulme et al. 2009). This is because many marine habitats (e.g. soft sediments of harbours) and taxa (e.g. Nematoda, Copepoda, Ostracoda and many parasitic taxa) remain poorly sampled for introduced species in South Africa and surely contain many more alien species. Additional factors, such as different duration and intensity of introduction histories and differences in the diversity of available habitats, may also contribute towards these regional differences.

The differences in the composition of the introduced faunas among major habitat types reflect (1) natural differences in biodiversity and faunal composition of terrestrial, marine and freshwater faunas and (2) differences between vectors that have transported these species. The dominance of the



Source: Data are from 397 species with known native ranges, as listed in the Appendix of Picker and Griffiths (2011)

FIGURE 3: Geographical origins of the terrestrial and freshwater alien faunas of South Africa, each expressed as percentages. Number of species originating from each region shown within bars.



Source: Distribution data derived from Picker and Griffiths (2011), using those 242 species for which adequate distributional data were presented

FIGURE 4: Species richness of alien animals across South Africa plotted by half-degree square. Coastal cells that straddle marine and terrestrial habitats include species from both habitats.

alien terrestrial fauna by insects is a reflection not only of the enormous natural diversity and species richness of this group in terrestrial systems but also of their importance as crop pests and their frequent use as biological control agents. Similarly, ascidians, echinoderms, bryozoans and cnidarians are all overwhelmingly marine groups and hence feature more prominently in the marine listing. However, it is of interest to note that no marine fishes have been introduced to South Africa, and no introduced marine nematodes have been reported, despite their high diversity in marine habitats. The latter is probably an artefact of poor sampling and lack of taxonomic expertise in marine nematodes, as numerous invasive nematodes have been reported from other regions, such as Europe (DAISIE). The high diversity of fishes among freshwater introductions stems from their frequent intentional introduction as sport-fishing targets, ornamental and forage species, or as biological control agents. This pattern was not paralleled in marine habitats, where sport-fishing targets are common among the indigenous fish fauna and no intentional alien fish introductions have taken place (other than of species that remain restricted within aquaculture facilities).

Our analysis of degree of establishment of species within the alien fauna suggests that 13% of analysed species have failed to spread from their sites of introduction, 16% have spread significantly (< 100 km) and 71% are fully invasive. However, as this analysis is based on species featured as full entries in the review by Picker and Griffiths (2011), it is (apart from the vertebrates) biased in favour of 'important' invasions, which also tend to be those that have spread widely. In addition, species with wider distributions are more likely to have been discovered, and their distribution is more likely to have been mapped when compared to those that remain localised. Thus, we suspect that that species in the early stages of invasion in fact make up a larger component of the fauna than this analysis suggests.

The initial rate of accumulation of the South African alien fauna was slow. During this period of early colonialism, the first Dutch settlers gradually expanded settlements into the interior and eastern parts of South Africa, with the last frontiers of the Northern and Eastern Cape and northern KwaZulu-Natal being breached by colonialists around 1900. During the last decades of the 19th century (1880 onwards), the numbers of alien species increased steeply, with the slope of the accumulation curve increasing from 0.16 to 0.65. This coincided with the discovery of diamonds in Kimberley (ca. 1871) and then gold on the Witwatersrand (1884) – both events galvanising urbanisation, international travel and trade links, which led to increased immigration rates (Christopher 1994; Deacon 1986). The dramatic increase in trade because of the mining industry was also associated with the industrialisation of ports. All these factors contributed to the steep increase in the number of alien animals since 1880. It should be noted that while these figures were derived from species whose invasion history is

well known, many (invertebrate) species are only being discovered long after their first date of introduction, and some species may have multiple dates of introduction. The pattern of invasion by alien species in Europe differs in many respects from that in South Africa. In Europe, there was no noticeable increase in the number of new species between the period 1951–1970 and the period 1971–1990 in marine and freshwater habitats, apart for marine invertebrates, which had a steep increase during the period 1951–2007 (Hulme et al. 2009). No new alien birds or mammals colonised Europe after 1951, comparable with the situation in South Africa, where few new alien vertebrates colonised after 1930. However, the number of escapee species appears to be increasing with time (Faulkner et al. 2016). In Europe there was a fairly steep increase in the number of new alien insects after 1951 and a flatter curve for new alien non-insect arthropods. In South Africa the curve was linear and steep after 1890. Roques et al. (2009) estimated that 60% of the alien insect fauna of Europe only established in the last 50 years. A similar trend is evident for South Africa (Figure 2), where approximately 50% of invertebrate introductions occurred prior to 1960. The major pathways for the introduction of South African alien invertebrates (besides deliberate release as biocontrol agents) were as contaminants and stowaways with the number of released biocontrol agents increasing sharply after 1970 (Faulkner et al. 2016). In contrast, the introduction of invertebrates as stowaways and contaminants was gradual in the 1900s and accelerated in the 2000s (Faulkner et al. 2016). The curve may thus not have been influenced to a large degree by biocontrol agents, as few had been introduced at the beginning of the 20th century and comprised only 21% of the 530 alien invertebrates considered here. See also Faulkner et al. (2017) for a discussion of introductions from other African countries.

The highest concentration of marine alien species in South Africa occurs in the vicinity of major urban areas, especially ports, which were the entry point for many groups of alien invaders, including plants (Deacon 1986). For animals, the highest density of terrestrial alien species (130–162 species/half-degree grid square) occurs in the metropolitan area of Cape Town. This area is the oldest port in South Africa, and its Mediterranean-type climate also provides a suitable eco-climatic match for alien fauna from the temperate regions of Europe and North America, with which the developing colony conducted most of its trade (Tribe & Richardson 1994). Interestingly, some alien vertebrates, such as the grey squirrel and European chaffinch, both introduced to Cape Town in the 1890s, have not managed to substantially extend their ranges further into the fynbos biome in over 100 years.

The least invaded region, with less than 50 introduced species per half-degree cell, is restricted to the arid, low population density areas of the Northern Cape in the interior of the country. Many of the alien species here are widely distributed species associated with human habitation, such as mice, house sparrows, cockroaches, booklice and pests

of domestic stock and stored products (see individual maps in Picker & Griffiths 2011). The low densities of alien animals in the semi-arid interior may also be related to low habitat diversity and poor ecoclimatic matching of that area. Most of the country has 50–100 introduced animal species per half-degree grid square. Areas with more than 100 species comprise the urban centres surrounding Johannesburg, Pretoria and Durban, plus a broad coastal swath running from Port Elizabeth to Cape Town. Cape Town and its close surrounds stand out as the only region with over 150 species (largely invertebrates) and represent by far the most heavily invaded area of the country. This is similar to the situation in Europe, where both alien plants and insects were found to be associated most closely with urban habitats (parks and gardens), followed by cultivated lands (Pyšek et al. 2010). Sampling intensity may also play some role here, as urban habitats also tend to be adjacent to research institutions and this may result in their being more intensively surveyed than more remote regions of the country.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

M.D.P. and C.L.G. contributed equally to the compilation of the inventory, data analysis and writing of the manuscript.

