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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)
Myriapoda	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)**

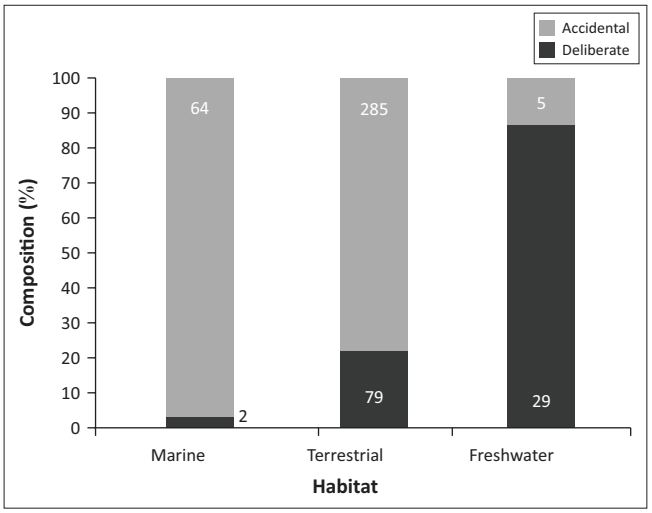
Source: Data from full Appendix of Picker and Griffiths (2011)

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



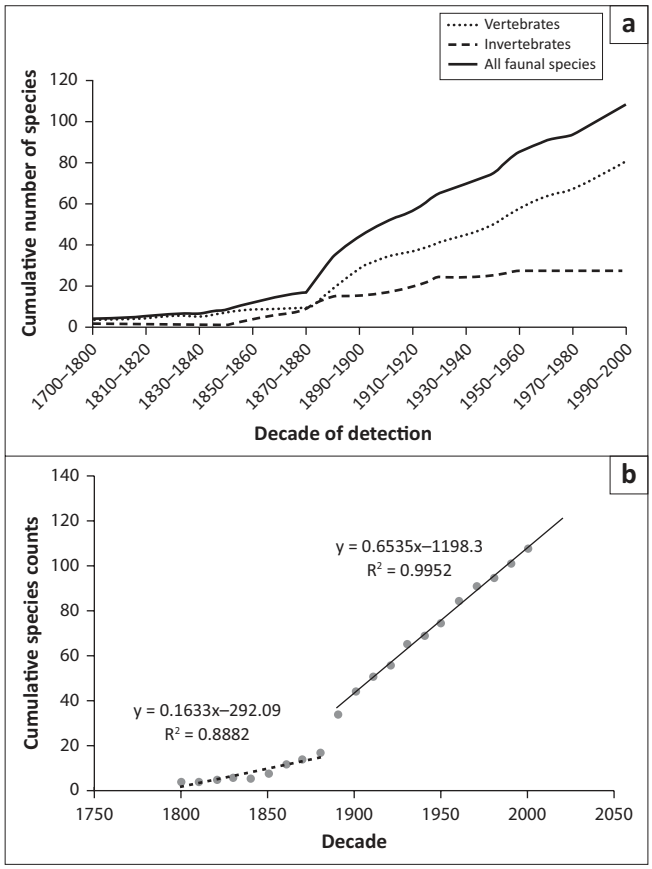
Source: Data based on the 571 species listed in the Appendix of Picker and Griffiths (2011), with biological control agents incorporated into the category of intentional introductions

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.

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)**

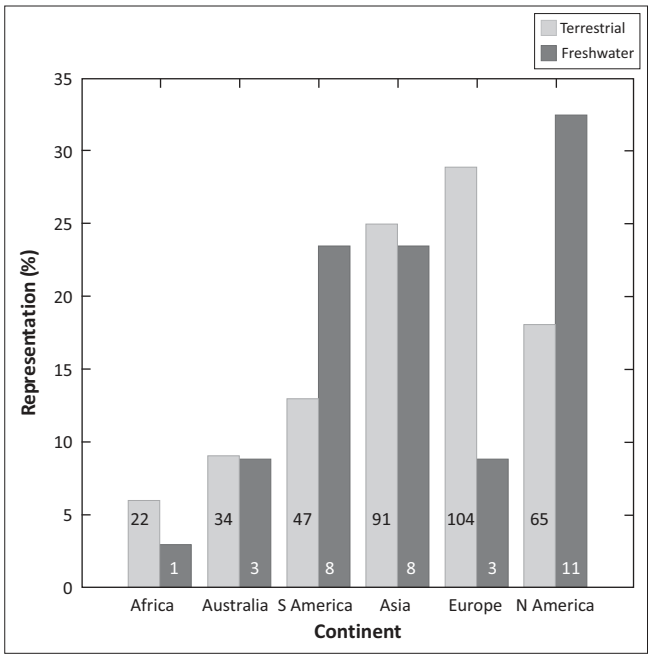
Source: Data for 240 species with adequate distribution data, from Picker and Griffiths (2011)

[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.

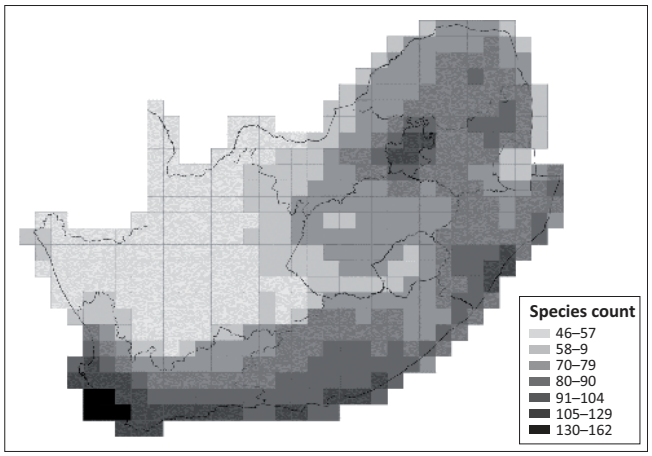
Intensity of faunal invasion across South Africa

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).



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.