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APPENDIX 1

Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Mammalia					
Bovidae	<i>Capra hircus</i>	Feral domestic goat	Iran	T	-
	<i>Hemitragus jemlahicus</i>	Himalayan Tahr	Central Asia to China	T	1930
	<i>Rusa unicolor</i>	Sambar deer	South East Asia	T	1880
Cervidae	<i>Dama dama</i>	European fallow deer	Iran, Iraq, Turkey	T	< 1869
Equidae	<i>Equus asinus</i>	Feral donkey	Egypt, Somalia	T	-
	<i>Equus ferus caballus</i>	Feral horse	Central Asia	T	-
Felidae	<i>Felis catus</i>	Feral domestic cat	Egypt	T	-
Leporidae	<i>Oryctolagus cuniculus</i>	European rabbit	Europe	T	1654
Muridae	<i>Mus musculus</i>	House mouse	Eurasia	T	-
	<i>Rattus norvegicus</i>	Brown rat	China, Russia, Japan	T	< 1830
	<i>Rattus rattus</i>	House rat	South Asia	T	< 800 AD
Sciuridae	<i>Sciurus carolinensis</i>	Grey squirrel	USA	T	1890
Suidae	<i>Sus scrofa</i>	Feral domestic pig	Eurasia	T	1926
Aves					
Anatidae	<i>Anas platyrhynchos</i>	Mallard	Nearctic	F	-
Columbidae	<i>Columba livia</i>	Rock Dove	Mediterranean, Asia	T	1850
Corvidae	<i>Corvus splendens</i>	House Crow	South Asia	T	1960s
Fringillidae	<i>Fringilla coelebs</i>	Common Chaffinch	Europe	T	1890s
Passeridae	<i>Passer domesticus</i>	House Sparrow	Eurasia, Northern Africa	T	1893
Phasianidae	<i>Alectoris chukar</i>	Chukar Partridge	Central Asia, China	T	1964
	<i>Pavo cristatus</i>	Common Peacock	South Asia	T	-
Psittidae	<i>Psittacula krameri</i>	Rose-ringed Parakeet	South Asia	T	1850s
Sturnidae	<i>Acridotheres tristis</i>	Common Myna	South Asia	T	1888
	<i>Sturnus vulgaris</i>	Common Starling	Europe	T	1889
Reptilia					
Typhlopidae	<i>Ramphotyphlops braminus</i>	Brahminy Blind Snake	South Asia	T	1920s
Teleostei					
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill sunfish	Eastern USA	F	1938
	<i>Micropterus dolomieu</i>	Smallmouth bass	USA	F	1937
	<i>Micropterus punctulatus</i>	Spotted bass	USA	F	1939
	<i>Micropterus salmoides</i>	Largemouth bass	USA, Mexico	F	1928
Cichlidae	<i>Oreochromis niloticus</i>	Nile tilapia	Sahel, Africa	F	1959
Cyprinidae	<i>Carassius auratus</i>	Goldfish	China	F	1726
	<i>Ctenopharyngodon idella</i>	Grass carp	China, Russia	F	1967
	<i>Cyprinus carpio</i>	Common carp	Eastern Europe, Russia	F	1859
	<i>Hypophthalmichthys molitrix</i>	Silver carp	China	F	1975
	<i>Tinca tinca</i>	Tench	Europe, Russia	F	1910
	<i>Pterygoplichthys disjunctivus</i>	Vermiculated sailfin	Amazon	F	2000
Locariidae	<i>Perca fluviatilis</i>	Perch	Europe, Russia	F	1915
Poeciliidae	<i>Gambusia affinis</i>	Mosquito fish	USA, Mexico	F	1936
	<i>Poecilia reticulata</i>	Guppy	South America/Caribbean	F	1912
	<i>Xiphophorus helleri</i>	Swordtail	Mexico	F	1974
	<i>Onchorhynchus mykiss</i>	Rainbow trout	Western North America	F	1897
Salmonidae	<i>Salmo trutta</i>	Brown trout	Europe	F	1892
Ascidacea					
Ascididae	<i>Ascidia sydneiensis</i>	Crevice ascidian	Asia	M	1932
	<i>Ascidella aspersa</i>	Dirty sea squirt	North Sea	M	-
Cionidae	<i>Ciona intestinalis</i>	Vase tunicate	Europe	M	1955
Clavelinidae	<i>Clavelina lepadiformis</i>	Light-bulb sea squirt	Europe	M	2001
Didemnidae	<i>Diplosoma listerianum</i>	Jelly crust tunicate	Europe	M	1949
Puridae	<i>Microcosmus squamiger</i>	Blunt-spined microcosmus	Australia	M	-
Styelidae	<i>Botryllus schlosseri</i>	Star sea squirt	Northeastern Atlantic	M	1946
	<i>Cnemidocarpa humilis</i>	Leathery sea squirt	Unknown	M	-
	<i>Styela plicata</i>	Pleated sea squirt	West Pacific	M	2010
Echinodermata					
Arbaciidae	<i>Tetrapygus niger</i>	Black sea urchin	Chile, Peru	M	2010
Ophiactidae	<i>Ophiactis savignyi</i>	Little six-arm brittlestar	North Indian and Pacific Oceans	M	< 1950

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Collembola					
Brachystomellidae	<i>Brachystomella parvula</i>	-	Europe	T	-
Entomobryidae	<i>Entomobrya nivalis</i>	Cosmopolitan springtail	Northern hemisphere	T	-
Hypogastruridae	<i>Hypogastrura armata</i>	-	Unknown	T	-
	<i>Hypogastrura manubrialis</i>	Mushroom springtail	Northern Europe	T	-
	<i>Hypogastrura purpurescens</i>	-	Probably Europe	T	-
	<i>Mesogastrura libyca</i>	-	Probably Europe	T	-
	<i>Xenylla maritima</i>	-	Probably Eurasia	T	-
	<i>Isotomurus palustris</i>	Marsh springtail	Europe	T	-
Isotomidae	<i>Parisotoma notabilis</i>	-	Europe	T	-
	<i>Proisotoma minuta</i>	-	Probably Northern hemisphere	T	-
Neanuridae	<i>Neanura muscorum</i>	Neanura/Moss springtail	Northern Europe	T	-
Sminthuridae	<i>Sminthurus viridis</i>	Clover springtail	Europe	T	-
Tomoceridae	<i>Tomocerus minor</i>	-	Probably Palaearctic	T	-
Thysanura					
Lepismatidae	<i>Ctenolepisma longicaudata</i>	Grey silverfish	Caribbean	T	< 1900
	<i>Ctenolepisma urbana</i>	Urban silverfish	Probably USA	T	-
	<i>Lepisma saccharina</i>	Silverfish	Unknown	T	-
Blattodea					
Blattellidae	<i>Blattella germanica</i>	German cockroach	South East Asia	T	-
Blattidae	<i>Periplaneta americana</i>	American cockroach	Tropical Africa	T	-
	<i>Blatta orientalis</i>	Oriental cockroach	Unknown	T	-
Isoptera					
Kalotermitidae	<i>Cryptotermes brevis</i>	House termite	West Indies	T	1918
Rhinotermitidae	<i>Coptotermes formosanus</i>	Formosan termite	China, Japan	T	1924
Dermaptera					
Anisolabididae	<i>Euborellia annulipes</i>	Ring-legged earwig	Southern Europe	T	1912
Labiduridae	<i>Labidura riparia</i>	Sand earwig	Siberia	T	1863
	<i>Nala lividipes</i>	Black field earwig	South East Asia	T	1900
Spongiphoridae	<i>Labia minor</i>	Lesser earwig	Palaearctic Europe, Northern Africa	T	1900
Phasmatodea					
Phasmatidae	<i>Carausius morosus</i>	Indian stick insect	India	T	-
Embioptera					
Oligotomidae	<i>Oligotoma saundersii</i>	Saunders embiid	India	T	-
Psocoptera					
Liposcelidae	<i>Liposcelis bostrychophila</i>	Domestic booklouse	Probably Tropical Africa	T	-
Hemiptera					
Aleyrodidae	<i>Aleurocanthus woglumi</i>	Citrus blackfly	Asia	T	-
	<i>Aleurothrix floccosus</i>	Woolly whitefly	Caribbean	T	2007
	<i>Bemisia tabaci</i>	Tobacco whitefly	Probably Asia	T	-
	<i>Siphoninus phillyreae</i>	Pomegranate whitefly	Southern Europe, Northern Africa	T	2009
	<i>Trialeurodes vaporariorum</i>	Greenhouse whitefly	Likely USA	T	1923
	<i>Acyrtosiphon kondoi</i>	Blue alfafa aphid	Asia	T	-
Aphididae	<i>Acyrtosiphon pisum</i>	Pea aphid	Palaearctic	T	-
	<i>Aphis armoraciae</i>	Western Aster root aphid	USA	T	-
	<i>Aphis chloris</i>	St Johns wort aphid	Eurasia	T (BIO)	-
	<i>Aphis craccivora</i>	Groundnut aphid	Europe	T	-
	<i>Aphis fabae</i>	Black bean aphid	Europe	T	-
	<i>Aphis gossypii</i>	Cotton aphid	Unknown	T	-
	<i>Aphis nasturtii</i>	Buckthorn aphid	Probably Europe	T	-
	<i>Aphis spiraecola</i>	Green citrus aphid	East Asia	T	-
	<i>Aulacorthum circumflexum</i>	Mottled arum aphid	South East Asia	T	-
	<i>Aulacorthum solani</i>	Greenhouse potato aphid	Europe	T	-
	<i>Brachycaudus amygdalinus</i>	Short-tailed almond aphid	Europe, Northern Africa	T	-
	<i>Brachycaudus helichrysi</i>	Leaf curling plum aphid	Palaearctic	T	-
	<i>Brevicoryne brassicae</i>	Cabbage aphid	Europe	T	-
	<i>Capitophorus elaeagni</i>	Artichoke aphid	Mediterranean	T	-
	<i>Cedrobium laportei</i>	Deodar aphid	Northern Africa	T	-
	<i>Cerataphis orchidearum</i>	Orchid aphid	South East Asia	T	-
	<i>Cerataphis brasiliensis</i>	Palm aphid	South East Asia	T	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
	<i>Chaetosiphon fragaefolii</i>	Strawberry aphid	Probably USA	T	-
	<i>Chaitophorus leucomelas</i>	-	Palearctic	T	-
	<i>Chaitophorus populialba</i>	-	Eurasia, Northern Africa	T	-
	<i>Cinara cronartii</i>	Black pine aphid	Eastern USA	T	1974
	<i>Cinara cupressivora</i>	Cypress aphid	Probably Eastern Greece	T	1993
	<i>Diuraphis noxia</i>	Russian wheat aphid	Russia, Palearctic	T	1978
	<i>Dysaphis apiifolia</i>	Hawthorn parsley aphid	Eurasia	T	-
	<i>Dysaphis foeniculus</i>	Carrot aphid	Eurasia	T	-
	<i>Dysaphis tulipae</i>	Tulip bulb aphid	Probably Eurasia, Northern Africa	T	-
	<i>Eriosoma lanigerum</i>	Woolly apple aphid	Possibly USA	T	1895
	<i>Eulachnus rileyi</i>	Pine needle aphid	USA, Europe	T	-
	<i>Hyadaphis coriandri</i>	Coriander aphid	Central Asia	T	-
	<i>Hydaphis foeniculi</i>	Honeysuckle aphid	Palearctic	T	-
	<i>Hyperomyzus lactucae</i>	Blackcurrant aphid	Palearctic	T	-
	<i>Hysteroneura setariae</i>	Rusty plum aphid	USA	T	-
	<i>Illinoia azalea</i>	-	USA	T	-
	<i>Lipaphis pseudobrassicae</i>	False cabbage aphid	Palearctic	T	-
	<i>Macrosiphon euphorbiae</i>	Potato aphid	USA	T	-
	<i>Macrosiphoniella sanborni</i>	Chrysanthemum aphid	East Asia	T	-
	<i>Monelliopsis pecanis</i>	Yellow pecan aphid	USA	T	-
	<i>Myzocallis castanicola</i>	Oak aphid	Europe	T	-
	<i>Myzus persicae</i>	Green peach aphid	Probably Asia	T	-
	<i>Neotoxoptera oliveri</i>	Marigold aphid	Probably Asia	T	-
	<i>Pemphigus populitransversus</i>	Poplar gall aphid	USA	T	-
	<i>Pentalonia nigronervosa</i>	Banana aphid	Probably South East Asia	T	-
	<i>Pineus pini</i>	Pine woolly aphid	Probably Eurasia	T	-
	<i>Prociphilus fraxinifolii</i>	Leafcurl ash aphid	USA	T	-
	<i>Rhodobium porosum</i>	Shiny rose aphid	Probably USA	T	-
	<i>Rhopalosiphum maidis</i>	Maize aphid	Probably Pakistan	T	-
	<i>Rhopalosiphum padi</i>	Bird cherry aphid	Palearctic	T	-
	<i>Schizaphis graminum</i>	Wheat aphid	Probably Palearctic, Asia	T	-
	<i>Schizaphis minuta</i>	-	Asia, Australia, Iran	T	-
	<i>Schizaphis rotundiventris</i>	Oil palm aphid	Southern Europe, Asia, Australia	T	-
	<i>Sipha maydis</i>	-	Eurasia, India, Middle East	T	-
	<i>Sitobium avenae</i>	Brown wheat ear aphid	Probably Eurasia	T	-
	<i>Smynthuroides betae</i>	Bean root aphid	Probably Mediterranean	T	-
	<i>Takecallis taiwanus</i>	-	Taiwan, Japan	T	-
	<i>Therioaphis trifolii</i>	Yellow clover aphid	Mediterranean	T	-