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

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	*Capra hircus*	Feral domestic goat	Iran	T	-
	Hemitragus jemlahicus	Himalayan Tahr	Central Asia to China	T	1930
	Rusa unicolor	Sambar deer	South East Asia	T	1880
Cervidae	*Dama dama*	European fallow deer	Iran, Iraq, Turkey	T	< 1869
Equidae	*Equus asinus*	Feral donkey	Egypt, Somalia	T	-
	Equus ferus caballus	Feral horse	Central Asia	T	-
Felidae	*Felis catus*	Feral domestic cat	Egypt	T	-
Leporidae	*Oryctolagus cuniculus*	European rabbit	Europe	T	1654
Muridae	*Mus musculus*	House mouse	Eurasia	T	-
	Rattus norvegicus	Brown rat	China, Russia, Japan	T	< 1830
	Rattus rattus	House rat	South Asia	T	< 800 AD
Sciuridae	*Sciuris carolinensis*	Grey squirrel	USA	T	1890
Suidae	*Sus scrofa*	Feral domestic pig	Eurasia	T	1926
Aves					
Anatidae	*Anas platyrhynchos*	Mallard	Nearctic	F	-
Columbidae	*Columba livia*	Rock Dove	Mediterranean, Asia	T	1850
Corvidae	*Corvus splendens*	House Crow	South Asia	T	1960s
Fringillidae	*Fringilla coelebs*	Common Chaffinch	Europe	T	1890s
Passeridae	*Passer domesticus*	House Sparrow	Eurasia, Northern Africa	T	1893
Phasianidae	*Alectoris chukar*	Chukar Partridge	Central Asia, China	T	1964
	Pavo cristatus	Common Peacock	South Asia	T	-
Psittadiae	*Psittacula krameri*	Rose-ringed Parakeet	South Asia	T	1850s
Sturnidae	*Acridotheres tristis*	Common Myna	South Asia	T	1888
	Sturnus vulgaris	Common Starling	Europe	T	1889
Reptilia					
Typhlopidae	*Ramphotyphlops braminus*	Brahminy Blind Snake	South Asia	T	1920s
Teleostei					
Centrarchidae	*Lepomis macrochirus*	Bluegill sunfish	Eastern USA	F	1938
	Micropterus dolomieu	Smallmouth bass	USA	F	1937
	Micropterus punctulatus	Spotted bass	USA	F	1939
	Micropterus salmoides	Largemouth bass	USA, Mexico	F	1928
Cichlidae	*Oreochromis niloticus*	Nile tilapia	Sahel, Africa	F	1959
Cyprinidae	*Carassius auratus*	Goldfish	China	F	1726
	Ctenopharyngodon idella	Grass carp	China, Russia	F	1967
	Cyprinus carpio	Common carp	Eastern Europe, Russia	F	1859
	Hypophthalmichthys molitrix	Silver carp	China	F	1975
	Tinca tinca	Tench	Europe, Russia	F	1910
Locariidae	*Pterygoplichthys disjunctivus*	Vermiculated sailfin	Amazon	F	2000
Perciidae	*Perca fluviatilis*	Perch	Europe, Russia	F	1915
Poeciliidae	*Gambusia affinis*	Mosquito fish	USA, Mexico	F	1936
	Poecilia reticulata	Guppy	South America/Caribbean	F	1912
	Xiphophorus helleri	Swordtail	Mexico	F	1974
Salmonidae	*Onchorhynchus mykiss*	Rainbow trout	Western North America	F	1897
	Salmo trutta	Brown trout	Europe	F	1892
Ascidiacea					
Ascidiidae	*Ascidia sydneiensis*	Crevice ascidian	Asia	M	1932
	Ascidiella aspersa	Dirty sea squirt	North Sea	M	-
Cionidae	*Ciona intestinalis*	Vase tunicate	Europe	M	1955
Clavelinidae	*Clavelina lepadiformis*	Light-bulb sea squirt	Europe	M	2001
Didemnidae	*Diplosoma listerianum*	Jelly crust tunicate	Europe	M	1949
Pyuridae	*Microcosmus squamiger*	Blunt-spined microcosmus	Australia	M	-
Styelidae	*Botryllus schlosseri*	Star sea squirt	Northeastern Atlantic	M	1946
	Cnemidocarpa humilis	Leathery sea squirt	Unknown	M	-
	Styela plicata	Pleated sea squirt	West Pacific	M	2010
Echinodermata					
Arbaciidae	*Tetrapygus niger*	Black sea urchin	Chile, Peru	M	2010
Ophiactidae	*Ophiactis savignyi*	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	*Brachystomella parvula*	-	Europe	T	-
Entomobryidae	*Entomobrya nivalis*	Cosmopolitan springtail	Northern hemisphere	T	-
Hypogastruridae	*Hypogastrura armata*	-	Unknown	T	-
	Hypogastrura manubrialis	Mushroom springtail	Northern Europe	T	-
	Hypogastrura purpurescens	-	Probably Europe	T	-
	Mesogastrura libyca	-	Probably Europe	T	-
	Xenylla maritima	-	Probably Eurasia	T	-
Isotomidae	*Isotomurus palustris*	Marsh springtail	Europe	T	-
	Parisotoma notabilis	-	Europe	T	-
	Proisotoma minuta	-	Probably Northern hemisphere	T	-
Neanuridae	*Neanura muscorum*	Neanura/Moss springtail	Northern Europe	T	-
Sminthuridae	*Sminthurus viridis*	Clover springtail	Europe	T	-
Tomoceridae	*Tomocerus minor*	-	Probably Palaearctic	T	-
Thysanura					
Lepismatidae	*Ctenolepisma longicaudata*	Grey silverfish	Caribbean	T	< 1900
	Ctenolepisma urbana	Urban silverfish	Probably USA	T	-
	Lepisma saccharina	Silverfish	Unknown	T	-
Blattodea					-
Blattellidae	*Blattella germanica*	German cockroach	South East Asia	T	-
Blattidae	*Periplaneta americana*	American cockroach	Tropical Africa	T	-
	Blatta orientalis	Oriental cockroach	Unknown	T	-
Isoptera					
Kalotermitidae	*Cryptotermes brevis*	House termite	West Indies	T	1918