	<i>Toxoptera odinae</i>	Mango aphid	India, South East Asia	T	-
Cicadellidae	<i>Circulifer tenellus</i>	Beet leafhopper	Europe	T	-
	<i>Opsiurus stactogalus</i>	Tamarix leafhopper	Europe	T	-
	<i>Orosius albicinctus</i>	Orosius leafhopper	Unknown	T	-
Coccidae	<i>Coccus hesperidum</i>	Soft brown scale	Probably Afro-Ethiopian	T	-
	<i>Pseudaulacaspis pentagona</i>	White peach scale	Probably Tropical Asia	T	-
	<i>Pulvinaria psidii</i>	Guava scale	Asia	T	-
Dactylopiidae	<i>Dactylopius austrinus</i>	Cochineal scale	Southern USA, Central America	T (BIO)	-
	<i>Dactylopius ceylonicus</i>	Wild cochineal insect	Southern USA, Central America	T (BIO)	-
	<i>Dactylopius opuntiae</i>	Prickly pear cochineal	USA, Mexico	T (BIO)	1937
	<i>Dactylopius tomentosus</i>	Tomentose cochineal scale	Southern USA, Central America	T (BIO)	-
Delphacidae	<i>Perkinsiella saccharicida</i>	Kirkaldy sugarcane hopper	Australasia	T	-
Diaspididae	<i>Aonidiella aurantii</i>	Red scale	Southeast Asia	T	-
	<i>Chrysomphalus aonidium</i>	Circular purple scale	Indian subcontinent	T	-
	<i>Cornuaspis beckii</i>	Citrus mussel scale	Indian subcontinent	T	-
	<i>Diaspidiotus perniciosus</i>	Pernicious scale	Northern China	T	1911
	<i>Diaspis bromeliae</i>	Pineapple scale	South America	T	-
	<i>Parlatoria pergandii</i>	Chaff scale	Asia	T	-
Miridae	<i>Ecritotarsus catarinensis</i>	-	Brazil	FW (BIO)	-
	<i>Falconia intermedia</i>	-	Southern USA, Caribbean	T (BIO)	-
Monophlebidae	<i>Icerya purchasi</i>	Australian bug	Australia	T	1873
Ortheziidae	<i>Orthezia insignis</i>	-	Southern and Central America	T (BIO)	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Pentatomidae	<i>Nezara viridula</i>	Green stinkbug	Probably Ethiopia	T	-
Phylloxeridae	<i>Moritzella corticalis</i>	Oak bark phylloxera	Europe	T	-
	<i>Viteus vitifoliae</i>	Grapevine phylloxera	Eastern USA	T	-
Pseudococcidae	<i>Ferrisia malvastrae</i>	White-tailed mealy bug	Americas	T	-
	<i>Hypogeococcus pungens</i>		South America	T (BIO)	-
	<i>Phenacoccus parvus</i>	Lantana mealy bug	Southern and Central America	T (BIO)	-
	<i>Planococcus citri</i>	Citrus mealy bug	Probably China, Japan	T	-
	<i>Planococcus ficus</i>	Grapevine mealy bug	Unknown	T	-
Psyllidae	<i>Blastopsylla occidentalis</i>	Eucalypt shoot psyllid	Australia	T	2004
	<i>Ctenarytaina eucalypti</i>	Blue gum psyllid	Australia	T	1923
Thaumastocoridae	<i>Thaumastocoris peregrinus</i>	Eucalyptus thaumastocorid	Australia	T	2003
Tingidae	<i>Carvalhotingis hollandi</i>	Cotton lace bug	Southern and Central America	T (BIO)	-
	<i>Carvalhotingis visenda</i>	Leafsucking lace bug	Southern and Central America	T (BIO)	-
	<i>Gargaphia decoris</i>	Woolly nightshade lace bug	Argentina	T (BIO)	-
	<i>Teleonemia elata</i>		Brazil	T (BIO)	-
	<i>Teleonemia scrupulosa</i>	Lantana lace bug	Mexico	T (BIO)	-
Thysanoptera					-
Thripidae	<i>Fulmekiola serrata</i>	Sugarcane thrips	Mauritius	T	< 2004
	<i>Heliothrips haemorrhoidalis</i>	Greenhouse thrips	South America	T	1912
	<i>Thrips palmi</i>	Melon thrips	Southern Asia	T	-
	<i>Thrips tabaci</i>	Onion thrips	Unknown	T	-
Phthiraptera					-
Boopidae	<i>Heterodoxus spiniger</i>	Dog louse	Australia	T	-
Haematopinidae	<i>Haematopinus eurysternus</i>	Short-nosed cattle louse	Unknown	T	-
	<i>Haematopinus suis</i>	Pig-louse	Unknown	T	-
Linognathidae	<i>Linognathus setosus</i>	Dog sucking louse	Unknown	T	-
	<i>Linognathus vituli</i>	Long-nosed cattle louse	Unknown	T	-
Menopodidae	<i>Goniocotes gallinae</i>	Poultry fluff louse	Probably Asia	T	-
	<i>Lipeurus caponis</i>	Poultry wing louse	Probably Asia	T	-
	<i>Menacanthus stramineus</i>	Poultry body louse	Unknown	T	-
	<i>Menopon gallinae</i>	Poultry shaft louse	Probably Asia	T	-
Polyplacidae	<i>Polyplax spinulosa</i>	Spined rat louse	Probably Asia	T	-
Trichodectidae	<i>Damalinia bovis</i>	Cattle biting louse	Unknown	T	-
	<i>Damalinia caprae</i>	Common goat-louse	Unknown	T	-
	<i>Damalinia ovis</i>	Sheep biting louse	Unknown	T	-
Coleoptera					-
Anobiidae	<i>Lasioderma serricorne</i>	Cigarette beetle	Unknown	T	-
	<i>Stegobium paniceum</i>	Drug store beetle	Unknown	T	-
Apionidae	<i>Coelocephalapion camarae</i>	Lantana petiole weevil	Mexico	T (BIO)	-
	<i>Trichapion lativentre</i>	-	South America	T (BIO)	-
Bostrichidae	<i>Prostephanus truncatus</i>	Larger grain borer	Central America	T	1999
	<i>Rhyzopertha dominica</i>	Lesser grain borer	Probably Tropical Asia	T	-
Buprestidae	<i>Hylaeogena jureceki</i>	Leaf-mining jewel beetle	Korea	T (BIO)	-
Cerambycidae	<i>Aphanasium australe</i>		Southeastern Australia	T (BIO)	-
	<i>Chlorophorus annularis</i>	Bamboo longhorn beetle	Indian subcontinent	T	-
	<i>Lagocheirus funestus</i>	Opuntia biocontrol beetle	Mexico	T (BIO)	-
	<i>Nealcidion cereicola</i>	-	Argentina	T (BIO)	-
	<i>Phoracantha recurva</i>	Eucalypt borer	Australia	T	1906
	<i>Phoracantha semipunctata</i>	Zig-zag eucalypt borer	Australia	T	1906
Chrysomelidae	<i>Acanthoscelides macrophthalmus</i>	Bean weevil	West Africa	T (BIO)	-
	<i>Acanthoscelides obtectus</i>	Bean weevil	Central America	T	-
	<i>Algarobius prosopis</i>	Prosopis seed beetle	Southwestern USA	T (BIO)	1987
	<i>Charidotis auroguttata</i>	-	Costa Rica	T (BIO)	-
	<i>Chrysolina quadrigemina</i>	St. John's wort beetle	Northern Africa, Europe	T (BIO)	-
	<i>Gratiana spadicea</i>	-	South America	T (BIO)	-
	<i>Leptinotarsa defecta</i>	Satansbos leaf beetle	North America	T (BIO)	1992
	<i>Leptinotarsa texana</i>	Texan Satansbos leaf beetle	North America	T (BIO)	1992
	<i>Longitarsus bethae</i>	Flea beetle	Mexico	T (BIO)	-
	<i>Lysathia species</i>	-	South America	T (BIO)	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Coccinellidae	<i>Neltumius arizonensis</i>	Prosopis seed beetle	Southwestern USA	T (BIO)	-
	<i>Octotoma scabripennis</i>	Lantana leaf beetle	Mexico, Central America	T (BIO)	-
	<i>Oulema bilineata</i>	Tobacco slug	South America	T	-
	<i>Oulema trilineata</i>	Three-lined potato beetle	South America	T	-
	<i>Phenrica guerini</i>	-	South America	T (BIO)	-
	<i>Sulcobruchus subsuturalis</i>	-	Asia	T (BIO)	-
	<i>Uroplata girardi</i>	Lantana hispid	South America	T (BIO)	-
	<i>Harmonia axyridis</i>	Harlequin lady beetle	Central and Eastern Asia	T	2001
	<i>Hippodamia variegata</i>	Variegated lady beetle	Palearctic	T	1965
	<i>Rodolia cardinalis</i>	Vedalia beetle	Probably Australia	T	1892
Curculionidae	<i>Anthonomus santacruzi</i>	-	South America	T (BIO)	-
	<i>Cosmopolites sordidus</i>	Banana root borer	Probably South East Asia	T	-
	<i>Cydmaea binotata</i>	-	Southeastern Australia	T (BIO)	-
	<i>Cylas formicarius</i>	Sweet potato weevil	Indonesia	T	-
	<i>Cyrtobagous salviniae</i>	Salvinia weevil	Southern and Central America	T (BIO)	-
	<i>Dicomada rufa</i>	-	Southeastern Australia	T (BIO)	-
	<i>Dixoncis pictus</i>	-	Southeastern Australia	T (BIO)	-
	<i>Erytenna consputa</i>	Hakea fruit weevil	Southeastern Australia	T (BIO)	-
	<i>Gonipterus cf. scutellatus</i>	Eucalyptus snout beetle	South Australia, Tasmania	T	-
	<i>Graphognathus leucoloma</i>	White-fringed beetle	South America	T	-
	<i>Listroderes costirostris</i>	Vegetable weevil	Brazil	T	-
	<i>Melanterius acacia</i>	-	Australia	T (BIO)	-
	<i>Melanterius compactus</i>	Acacia seed weevil	Australia	T (BIO)	-
	<i>Melanterius maculatus</i>	Acacia seed weevil	Australia	T (BIO)	-
	<i>Melanterius servulus</i>	Acacia seed weevil	Australia	T (BIO)	-
	<i>Melanterius ventralis</i>	Acacia seed weevil	Australia	T (BIO)	-
	<i>Metamasius spinolae</i>	Cactus weevil	Neotropics	T (BIO)	-
	<i>Naupactus leucoloma</i>	White-fringed weevil	South America	T	-
	<i>Neochetina bruchi</i>	Water hyacinth weevil	Southern and Central America	T (BIO)	-
	<i>Neochetina eichhorniae</i>	Mottled water hyacinth weevil	Southern and Central America	T (BIO)	-
	<i>Neodiplogrammus quadrivittatus</i>	Trunk-boring curculionid	South America	T (BIO)	-
	<i>Neohydronomus affinis</i>	Waterlettuce weevil	South and Central America	FW (BIO)	-
	<i>Pantomorus cervinus</i>	Fuller's rose beetle	Probably Americas	T	-
	<i>Pissodes nemorensis</i>	Northern pine weevil	Southeastern USA	T	1942
	<i>Rhinocyllus conicus</i>	Thistle-head weevil	Eurasia	T (BIO)	-
	<i>Rhyssomatus marginatus</i>	Seed feeding weevil	South America	T (BIO)	-
	<i>Sitophilus granarius</i>	Granary weevil	Palearctic	T	-
	<i>Stenopelmus rufinasus</i>	Azolla weevil	Americas	T (BIO)	1997
	<i>Sternochetus mangiferae</i>	Mango weevil	South East Asia	T	-
Dermestidae	<i>Anthrenus verbasci</i>	Varied carpet beetle	Probably California	T	-
	<i>Dermestes maculatus</i>	Hide beetle	Unknown	T	-
	<i>Trogoderma granarium</i>	Khapra beetle	Asia	T	-
	<i>Trogoderma inclusum</i>	Larger cabinet beetle	USA	T	-
	<i>Trogoderma variabile</i>	Warehouse beetle	Asia	T	-
Melyridae	<i>Astylus atromaculatus</i>	Spotted maize beetle	South America	T	1916
Nitidulidae	<i>Carpophilus dimidiatus</i>	Corn-sap beetle	Neotropics	T	-
Ptinidae	<i>Trigonogenius globulus</i>	Globular spider beetle	Americas	T	-
Scolytidae	<i>Hylastes angustatus</i>	Pine bark beetle	Europe	T	-
Silvanidae	<i>Ahasverus advena</i>	Foreign grain beetle	Americas	T	-
	<i>Oryzaephilus mercator</i>	Merchant grain beetle	Unknown	T	-
	<i>Oryzaephilus surinamensis</i>	Saw-toothed grain beetle	Unknown	T	-
	<i>Cafius xantholoma</i>	-	Europe	T/M	-
Staphylinidae	<i>Habrocerus capillaricornis</i>	Verticillate rove beetle	Europe, Northern Africa	T	1909
	<i>Alphitobius diaperinus</i>	Lesser mealworm beetle	Probably African	T	-
	<i>Gnathocerus cornutus</i>	Broad-horned flour beetle	Americas	T	-
	<i>Latheticus oryzae</i>	Long-headed flour beetle	Asia	T	-
Tenebrionidae	<i>Tenebrio molitor</i>	Yellow mealworm	Probably Eurasia	T	-
Lepidoptera					-
Arctidae	<i>Pareuchaetes insulata</i>	Yellow-winged Pareuchaetes	Cuba, Jamaica	T (BIO)	-
Carposinidae	<i>Carposina autologa</i>	Hakea seed-moth	Australia	T (BIO)	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Crambidae	<i>Niphograptus albipunctatus</i>	Water hyacinth moth	Amazon	F (BIO)	-
	<i>Salbia haemorrhoidalis</i>	Lantana leaf-tier	Caribbean, Central America	T (BIO)	-
Gelechiidae	<i>Pectinophora gossypiella</i>	Pink bollworm	Australasia	T	-
	<i>Phthorimaea operculella</i>	Potato tuber moth	Bolivia	T	1900
	<i>Sitotroga cerealella</i>	French grain moth	Australia	T	-
Gracillariidae	<i>Aristaea thalassias</i>		Australia	T (BIO)	-
Noctuidae	<i>Spodoptera exigua</i>	Beet armyworm	South East Asia	T	-
Pieridae	<i>Pieris brassicae</i>	Large cabbage white butterfly	Eurasia	T	1994
Plutellidae	<i>Plutella xylostella</i>	Diamond-backed moth	Mediterranean	T	-
Pterophoridae	<i>Lantanophaga pusillidactyla</i>	Lantana plume moth	Southern USA to Central America	T (BIO)	-
Pyralidae	<i>Achroia grisella</i>	Lesser wax moth	Europe	T	-
	<i>Cactoblastis cactorum</i>	Prickly pear moth	South America	T (BIO)	1933
	<i>Chilo partellus</i>	Sorghum stem borer	Likely Asia	T	1950s
	<i>Ephestia elutella</i>	Tobacco moth	Europe	T	-
	<i>Ephestia kuehniella</i>	Mediterranean flour moth	India	T	-
	<i>Galleria mellonella</i>	Greater wax moth	Probably Eurasia	T	-
	<i>Hellula undalis</i>	Cabbage web worm	Probably Southern Europe or Asia	T	-
	<i>Plodia interpunctella</i>	Indian meal moth	Probably South America	T	-
	<i>Tinea pellionella</i>	Case-making clothes moth	Europe	T	-
	<i>Cydia pomonella</i>	Codling moth	Temperate Asia	T	1892
	<i>Crocosema lantana</i>	Lantana tortricid moth	Mexico, Southern USA	T (BIO)	-
Diptera					
Agromyzidae	<i>Calycomyza eupatorivora</i>	Leafmining fly	Neotropics	T (BIO)	-
	<i>Calycomyza lantanae</i>	Lantana leafmining fly	Americas	T (BIO)	-
	<i>Chromatomyia horticola</i>	Pea leafminer	Probably Eurasia	T	-
	<i>Liriomyza huidobrensis</i>	Potato leafminer	Probably South America	T	-
	<i>Liriomyza trifolii</i>	American leafminer	USA	T	-
	<i>Ophiomyia camarae</i>	Leafmining fly	Neotropics, Southern USA	T (BIO)	-
	<i>Ophiomyia lantanae</i>	Lantana seed fly	Southern USA, South America	T (BIO)	-
	<i>Psila rosae</i>	Carrot rust fly	Temperate Eurasia	T	-