Rhinotermitidae	*Coptotermes formosanus*	Formosan termite	China, Japan	T	1924
Dermaptera					-
Anisolabididae	*Euborellia annulipes*	Ring-legged earwig	Southern Europe	T	1912
Labiduridae	*Labidura riparia*	Sand earwig	Siberia	T	1863
	Nala lividipes	Black field earwig	South East Asia	T	1900
Spongiphoridae	*Labia minor*	Lesser earwig	Palaearctic Europe, Northern Africa	T	1900
Phasmatodea					
Phasmatidae	*Carausius morosus*	Indian stick insect	India	T	-
Embioptera					
Oligotomidae	*Oligotoma saundersii*	Saunders embiid	India	T	-
Psocoptera					-
Liposcelidae	*Liposcelis bostrychophila*	Domestic booklouse	Probably Tropical Africa	T	-
Hemiptera					-
Aleyrodidae	*Aleurocanthus woglumi*	Citrus blackfly	Asia	T	-
	Aleurothrixus floccosus	Woolly whitefly	Caribbean	T	2007
	Bemisia tabaci	Tobacco whitefly	Probably Asia	T	-
	Siphoninus phillyreae	Pomegranate whitefly	Southern Europe, Northern Africa	T	2009
	Trialeurodes vaporariorum	Greenhouse whitefly	Likely USA	T	1923
Aphididae	*Acyrthosiphon kondoi*	Blue alfafa aphid	Asia	T	-
	Acyrthosiphon pisum	Pea aphid	Palaearctic	T	-
	Aphis armoraciae	Western Aster root aphid	USA	T	-
	Aphis chloris	St Johns wort aphid	Eurasia	T (BIO)	-
	Aphis craccivora	Groundnut aphid	Europe	T	-
	Aphis fabae	Black bean aphid	Europe	T	-
	Aphis gossypii	Cotton aphid	Unknown	T	-
	Aphis nasturtii	Buckthorn aphid	Probably Europe	T	-
	Aphis spiraecola	Green citrus aphid	East Asia	T	-
	Aulacorthum circumflexum	Mottled arum aphid	South East Asia	T	-
	Aulacorthum solani	Greenhouse potato aphid	Europe	T	-
	Brachycaudus amygdalinus	Short-tailed almond aphid	Europe, Northern Africa	T	-
	Brachycaudus helichrysi	Leaf curling plum aphid	Palaearctic	T	-
	Brevicoryne brassicae	Cabbage aphid	Europe	T	-
	Capitophorus elaeagni	Artichoke aphid	Mediterranean	T	-
	Cedrobium laportei	Deodar aphid	Northern Africa	T	-
	Cerataphis orchidearum	Orchid aphid	South East Asia	T	-
	Cerataphis brasiliensis	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
	Chaetosiphon fragaefolii	Strawberry aphid	Probably USA	T	-
	Chaitophorus leucomelas	-	Palaearctic	T	-
	Chaitophorus populialba	-	Eurasia, Northern Africa	T	-
	Cinara cronartii	Black pine aphid	Eastern USA	T	1974
	Cinara cupressivora	Cypress aphid	Probably Eastern Greece	T	1993
	Diuraphis noxia	Russian wheat aphid	Russia, Palaearctic	T	1978
	Dysaphis apiifolia	Hawthorn parsley aphid	Eurasia	T	-
	Dysaphis foeniculus	Carrot aphid	Eurasia	T	-
	Dysaphis tulipae	Tulip bulb aphid	Probably Eurasia, Northern Africa	T	-
	Eriosoma lanigerum	Woolly apple aphid	Possibly USA	T	1895
	Eulachnus rileyi	Pine needle aphid	USA, Europe	T	-
	Hyadaphis coriandri	Coriander aphid	Central Asia	T	-
	Hydaphis foeniculi	Honeysuckle aphid	Palaearctic	T	-
	Hyperomyzus lactucae	Blackcurrant aphid	Palaearctic	T	-
	Hysteroneura setariae	Rusty plum aphid	USA	T	-
	Illinoia azalea	-	USA	T	-
	Lipaphis pseudobrassicae	False cabbage aphid	Palaearctic	T	-
	Macrosiphon euphorbiae	Potato aphid	USA	T	-
	Macrosiphoniella sanborni	Chrysanthemum aphid	East Asia	T	-
	Monelliopsis pecanis	Yellow pecan aphid	USA	T	-
	Myzocallis castanicola	Oak aphid	Europe	T	-
	Myzus persicae	Green peach aphid	Probably Asia	T	-
	Neotoxoptera oliveri	Marigold aphid	Probably Asia	T	-
	Pemphigus populitransversus	Poplar gall aphid	USA	T	-
	Pentalonia nigronervosa	Banana aphid	Probably South East Asia	T	-
	Pineus pini	Pine woolly aphid	Probably Eurasia	T	-
	Prociphilus fraxinifolii	Leafcurl ash aphid	USA	T	-
	Rhodobium porosum	Shiny rose aphid	Probably USA	T	-
	Rhopalosiphum maidis	Maize aphid	Probably Pakistan	T	-
	Rhopalosiphum padi	Bird cherry aphid	Palaearctic	T	-
	Schizaphis graminum	Wheat aphid	Probably Palaearctic, Asia	T	-
	Schizaphis minuta	-	Asia, Australia, Iran	T	-
	Schizaphis rotundiventris	Oil palm aphid	Southern Europe, Asia, Australia	T	-
	Sipha maydis	-	Eurasia, India, Middle East	T	-
	Sitobium avenae	Brown wheat ear aphid	Probably Eurasia	T	-
	Smynthurodes betae	Bean root aphid	Probably Mediterranean	T	-
	Takecallis taiwanus	-	Taiwan, Japan	T	-
	Therioaphis trifolii	Yellow clover aphid	Mediterranean	T	-
	Toxoptera odinae	Mango aphid	India, South East Asia	T	-
Cicadellidae	*Circulifer tenellus*	Beet leafhopper	Europe	T	-
	Opsius stactogalus	Tamarix leafhopper	Europe	T	-
	Orosius albicinctus	Orosius leafhopper	Unknown	T	-
Coccidae	*Coccus hesperidum*	Soft brown scale	Probably Afro-Ethiopian	T	-
	Pseudaulacaspis pentagona	White peach scale	Probably Tropical Asia	T	-
	Pulvinaria psidii	Guava scale	Asia	T	-