Anthomyiidae	<i>Delia platura</i>	Bean seed maggot	Europe	T	-
	<i>Fucellia tergina</i>	Common kelp fly	Europe	M/T	1949
Calliphoridae	<i>Calliphora vicina</i>	European bluebottle	Europe, North America	T	1965
	<i>Chrysomya megacephala</i>	Oriental latrine fly	South East Asia, Eastern Africa	T	1971
	<i>Lucilia sericata</i>	Common green bottle	Europe, North America	T	1900
Cecidomyiidae	<i>Contarinia sorghicola</i>	Sorghum midge	Probably Asia	T	-
	<i>Dasineura dielsi</i>	Rooikrans gall midge	Australia	T (BIO)	-
	<i>Dasineura rubiformis</i>	Black wattle gall midge	Western Australia	T (BIO)	-
	<i>Zeuxidiplosis giardi</i>	St Johns wort midge	France	T (BIO)	-
Culicidae	<i>Aedes albopictus</i>	Asian tiger mosquito	South East Asia	T	1990
Fanniidae	<i>Fannia albipennis</i>	White-footed lesser house fly	South America	T	1953
Phoridae	<i>Megaselia scalaris</i>	Common coffin fly	Americas	T	-
Piophilidae	<i>Piophilidae casei</i>	European cheese fly	Europe	T	-
Psychodidae	<i>Clogmia albipunctata</i>	Moth fly	Unknown	T	-
Stratiomyidae	<i>Hermetia illucens</i>	Window-waisted soldier fly	Americas	T	-
Syrphidae	<i>Eristalis tenax</i>	European drone fly	Northern Europe, Asia	T	> 1860
Tephritidae	<i>Bactrocera invadens</i>	Invasive fruit fly	Sri Lanka	T	2010
	<i>Ceratitis capitata</i>	Mediterranean fruit fly	Mediterranean	T	-
	<i>Procecidochares utilis</i>	Eupatorium gall fly	Mexico	T (BIO)	-
Siphonaptera					
Tungidae	<i>Tunga penetrans</i>	Jigger flea	Tropical South America	T	1700s
Pulicidae	<i>Ctenocephalides felis</i>	Cat flea	Egypt	T	-
	<i>Echidnophaga gallinacea</i>	Stick-tight flea	South East Asia	T	-
	<i>Pulex irritans</i>	Human flea	Southern and Central America	T	1700s
	<i>Xenopsylla cheopis</i>	Oriental rat flea	Egypt, Sudan	T	-
Hymenoptera					
Aphelinidae	<i>Aphytis coheni</i>	-	Asia	T (BIO)	-
	<i>Aphytis holoxanthus</i>	-	Indian subcontinent	T (BIO)	-
	<i>Aphytis lepidosaphes</i>	-	Indian subcontinent	T (BIO)	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Braconidae	<i>Aphytis lingnanensis</i>	-	Asia	T (BIO)	-
	<i>Aphytis melinus</i>	-	Asia	T (BIO)	-
	<i>Apanteles subandinus</i>	Potato tuber moth parasitoid	Bolivian Andes	T	1960s
	<i>Cotesia plutellae</i>	Diamondback moth parasitoid	Europe	T	-
Encyrtidae	<i>Comperiella bifasciata</i>	Red scale parasite	Asia	T (BIO)	-
	<i>Copidosoma koehleri</i>	-	South America	T (BIO)	-
Eulophidae	<i>Leptocybe invasa</i>	Eucalyptus gall wasp	Australia	T	2007
	<i>Quadrastichus erythrinae</i>	Erythrina gall wasp	Western Africa	T	-
Evaniidae	<i>Evania appendigaster</i>	Ensign wasp	Southern China, South East Asia	T	-
Formicidae	<i>Linepithema humile</i>	Argentine ant	South America	T	1908
Ibaliidae	<i>Ibalia leucospoides</i>	Sirex ibaliid wasp	Holarctic	T (BIO)	1990s
Megalyridae	<i>Megalyra fasciipennis</i>	Megalyrid wasp	Australia	T	1910
Mymaridae	<i>Patasson nitens</i>	-	Southern Australia	T (BIO)	-
Pteromalidae	<i>Trichilogaster acacialongifoliae</i>	Acacia gall wasp	Australia	T	1990s
	<i>Trichilogaster signiventris</i>	Acacia gall wasp	Australia	T	-
Siricidae	<i>Sirex noctilio</i>	Sirex wood wasp	Europe, Asia, Northern Africa	T	1962
Tenthredinidae	<i>Caliroa cerasi</i>	Pear slug	Europe	T	-
	<i>Fenusa dohrnii</i>	Alder leafminer	Europe, USA	T	-
Vespidae	<i>Polistes dominulus</i>	European paper wasp	Europe, Asia, Northern Africa	T	2008
	<i>Vespula germanica</i>	German wasp	Europe, Asia, Northern Africa	T	1975
Myriopoda					
Blaniulidae	<i>Proteroiulus fuscus</i>	Snake millipede	Europe	T	-
Julidae	<i>Brachyiulus pusillus</i>	-	Europe	T	-
	<i>Cylindroiulus brittanicus</i>	-	Europe	T	-
	<i>Cylindroiulus truncorum</i>	-	Northern Africa	T	-
	<i>Ommatoiulus moreleti</i>	Portuguese millipede	Western Europe	T	-
Lithobiidae	<i>Lithobius obscurus</i>	Purple stone centipede	Western Mediterranean	T	-
	<i>Lithobius peregrinus</i>	Peregrine's Stone centipede	Central Europe	T	-
Paradoxosomatidae	<i>Orthomorpha gracilis</i>	Hothouse millipede	East Indies	T	-
Scutigeridae	<i>Scutigera coleoptrata</i>	House centipede	Southern Europe	T	-
Pycnogonida					
Ammonotheidae	<i>Ammonothea appendiculata</i>	-	Pacific	M	-
Arachnida					
Agelenidae	<i>Tegenaria domestica</i>	Barn funnel-web spider	Europe	T	-
Araneidae	<i>Cyrtophora citricola</i>	Tropical tent-web spider	Unknown	T	-
Dysderidae	<i>Dysdera crocata</i>	Long-fanged six-eyed spider	Mediterranean	T	-
Linyphiidae	<i>Ostearius melanopygius</i>	Black tailed sheet-web spider	New Zealand	T	-
Theridiidae	<i>Latrodectus geometricus</i>	Brown button spider	South America	T	-
	<i>Parasteatoda tepidariorum</i>	Common house orb-web spider	New World	T	-
	<i>Steatoda grossa</i>	False widow spider	Greece	T	-
Oecobiidae	<i>Oecobius navus</i>	House ant-eater	Unknown	T	-
Pholcidae	<i>Crossopriza lyoni</i>	Humped back daddy-long-legs	South East Asia	T	2007
	<i>Pholcus phalangoides</i>	House daddy-long-legs	Europe	T	-
Salticidae	<i>Hasarius adansonii</i>	Adanson's house jumping spider	Egypt	T	-
Scytodidae	<i>Scytodes thoracica</i>	House spitting spider	Probably Northern Africa	T	-
Sparassidae	<i>Heteropoda venatoria</i>	Brown huntsman spider	Unknown	T	-
Tetragnathidae	<i>Tetragnatha boydi</i>	Long-jawed water spider	Mexico	T	-
Uloboridae	<i>Uloborus plumipes</i>	Feather-legged lace weaver	Old World	T	-
Ixodidae	<i>Rhipicephalus microplus</i>	Asiatic cattle tick	Australasia, Madagascar, Neotropics	T	1896
Eriophyidae	<i>Aceria aloinis</i>	Aloe gall mite	USA	T	-
	<i>Aceria cynodonensis</i>	Grass rosette mite	Egypt	T	-
	<i>Aceria ficus</i>	Fig bud mite	France	T	-
	<i>Aceria lantanae</i>	Lantana gall mite	Southern USA to South America	T (BIO)	-
	<i>Aceria mangiferae</i>	Mango bud mite	Egypt	T	-
	<i>Aceria oleae</i>	Olive bud mite	Europe	T	-
	<i>Aceria sheldoni</i>	Citrus bud mite	USA	T	-
	<i>Aculops lycopersici</i>	Tomato rust mite	Japan	T	1960
	<i>Orthogalumna terebrantis</i>	Water hyacinth mite	Americas	FW (BIO)	-
Penthaletidae	<i>Halotydeus destructor</i>	Black sand mite	Unknown	T	1908

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Bdellidae	<i>Bdellodes lapidaria</i>	Snout mite	Probably Europe	T	-
Phytoseiidae	<i>Neoseiulus californicus</i>	Predatory mite	Probably California	T	-
Tarsonemidae	<i>Polyphagotarsonemus latus</i>	Citrus silver mite	Probably USA	T	1890
	<i>Tarsonemus waitei</i>		Probably USA	T	-
Anystidae	<i>Anystis wallacei</i>	Wriggling mite	Probably France	T	-
Tenuipalpidae	<i>Brevipalpus californicus</i>	Citrus flat mite	Probably California	T	1959
	<i>Brevipalpus obovatus</i>	Ornamental flat mite	Unknown	T	-
	<i>Brevipalpus phoenicis</i>	Reddish black mite	Probably France	T	1962
Tetranychidae	<i>Bryobia praetiosa</i>	Brown clover mite	Probably Germany	T	-
	<i>Panonychus citri</i>	Citrus mite	Probably Florida	T	1950
	<i>Panonychus ulmi</i>	European red mite	Probably Germany	T	1974
	<i>Tetranychus evansi</i>	Tobacco spider mite	Brazil, Argentina	T	1980s
	<i>Tetranychus urticae</i>	Two-spotted mite	Mediterranean region	T	1970
Varroidae	<i>Varroa destructor</i>	Varroa mite	Asia	T	1997
Crustacea					
Armadillidiidae	<i>Armadillidium vulgare</i>	Pill bug	Europe	T	1943
Argulidae	<i>Argulus japonicus</i>	Fish louse	South East Asia	F	< 1983
Acartiidae	<i>Acartia spinicauda</i>	Spinytailed copepod	South East Asia	M	-
Balanidae	<i>Amphibalanus venustus</i>	Striped acorn barnacle	Tropical Northern Atlantic	M	-
	<i>Balanus glandula</i>	Pacific barnacle	Northern American Pacific	M	< 1992
Coropiidae	<i>Apocorophium acutum</i>	Tube-building amphipod	Northern Atlantic	M	-
	<i>Erichthonius brasiliensis</i>	-	Northern Atlantic	M	-
	<i>Monocorophium acherusicum</i>	Stout-antenna amphipod	Northern Atlantic	M	1915
Cheluridae	<i>Chelura terebrans</i>	Wood boring amphipod	Pacific Northern America	M	-
Ischyroceridae	<i>Cerapus tubularis</i>	Hermit amphipod	Atlantic Northern America	M	-
	<i>Ischyrocerus anguipes</i>	-	Northern Atlantic	M	-
	<i>Jassa marmorata</i>	-	Northern Atlantic	M	-
	<i>Jassa slatteri</i>	Hitchhiker amphipod	Pacific Northern America	M	-
Limnoriidae	<i>Limnoria quadripunctata</i>	Gribble	Unknown	M	-
	<i>Limnoria tripunctata</i>	Gribble	Unknown	M	2008
Oniscidae	<i>Philoscia elongata</i>	-	Europe, Middle East	T	-
	<i>Philoscia musicorum</i>	Fast woodlouse	Europe	T	-
Parastacidae	<i>Cherax destructor</i>	Yabby	Australia	F	-
	<i>Cherax quadricarinatus</i>	Australian redclaw	Australia	F	-
	<i>Cherax tenuimanus</i>	Marron	Southwestern Australia	F	1980s
	<i>Procambarus clarkia</i>	North American red swamp crayfish	Northern America	F	-
Pinnotheridae	<i>Pinnixa occidentalis</i>	Pea crab	Pacific Northern America	M	2004
Porcellionidae	<i>Porcellio laevis</i>	Smooth woodlouse	British Isles	T	1932
	<i>Porcellio scaber</i>	Rough woodlouse	Southern and Western Europe	T	1885
	<i>Porcellionides pruinosus</i>	Plum woodlouse	Europe, Northern America	T	-
Portunidae	<i>Carcinus maenas</i>	European shore crab	Europe, Mediterranean	M	1983
Xanthidae	<i>Xantho incisus</i>	Black-fingered crab	Europe, Mediterranean	M	-
Sphaeromidae	<i>Dymanene bidentata</i>	Horned isopod	Europe	M	-
	<i>Paracerceis sculpta</i>	Sponge isopod	North-east Pacific	M	-
	<i>Sphaeroma serratum</i>	-	Europe	M	-
	<i>Sphaeroma walkeri</i>	Pill isopod	Northern Indian Ocean	M	-
Talitridae	<i>Orchestia gammarella</i>	Beachhopper	Europe, Mediterranean	M	1900s
	<i>Platorchestia platensis</i>	Beach flea	Unknown	M	-
	<i>Talitroides topitotum</i>	Land hopper	Unknown	T	-
Nematoda					
Beddingiidae	<i>Beddingia siricidicola</i>	Wood wasp nematode	Europe	T	2004
Heteroderidae	<i>Globodera rostochiensis</i>	Potato cyst nematode	Bolivia and Peru	T	-
	<i>Meloidogyne javanica</i>	Root-knot nematode	South America	T	-
Tylenchulidae	<i>Radapholus similis</i>	Burrowing nematode	Australasia	T	-
	<i>Tylenchulus semipenetrans</i>	Citrus nematode	Unknown	T	-
Annelida					
Acanthodrilidae	<i>Dichogaster affinis</i>	-	Probably Zanzibar	T	-
	<i>Dichogaster annae</i>	-	Java	T	-
	<i>Dichogaster bolaii</i>	-	Probably Germany	T	-
	<i>Dichogaster modiglianii</i>	-	Sumatra	T	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Eudrilidae	<i>Dichogaster saliens</i>	-	Western Africa	T	-
	<i>Microscolex dubius</i>	-	South America	T	-
	<i>Microscolex phosphoreus</i>	-	South America	T	-
	<i>Eudrilus eugeniae</i>	African nightcrawler	Western Africa	T	-
Glossoscolecidae	<i>Pontoscolex corethrurus</i>	Quincunx worm	Amazonian Brazil	T	-
Lumbricidae	<i>Allolobophora eiseni</i>	-	Europe, Americas	T	-
	<i>Allolobophora parva</i>	-	USA	T	-
	<i>Aporrectodea caliginosa</i>	Common earthworm	Palearctic	T	-
	<i>Aporrectodea longa</i>	Black-headed worm	Probably Germany	T	-
Megascolecidae	<i>Aporrectodea rosea</i>	Pink soil worm	Temperate Eurasia	T	-
	<i>Aporrectodea trapezoides</i>	Southern worm	Probably France	T	-
	<i>Dendrobaena cognettii</i>	-	Probably Sardinia	T	-
	<i>Dendrobaena hortensis</i>	European nightcrawler	Probably Germany	T	-
	<i>Dendrobaena octaedra</i>	-	Probably France	T	-
	<i>Dendrodrius rubidus</i>	Bark-eating worm	Temperate Eurasia	T	-
	<i>Eisenia fetida</i>	Composting earthworm	Probably Eurasia	T	-
	<i>Eiseniella tetraedra</i>	Square-tailed worm	Probably France	T	-
	<i>Lumbricus castaneus</i>	Chestnut worm	Unknown	T	-
	<i>Lumbricus rubellus</i>	Red worm	Unknown	T	-
	<i>Octolasion cyaneum</i>	Blue-grey worm	Probably France	T	-
	<i>Octolasion lacteum</i>	-	Unknown	T	-
	<i>Amyntas aeruginosus</i>	-	Probably Guam	T	-
	<i>Amyntas corticis</i>	Black wriggler	Probably Hawaii	T	-
	<i>Amyntas diffringens</i>	Snake worm	Probably Wales	T	-
	<i>Amyntas gracilis</i>	-	Probably Argentina	T	-
	<i>Amyntas hawayanus</i>	-	Probably Hawaii	T	-
	<i>Amyntas minimus</i>	-	Probably Java	T	-
	<i>Amyntas morrisi</i>	-	Probably Malaysia	T	-
	<i>Amyntas rodericensis</i>	-	Probably Rodrigues	T	-
Cirratulidae	<i>Perionyx excavatus</i>	Blue worm	Asia	T	-
	<i>Pontodrilus litoralis</i>	-	Probably France	T	-
	<i>Dodecaceria fewkesi</i>	Black coral worm	Pacific Northern America	M	2007
Nereidae	<i>Neanthes succinea</i>	Pileworm	Europe	M	-
Ocnodrilidae	<i>Eukeria saltensis</i>	-	South America	T/F	-
	<i>Nematogonia lacuum</i>	-	Unknown	T	-
	<i>Ocnodrilus occidentalis</i>	-	Unknown	T	-
Opheliidae	<i>Travesia forbesii</i>	Pink spindle worm	Palearctic, Japan	M	-
Serpulidae	<i>Ficopomatus enigmaticus</i>	Estuarine tubeworm	Australia	M	< 1951
	<i>Hydroides elegans</i>	Calcareous tubeworm	Indo Pacific	M	-
	<i>Janua pagenstecheri</i>	-	Europe	M	-
	<i>Neodexiospira brasiliensis</i>	Spiral fan worm	West Indies, Brazil	M	-
Spionidae	<i>Boccardia proboscidea</i>	Shell worm	Northern Pacific	M	1980s
	<i>Polydora hoplura</i>	Mudworm	Europe, Mediterranean	M	-
Mollusca					
Agriolimacidae	<i>Deroceras laeve</i>	Marsh slug	Europe	T	1898
	<i>Deroceras panormitanum</i>	Brown field slug	Europe	T	1964
	<i>Deroceras reticulatum</i>	Grey field slug	Europe	T	1898
Ampullariidae	<i>Pomacea diffusa</i>	Mystery snail	Brazil	F	-
Arionidae	<i>Arion hortensis</i> aggregate	Garden arion	Western Europe	T	-
	<i>Arion intermedius</i>	Hedgehog slug	Western Europe	T	< 1898
Bradybaenidae	<i>Bradybaena similis</i>	Asian tramp snail	Eastern Asia	T	-
Cochlicellidae	<i>Cochlicella barbara</i>	Small conical snail	Mediterranean	T	< 1909
Cochlicopidae	<i>Cochlicopa cf. lubrica</i>	Slippery moss snail	Europe, Northern America	T	-
Littorinidae	<i>Littorina saxatilis</i>	Lagoon snail	Europe, Mediterranean, Western Atlantic	M	-
Discidae	<i>Discus rotundatus</i>	Spotted disc	Europe	T	-
Gastrodontidae	<i>Zonitoides arboreus</i>	Orchid snail	Northern America	T	1898
Helicidae	<i>Cornu aspersum</i>	European brown garden snail	Western Europe, Mediterranean	T	1855
	<i>Eobania vermiculata</i>	Vermiculate snail	Mediterranean	T	1980s
	<i>Otala punctata</i>	White-lipped milk snail	Western Mediterranean	T	-
	<i>Theba pisana</i>	Dune snail	Mediterranean	T	1881