Dactylopiidae	*Dactylopius austrinus*	Cochineal scale	Southern USA, Central America	T (BIO)	-
	Dactylopius ceylonicus	Wild cochineal insect	Southern USA, Central America	T (BIO)	-
	Dactylopius opuntiae	Prickly pear cochineal	USA, Mexico	T (BIO)	1937
	Dactylopius tomentosus	Tomentose cochineal scale	Southern USA, Central America	T (BIO)	-
Delphacidae	*Perkinsiella saccharicida*	Kirkaldy sugarcane hopper	Australasia	T	-
Diaspididae	*Aonidiella aurantii*	Red scale	Southeast Asia	T	-
	Chrysomphalus aonidium	Circular purple scale	Indian subcontinent	T	-
	Cornuaspis beckii	Citrus mussel scale	Indian subcontinent	T	-
	Diaspidiotus perniciosus	Pernicious scale	Northern China	T	1911
	Diaspis bromeliae	Pineapple scale	South America	T	-
	Parlatoria pergandii	Chaff scale	Asia	T	-
Miridae	*Eccritotarsus catarinensis*		Brazil	FW (BIO)	-
	Falconia intermedia	-	Southern USA, Caribbean	T (BIO)	-
Monophlebidae	*Icerya purchasi*	Australian bug	Australia	T	1873
Ortheziidae	*Orthezia insignis*		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
Pentotamidae	*Nezara viridula*	Green stinkbug	Probably Ethiopia	T	-
Phylloxeridae	*Moritziella corticalis*	Oak bark phylloxera	Europe	T	-
	Viteus vitifoliae	Grapevine phylloxera	Eastern USA	T	-
Pseudococcidae	*Ferrisia malvastra*	White-tailed mealy bug	Americas	T	-
	Hypogeococcus pungens		South America	T (BIO)	-
	Phenacoccus parvus	Lantana mealy bug	Southern and Central America	T (BIO)	-
	Planococcus citri	Citrus mealy bug	Probably China, Japan	T	-
	Planococcus ficus	Grapevine mealy bug	Unknown	T	-
Psyllidae	*Blastopsylla occidentalis*	Eucalypt shoot psyllid	Australia	T	2004
	Ctenarytaina eucalypti	Blue gum psyllid	Australia	T	1923
Thaumastocoridae	*Thaumastocoris peregrinus*	Eucalyptus thaumastocorid	Australia	T	2003
Tingidae	*Carvalhotingis hollandi*	Cotton lace bug	Southern and Central America	T (BIO)	-
	Carvalhotingis visenda	Leafsucking lace bug	Southern and Central America	T (BIO)	-
	Gargaphia decoris	Woolly nightshade lace bug	Argentina	T (BIO)	-
	Teleonemia elata		Brazil	T (BIO)	-
	Teleonemia scrupulosa	Lantana lace bug	Mexico	T (BIO)	-
Thysanoptera					-
Thripidae	*Fulmekiola serrata*	Sugarcane thrips	Mauritius	T	< 2004
	Heliothrips haemorrhoidalis	Greenhouse thrips	South America	T	1912
	Thrips palmi	Melon thrips	Southern Asia	T	-
	Thrips tabaci	Onion thrips	Unknown	T	-
Phthiraptera					-
Boopiidae	*Heterodoxus spiniger*	Dog louse	Australia	T	-
Haematopinidae	*Haematopinus eurysternus*	Short-nosed cattle louse	Unknown	T	-
	Haematopinus suis	Pig-louse	Unknown	T	-
Linognathidae	*Linognathus setosus*	Dog sucking louse	Unknown	T	-
	Linognathus vituli	Long-nosed cattle louse	Unknown	T	-
Menopodidae	*Goniocotes gallinae*	Poultry fluff louse	Probably Asia	T	-
	Lipeurus caponis	Poultry wing louse	Probably Asia	T	-
	Menacanthus stramineus	Poultry body louse	Unknown	T	-
	Menopon gallinae	Poultry shaft louse	Probably Asia	T	-
Polyplacidae	*Polyplax spinulosa*	Spined rat louse	Probably Asia	T	-
Trichodectidae	*Damalinia bovis*	Cattle biting louse	Unknown	T	-
	Damalinia caprae	Common goat-louse	Unknown	T	-
	Damalinia ovis	Sheep biting louse	Unknown	T	-
Coleoptera					-
Anobiidae	*Lasioderma serricorne*	Cigarette beetle	Unknown	T	-
	Stegobium paniceum	Drug store beetle	Unknown	T	-
Apionidae	*Coelocephalapion camarae*	Lantana petiole weevil	Mexico	T (BIO)	-
	Trichapion lativentre	-	South America	T (BIO)	-
Bostrichidae	*Prostephanus truncatus*	Larger grain borer	Central America	T	1999
	Rhyzopertha dominica	Lesser grain borer	Probably Tropical Asia	T	-
Buprestidae	*Hylaeogena jureceki*	Leaf-mining jewel beetle	Korea	T (BIO)	-
Cerambycidae	*Aphanasium australe*		Southeastern Australia	T (BIO)	-
	Chlorophorus annularis	Bamboo longhorn beetle	Indian subcontinent	T	-
	Lagocheirus funestus	Opuntia biocontrol beetle	Mexico	T (BIO)	-
	Nealcidion cereicola	-	Argentina	T (BIO)	-
	Phoracantha recurva	Eucalypt borer	Australia	T	1906
	Phoracantha semipunctata	Zig-zag eucalypt borer	Australia	T	1906
Chrysomelidae	*Acanthoscelides macrophthalmus*	Bean weevil	West Africa	T (BIO)	-
	Acanthoscelides obtectus	Bean weevil	Central America	T	-
	Algarobius prosopis	Prosopis seed beetle	Southwestern USA	T (BIO)	1987
	Charidotis auroguttata	-	Costa Rica	T (BIO)	-
	Chrysolina quadrigemina	St. John's wort beetle	Northern Africa, Europe	T (BIO)	-
	Gratiana spadicea	-	South America	T (BIO)	-
	Leptinotarsa defecta	Satansbos leaf beetle	North America	T (BIO)	1992
	Leptinotarsa texana	Texan Satansbos leaf beetle	North America	T (BIO)	1992
	Longitarsus bethae	Flea beetle	Mexico	T (BIO)	-
	Lysathia species	-	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
	Neltumius arizonensis	Prosopis seed beetle	Southwestern USA	T (BIO)	-
	Octotoma scabripennis	Lantana leaf beetle	Mexico, Central America	T (BIO)	-
	Oulema bilineata	Tobacco slug	South America	T	-
	Oulema trilineata	Three-lined potato beetle	South America	T	-
	Phenrica guerini	-	South America	T (BIO)	-
	Sulcobruchus subsuturalis	-	Asia	T (BIO)	-
	Uroplata girardi	Lantana hispid	South America	T (BIO)	-
Coccinellidae	*Harmonia axyridis*	Harlequin lady beetle	Central and Eastern Asia	T	2001
	Hippodamia variegata	Variegated lady beetle	Palaearctic	T	1965
	Rodolia cardinalis	Vedalia beetle	Probably Australia	T	1892
Curculionidae	*Anthonomus santacruzi*	-	South America	T (BIO)	-
	Cosmopolites sordidus	Banana root borer	Probably South East Asia	T	-
	Cydmaea binotata	-	Southeastern Australia	T (BIO)	-
	Cylas formicarius	Sweet potato weevil	Indonesia	T	-
	Cyrtobagous salviniae	Salvinia weevil	Southern and Central America	T (BIO)	-
	Dicomada rufa	-	Southeastern Australia	T (BIO)	-
	Dixoncis pictus	-	Southeastern Australia	T (BIO)	-
	Erytenna consputa	Hakea fruit weevil	Southeastern Australia	T (BIO)	-
	Gonipterus cf. scutellatus	Eucalyptus snout beetle	South Australia, Tasmania	T	-
	Graphognathus leucoloma	White-fringed beetle	South America	T	-
	Listroderes costirostris	Vegetable weevil	Brazil	T	-
	Melanterius acacia	-	Australia	T (BIO)	-
	Melanterius compactus	Acacia seed weevil	Australia	T (BIO)	-
	Melanterius maculatus	Acacia seed weevil	Australia	T (BIO)	-
	Melanterius servulus	Acacia seed weevil	Australia	T (BIO)	-
	Melanterius ventralis	Acacia seed weevil	Australia	T (BIO)	-
	Metamasius spinolae	Cactus weevil	Neotropics	T (BIO)	-
	Naupactus leucoloma	White-fringed weevil	South America	T	-
	Neochetina bruchi	Water hyacinth weevil	Southern and Central America	T (BIO)	-
	Neochetina eichhorniae	Mottled water hyacinth weevil	Southern and Central America	T (BIO)	-
	Neodiplogrammus quadrivittatus	Trunk-boring curculionid	South America	T (BIO)	-
	Neohydronomus affinis	Waterlettuce weevil	South and Central America	FW (BIO)	-
	Pantomorus cervinus	Fuller's rose beetle	Probably Americas	T	-
	Pissodes nemorensis	Northern pine weevil	Southeastern USA	T	1942
	Rhinocyllus conicus	Thistle-head weevil	Eurasia	T (BIO)	-
	Rhyssomatus marginatus	Seed feeding weevil	South America	T (BIO)	-
	Sitophylus granarius	Granary weevil	Palaearctic	T	-
	Stenopelmus rufinasus	Azolla weevil	Americas	T (BIO)	1997
	Sternochetus mangiferae	Mango weevil	South East Asia	T	-
Dermestidae	*Anthrenus verbasci*	Varied carpet beetle	Probably California	T	-
	Dermestes maculatus	Hide beetle	Unknown	T	-
	Trogoderma granarium	Khapra beetle	Asia	T	-
	Trogoderma inclusum	Larger cabinet beetle	USA	T	-
	Trogoderma variabile	Warehouse beetle	Asia	T	-
Melyridae	*Astylus atromaculatus*	Spotted maize beetle	South America	T	1916
Nitidulidae	*Carpophilus dimidiatus*	Corn-sap beetle	Neotropics	T	-
Ptinidae	*Trigonogenius globulus*	Globular spider beetle	Americas	T	-
Scolytidae	*Hylastes angustatus*	Pine bark beetle	Europe	T	-
Silvanidae	*Ahasverus advena*	Foreign grain beetle	Americas	T	-
	Oryzaephilus mercator	Merchant grain beetle	Unknown	T	-
	Oryzaephilus surinamensis	Saw-toothed grain beetle	Unknown	T	-
Staphylinidae	*Cafius xantholoma*	-	Europe	T/M	-
	Habrocerus capillaricornis	Verticillate rove beetle	Europe, Northern Africa	T	1909
Tenebrionidae	*Alphitobius diaperinus*	Lesser mealworm beetle	ProbablyAfrican	T	-
	Gnathocerus cornutus	Broad-horned flour beetle	Americas	T	-
	Latheticus oryzae	Long-headed flour beetle	Asia	T	-
	Tenebrio molitor	Yellow mealworm	Probably Eurasia	T	-
Lepidoptera					-
Arctiidae	*Pareuchaetes insulata*	Yellow-winged Pareuchaetes	Cuba, Jamaica	T (BIO)	-
Carposinidae	*Carposina autologa*	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	*Niphograpta albiguttalis*	Water hyacinth moth	Amazon	F (BIO)	-
	Salbia haemorrhoidalis	Lantana leaftier	Caribbean, Central America	T (BIO)	-
Gelechiidae	*Pectinophora gossypiella*	Pink bollworm	Australasia	T	-
	Phthorimaea operculella	Potato tuber moth	Bolivia	T	1900
	Sitotroga cerealella	French grain moth	Australia	T	-
Gracillariidae	*Aristaea thalassias*		Australia	T (BIO)	-
Noctuidae	*Spodoptera exigua*	Beet armyworm	South East Asia	T	-
Pieridae	*Pieris brassicae*	Large cabbage white butterfly	Eurasia	T	1994
Plutellidae	*Plutella xylostella*	Diamond-backed moth	Mediterranean	T	-
Pterophoridae	*Lantanophaga pusillidactyla*	Lantana plume moth	Southern USA to Central America	T (BIO)	-