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Lauriidae	<i>Lauria cylindracea</i>	Common chrysalis snail	Western Europe, Mediterranean	T	-
Limacidae	<i>Lehmannia nyctelia</i>	Striped garden slug	Eastern Europe	T	1939
	<i>Lehmannia valentiana</i>	Three-banded garden slug	Eastern Europe	T	1962
	<i>Limacus flavus</i>	Yellow garden slug	Mediterranean	T	< 1898
	<i>Limax maximus</i>	Giant garden slug	Europe	T	1898
Lymnaeidae	<i>Lymnaea columella</i>	Reticulate pond snail	North America	F	1942
	<i>Radix rubiginosa</i>	Rust-coloured pond snail	South East Asia	F	2006
Milacidae	<i>Milax gagates</i>	Black keeled slug	Mediterranean	T	< 1873
Muricidae	<i>Thais blanfordi</i>	Blanford's whelk	Tropical Indo-Pacific	M	1950
	<i>Thais tissoti</i>		Tropical Indo-Pacific	M	-
Mytilidae	<i>Mytilus galloprovincialis</i>	Mediterranean mussel	Mediterranean, Northeastern Atlantic	M	1979
	<i>Perna viridis</i>	Green mussel	South East Asia	M	-
	<i>Semimytilus algosus</i>	Bisexual mussel	Pacific South America	M	2010
Ostreidae	<i>Crassostrea gigas</i>	Japanese oyster	Japan, Northwestern Pacific	M	2005
	<i>Ostrea edulis</i>	European oyster	Europe, Mediterranean	M	1946
Oxychilidae	<i>Aegopinella nitidula</i>	Smooth glass snail	Europe	T	-
	<i>Oxychilus alliarius</i>	Garlic glass snail	Western Europe	T	-
	<i>Oxychilus cellarius</i>	Cellar glass snail	Europe	T	-
	<i>Oxychilus draparnaudi</i>	Draparnaud's glass snail	Western Europe, Mediterranean	T	< 1908
Physidae	<i>Aplexa marmorata</i>	Slender bladder snail	South America	F	1986
	<i>Physa acuta</i>	Sharp-spined bladder snail	South America, Caribbean	F	1954
Planorbidae	<i>Gyraulus chinensis</i>	Chinese ram's-horn snail	South East Asia	F	2007
	<i>Helisoma duryi</i>	Dury's Ram's-horn snail	Southeastern USA	F	1964
Teredinidae	<i>Lyrodus pedicellatus</i>	Shipworm	Unknown	M	-
	<i>Teredo navalis</i>	Shipworm	Europe, Mediterranean	M	< 1800
Pristilomatidae	<i>Hawaiiia minuscula</i>	Minute gem	North America	T	-
	<i>Vitrea contracta</i>	Milky crystal snail	Europe, Middle East, Northern Africa	T	-
Subulinidae	<i>Vitrea crystallina</i>	Common crystal snail	Europe	T	-
	<i>Rumina decollata</i>	Decollate snail	Mediterranean	T	-
	<i>Subulina octona</i>	Wandering awl snail	Caribbean	T	-
Tergipedidae	<i>Catriona columbiana</i>	Columbian nudibranch	North Pacific	M	< 1972
Testacellidae	<i>Testacella maugei</i>	Maug's shelled slug	Western Europe, Mediterranean	T	-
Thiaridae	<i>Tarebia granifera</i>	Quilted melania	South East Asia	F	1999
Valloniidae	<i>Vallonia costata</i>	Ribbed grass snail	Europe, Eastern USA	T	-
	<i>Vallonia pulchella</i>	Smooth grass snail	Europe, eastern North America	T	-
Brachiopoda					
Discinidae	<i>Disciniscus tenuis</i>	Disc lampshell	Namibian Coast	M	2008
Bryozoa					
Bugulidae	<i>Bugula dentata</i>	Blue dentate moss animal	Indo-Pacific	M	1852
	<i>Bugula flabellata</i>	-	Unknown	M	-
	<i>Bugula neritina</i>	Purple dentate moss animal	Unknown	M	1944
Cryptosulidae	<i>Cryptosula pallasiana</i>	-	Europe	M	-
Membraniporidae	<i>Conopeum seurati</i>	-	Europe	M	-
Watersiporidae	<i>Watersipora subtorquata</i>	Red-rust bryozoan	Caribbean	M	-
Platyhelminthes					
Botryocephalidae	<i>Botryocephalus acheilognathi</i>	Fish tapeworm	China	F	1975
Dactylogyridae	<i>Pseudodactylogyrus anguillae</i>	Eel gill fluke	China, Japan, Taiwan	F	-
Geoplanidae	<i>Bipalium kewense</i>	Spade-headed planarian	South East Asia	T	-
	<i>Kontikia ventrolineata</i>	Kontikia flatworm	Australia	T	-
Gyrodactylidae	<i>Gyrodactylus kherulensis</i>	Fish skin fluke	Eastern Asia	F	-
	<i>Gyrodactylus kobayashii</i>	Fish gillworm	Asia	F	-
Cnidaria					
Corynidae	<i>Coryne eximia</i>	-	North Atlantic, Pacific	M	-
Campanulariidae	<i>Gonothyrea loveni</i>	-	North Atlantic	M	-
	<i>Laomedea calceolifera</i>	-	North Atlantic	M	-
	<i>Obelia bidentata</i>	Double-toothed hydroid	Unknown	M	-
	<i>Obelia dichotoma</i>	Thin-walled obelia	Unknown	M	-
	<i>Obelia geniculata</i>	Zigzag hydroid	Europe, Mediterranean	M	-

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APPENDIX 1 (continues...): Alien animals recorded from South Africa up to 2011.

Group	Species	Common name	Origin	Habitat	Date of introduction/ first detection
Limnomedusae	<i>Craspedacusta sowerbyi</i>	Freshwater jellyfish	Nearctic, Palearctic	F	1970s
Metridiidae	<i>Metridium senile</i>	Plumose anemone	North Atlantic	M	1995
Moerisiidae	<i>Moerisia maeotica</i>	-	Black sea region	M	-
Oceanidae	<i>Pachycordyle navis</i>	Brackish hydroid	Europe, Mediterranean	M	-
Pennariidae	<i>Pennaria disticha</i>	Sea fern hydroid	Unknown	M	1906
Sagartiidae	<i>Sagartia ornata</i>	Brooding anemone	Europe, Mediterranean	M	-
Tubulariida	<i>Pinauay larynx</i>	-	North Atlantic	M	-
	<i>Pinauay ralphi</i>	-	North Atlantic	M	-
Porifera					
Suberitidae	<i>Suberites ficus</i>	Sulphur sponge	Northeastern Atlantic and Mediterranean	M	1998

Source: Picker and Griffiths (2011)