Pyralidae	*Achroia grisella*	Lesser wax moth	Europe	T	-
	Cactoblastis cactorum	Prickly pear moth	South America	T (BIO)	1933
	Chilo partellus	Sorghum stem borer	Likely Asia	T	1950s
	Ephestia elutella	Tobacco moth	Europe	T	-
	Ephestia kuehniella	Mediterranean flour moth	India	T	-
	Galleria mellonella	Greater wax moth	Probably Eurasia	T	-
	Hellula undalis	Cabbage web worm	Probably Southern Europe or Asia	T	-
	Plodia interpunctella	Indian meal moth	Probably South America	T	-
Tineidae	*Tinea pellionella*	Case-making clothes moth	Europe	T	-
Tortricidae	*Cydia pomonella*	Codling moth	Temperate Asia	T	1892
	Crocidosema lantana	Lantana tortricid moth	Mexico, Southern USA	T (BIO)	-
Diptera					
Agromyzidae	*Calycomyza eupatorivora*	Leafmining fly	Neotropics	T (BIO)	-
	Calycomyza lantanae	Lantana leafmining fly	Americas	T (BIO)	-
	Chromatomyia horticola	Pea leafminer	Probably Eurasia	T	-
	Liriomyza huidobrensis	Potato leafminer	Probably South America	T	-
	Liriomyza trifolii	American leafminer	USA	T	-
	Ophiomyia camarae	Leafmining fly	Neotropics, Southern USA	T (BIO)	-
	Ophiomyia lantanae	Lantana seed fly	Southern USA, South America	T (BIO)	-
	Psila rosae	Carrot rust fly	Temperate Eurasia	T	-
Anthomyiidae	*Delia platura*	Bean seed maggot	Europe	T	-
	Fucellia tergina	Common kelp fly	Europe	M/T	1949
Calliphoridae	*Calliphora vicina*	European bluebottle	Europe, North America	T	1965
	Chrysomya megacephala	Oriental latrine fly	South East Asia, Eastern Africa	T	1971
	Lucilia sericata	Common green bottle	Europe, North America	T	1900
Cecidomyiidae	*Contarinia sorghicola*	Sorghum midge	Probably Asia	T	-
	Dasineura dielsi	Rooikrans gall midge	Australia	T (BIO)	-
	Dasineura rubiformis	Black wattle gall midge	Western Australia	T (BIO)	-
	Zeuxidiplosis giardi	St Johns wort midge	France	T (BIO)	-
Culicidae	*Aedes albopictus*	Asian tiger mosquito	South East Asia	T	1990
Faniidae	*Fannia albitarsis*	White-footed lesser house fly	South America	T	1953
Phoridae	*Megaselia scalaris*	Common coffin fly	Americas	T	-
Piophilidae	*Piophila casei*	European cheese fly	Europe	T	-
Psychodidae	*Clogmia albipunctata*	Moth fly	Unknown	T	-
Stratiomyidae	*Hermetia illucens*	Window-waisted soldier fly	Americas	T	-
Syrphidae	*Eristalis tenax*	European drone fly	Northern Europe, Asia	T	> 1860
Tephritidae	*Bactrocera invadens*	Invasive fruit fly	Sri Lanka	T	2010
	Ceratitis capitata	Mediterranean fruit fly	Mediterranean	T	-
	Procecidochares utilis	Eupatorium gall fly	Mexico	T (BIO)	-
Siphonaptera					
Tungidae	*Tunga penetrans*	Jigger flea	Tropical South America	T	1700s
Pucilidae	*Ctenocephalides felis*	Cat flea	Egypt	T	-
	Echidnophaga gallinacea	Stick-tight flea	South East Asia	T	-
	Pulex irritans	Human flea	Southern and Central America	T	1700s
	Xenopsylla cheopis	Oriental rat flea	Egypt, Sudan	T	-
Hymenoptera					
Aphelinidae	*Aphytis coheni*	-	Asia	T (BIO)	-
	Aphytis holoxanthus	-	Indian subcontinent	T (BIO)	-
	Aphytis lepidosaphes	-	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
	Aphytis lingnanensis	-	Asia	T (BIO)	-
	Aphytis melinus	-	Asia	T (BIO)	-
Braconidae	*Apanteles subandinus*	Potato tuber moth parasitoid	Bolivian Andes	T	1960s
	Cotesia plutellae	Diamondback moth parasitoid	Europe	T	-
Encyrtidae	*Comperiella bifasciata*	Red scale parasite	Asia	T (BIO)	-
	Copidosoma koehleri	-	South America	T (BIO)	-
Eulophidae	*Leptocybe invasa*	Eucalyptus gall wasp	Australia	T	2007
	Quadrastichus erythrinae	Erythrina gall wasp	Western Africa	T	-
Evaniidae	*Evania appendigaster*	Ensign wasp	Southern China, South East Asia	T	-
Formicidae	*Linepithema humile*	Argentine ant	South America	T	1908
Ibaliidae	*Ibalia leucospoides*	Sirex ibaliid wasp	Holarctic	T (BIO)	1990s
Megalyridae	*Megalyra fasciipennis*	Megalyrid wasp	Australia	T	1910
Mymaridae	*Patasson nitens*	-	Southern Australia	T (BIO)	-
Pteromalidae	*Trichilogaster acacialongifoliae*	Acacia gall wasp	Australia	T	1990s
	Trichilogaster signiventris	Acacia gall wasp	Australia	T	-
Siricidae	*Sirex noctilio*	Sirex wood wasp	Europe, Asia, Northern Africa	T	1962
Tenthridinidae	*Caliroa cerasi*	Pear slug	Europe	T	-
	Fenusa dohrnii	Alder leafminer	Europe, USA	T	-
Vespidae	*Polistes dominulus*	European paper wasp	Europe, Asia, Northern Africa	T	2008
	Vespula germanica	German wasp	Europe, Asia, Northern Africa	T	1975
Myriopoda					
Blaniulidae	*Proteroiulus fuscus*	Snake millipede	Europe	T	-
Julidae	*Brachyiulus pusillus*	-	Europe	T	-
	Cylindroiulus brittanicus	-	Europe	T	-
	Cylindroiulus truncorum	-	Northern Africa	T	-
	Ommattoiulus moreleti	Portuguese millipede	Western Europe	T	-
Lithobiidae	*Lithobius obscurus*	Purple stone centipede	Western Mediterranean	T	-
	Lithobius peregrinus	Peregrine's Stone centipede	Central Europe	T	-
Paradoxosomatidae	*Orthomorpha gracilis*	Hothouse millipede	East Indies	T	-
Scutigeridae	*Scutigera coleoptrata*	House centipede	Southern Europe	T	-
Pycnogonida					
Ammotheidae	*Ammothella appendiculata*	-	Pacific	M	-
Arachnida					
Agelenidae	*Tegenaria domestica*	Barn funnel-web spider	Europe	T	-
Araneidae	*Cyrtophora citricola*	Tropical tent-web spider	Unknown	T	-
Dysderidae	*Dysdera crocata*	Long-fanged six-eyed spider	Mediterranean	T	-
Linyphiidae	*Ostearius melanopygius*	Black tailed sheet-web spider	New Zealand	T	-
Theridiidae	*Latrodectus geometricus*	Brown button spider	South America	T	-
	Parasteatoda tepidariorum	Common house orb-web spider	New World	T	-
	Steatoda grossa	False widow spider	Greece	T	-
Oecobiidae	*Oecobius navus*	House ant-eater	Unknown	T	-
Pholcidae	*Crossopriza lyoni*	Humped back daddy-long-legs	South East Asia	T	2007
	Pholcus phalangiodes	House daddy-long-legs	Europe	T	-
Salticidae	*Hasarius adansoni*	Adanson's house jumping spider	Egypt	T	-
Scytodidae	*Scytodes thoracica*	House spitting spider	Probably Northern Africa	T	-
Sparassidae	*Heteropoda venatoria*	Brown huntsman spider	Unknown	T	-
Tetragnathidae	*Tetragnatha boydi*	Long-jawed water spider	Mexico	T	-
Uloboridae	*Uloborus plumipes*	Feather-legged lace weaver	Old World	T	-
Ixodidae	*Rhipicephalus microplus*	Asiatic cattle tick	Australasia, Madagascar, Neotropics	T	1896
Eriophyidae	*Aceria aloinis*	Aloe gall mite	USA	T	-
	Aceria cynodoniensis	Grass rosette mite	Egypt	T	-
	Aceria ficus	Fig bud mite	France	T	-
	Aceria lantanae	Lantana gall mite	Southern USA to South America	T (BIO)	-
	Aceria mangiferae	Mango bud mite	Egypt	T	-
	Aceria oleae	Olive bud mite	Europe	T	-
	Aceria sheldoni	Citrus bud mite	USA	T	-
	Aculops lycopersici	Tomato rust mite	Japan	T	1960
Galumnidae	*Orthogalumna terebrantis*	Water hyacinth mite	Americas	FW (BIO)	-
Penthaleidae	*Halotydeus destructor*	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	*Bdellodes lapidaria*	Snout mite	Probably Europe	T	-
Phytoseiidae	*Neoseiulus californicus*	Predatory mite	Probably California	T	-
Tarsonemidae	*Polyphagotarsonemus latus*	Citrus silver mite	Probably USA	T	1890
	Tarsonemus waitei		Probably USA	T	-
Anystidae	*Anystis wallacei*	Wriggling mite	Probably France	T	-
Tenuipalpidae	*Brevipalpus californicus*	Citrus flat mite	Probably California	T	1959
	Brevipalpus obovatus	Ornamental flat mite	Unknown	T	-
	Brevipalpus phoenicis	Reddish black mite	Probably France	T	1962
Tetranychidae	*Bryobia praetiosa*	Brown clover mite	Probably Germany	T	-
	Panonychus citri	Citrus mite	Probably Florida	T	1950
	Panonychus ulmi	European red mite	Probably Germany	T	1974
	Tetranychus evansi	Tobacco spider mite	Brazil, Argentina	T	1980s
	Tetranychus urticae	Two-spotted mite	Mediterranean region	T	1970
Varroidae	*Varroa destructor*	Varroa mite	Asia	T	1997
Crustacea					
Armadillidiidae	*Armadillidium vulgare*	Pill bug	Europe	T	1943
Argulidae	*Argulus japonicus*	Fish louse	South East Asia	F	< 1983
Acartiidae	*Acartia spinicauda*	Spinytailed copepod	South East Asia	M	-
Balanidae	*Amphibalanus venustus*	Striped acorn barnacle	Tropical Northern Atlantic	M	-
	Balanus glandula	Pacific barnacle	Northern American Pacific	M	< 1992
Coropiidae	*Apocorophium acutum*	Tube-building amphipod	Northern Atlantic	M	-
	Erichthonius brasiliensis	-	Northern Atlantic	M	-
	Monocorophium acherusicum	Stout-antenna amphipod	Northern Atlantic	M	1915
Cheluridae	*Chelura terebrans*	Wood boring amphipod	Pacific Northern America	M	-
Ischyroceridae	*Cerapus tubularis*	Hermit amphipod	Atlantic Northern America	M	-
	Ischyrocerus anguipes	-	Northern Atlantic	M	-
	Jassa marmorata	-	Northern Atlantic	M	-
	Jassa slatteri	Hitchhiker amphipod	Pacific Northern America	M	-
Limnoriidae	*Limnoria quadripunctata*	Gribble	Unknown	M	-
	Limnoria tripunctata Gribble	Gribble	Unknown	M	2008
Oniscidae	*Philoscia elongata*	-	Europe, Middle East	T	-
	Philoscia musicorum	Fast woodlouse	Europe	T	-
Parastacidae	*Cherax destructor*	Yabby	Australia	F	-
	Cherax quadricarinatus	Australian redclaw	Australia	F	-
	Cherax tenuimanus	Marron	Southwestern Australia	F	1980s
	Procambarus clarkia	North American red swamp crayfish	Northern America	F	-
Pinnotheridae	*Pinnixa occidentalis*	Pea crab	Pacific Northern America	M	2004
Porcellionidae	*Porcellio laevis*	Smooth woodlouse	British Isles	T	1932
	Porcellio scaber	Rough woodlouse	Southern and Western Europe	T	1885
	Porcellionides pruinosus	Plum woodlouse	Europe, Northern America	T	-
Portunidae	*Carcinus maenas*	European shore crab	Europe, Mediterranean	M	1983
Xanthidae	*Xantho incisus*	Black-fingered crab	Europe, Mediterranean	M	-
Sphaeromidae	*Dymanene bidentata*	Horned isopod	Europe	M	-
	Paracerceis sculpta	Sponge isopod	North-east Pacific	M	-
	Sphaeroma serratum	-	Europe	M	-
	Sphaeroma walkeri	Pill isopod	Northern Indian Ocean	M	-
Talitridae	*Orchestia gammarella*	Beachhopper	Europe, Mediterranean	M	1900s
	Platorchestia platensis	Beach flea	Unknown	M	-
	Talitroides topitotum	Land hopper	Unknown	T	-
Nematoda					-
Beddingiidae	*Beddingia siricidicola*	Wood wasp nematode	Europe	T	2004
Heteroderidae	*Globodera rostochiensis*	Potato cyst nematode	Bolivia and Peru	T	-
	Meloidogyne javanica	Root-knot nematode	South America	T	-
Tylenchulidae	*Radopholus similis*	Burrowing nematode	Australasia	T	-
	Tylenchulus semipenetrans	Citrus nematode	Unknown	T	-
Annelida					-
Acanthodrilidae	*Dichogaster affinis*	-	Probably Zanzibar	T	-
	Dichogaster annae	-	Java	T	-
	Dichogaster bolaui	-	Probably Germany	T	-
	Dichogaster modiglianii	-	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
	Dichogaster saliens	-	Western Africa	T	-
	Microscolex dubius	-	South America	T	-
	Microscolex phosphoreus	-	South America	T	-
Eudrilidae	*Eudrilus eugeniae*	African nightcrawler	Western Africa	T	-
Glossoscolecidae	*Pontoscolex corethrurus*	Quincunx worm	Amazonian Brazil	T	-
Lumbricidae	*Allolobophoridella eiseni*	-	Europe, Americas	T	-
	Allolobophoridella parva	-	USA	T	-
	Aporrectodea caliginosa	Common earthworm	Palaearctic	T	-
	Aporrectodea longa	Black-headed worm	Probably Germany	T	-
	Aporrectodea rosea	Pink soil worm	Temperate Eurasia	T	-
	Aporrectodea trapezoids	Southern worm	Probably France	T	-
	Dendrobaena cognettii	-	Probably Sardinia	T	-
	Dendrobaena hortensis	European nightcrawler	Probably Germany	T	-
	Dendrobaena octaedra	-	Probably France	T	-
	Dendrodrilus rubidus	Bark-eating worm	Temperate Eurasia	T	-
	Eisenia fetida	Composting earthworm	Probably Eurasia	T	-
	Eiseniella tetraedra	Square-tailed worm	Probably France	T	-
	Lumbricus castaneus	Chestnut worm	Unknown	T	-
	Lumbricus rubellus	Red worm	Unknown	T	-
	Octolasion cyaneum	Blue-grey worm	Probably France	T	-
	Octolasion lacteum	-	Unknown	T	-
Megascolecidae	*Amynthas aeruginosus*	-	Probably Guam	T	-
	Amynthas corticis	Black wriggler	Probably Hawaii	T	-
	Amynthas diffringens	Snake worm	Probably Wales	T	-
	Amynthas gracilis	-	Probably Argentina	T	-
	Amynthas hawayanus	-	Probably Hawaii	T	-
	Amynthas minimus	-	Probably Java	T	-
	Amynthas morrisi	-	Probably Malaysia	T	-
	Amynthas rodericensis	-	Probably Rodrigues	T	-
	Perionyx excavatus	Blue worm	Asia	T	-
	Pontodrilus litoralis	-	Probably France	T	-
Cirratulidae	*Dodecaceria fewkesi*	Black coral worm	Pacific Northern America	M	2007
Nereidae	*Neanthes succinea*	Pileworm	Europe	M	-
Ocnerodrilidae	*Eukerria saltensis*	-	South America	T/F	-
	Nematogenia lacuum	-	Unknown	T	-
	Ocnerodrilus occidentalis	-	Unknown	T	-
Opheliidae	*Travesia forbesii*	Pink spindle worm	Palaearctic, Japan	M	-
Serpulidae	*Ficopomatus enigmaticus*	Estuarine tubeworm	Australia	M	< 1951
	Hydroides elegans	Calcareous tubeworm	Indo Pacific	M	-
	Janua pagenstecheri	-	Europe	M	-
	Neodexiospira brasiliensis	Spiral fan worm	West Indies, Brazil	M	-
Spionidae	*Boccardia proboscidea*	Shell worm	Northern Pacific	M	1980s
	Polydora hoplura	Mudworm	Europe, Mediterranean	M	-
Mollusca					
Agriolimacidae	*Deroceras laeve*	Marsh slug	Europe	T	1898
	Deroceras panormitanum	Brown field slug	Europe	T	1964
	Deroceras reticulatum	Grey field slug	Europe	T	1898
Ampullariidae	*Pomacea diffusa*	Mystery snail	Brazil	F	-
Arionidae	*Arion hortensis* aggregate	Garden arion	Western Europe	T	-
	Arion intermedius	Hedgehog slug	Western Europe	T	< 1898
Bradybaenidae	*Bradybaena similaris*	Asian tramp snail	Eastern Asia	T	
Cochlicellidae	*Cochlicella barbara*	Small conical snail	Mediterranean	T	< 1909
Cochlicopidae	*Cochlicopa* cf. *lubrica*	Slippery moss snail	Europe, Northern America	T	-
Littorinidae	*Littorina saxatilis*	Lagoon snail	Europe, Mediterranean, Western Atlantic	M	-
Discidae	*Discus rotundatus*	Spotted disc	Europe	T	-
Gastrodontidae	*Zonitoides arboreus*	Orchid snail	Northern America	T	1898
Helicidae	*Cornu aspersum*	European brown garden snail	Western Europe, Mediterranean	T	1855
	Eobania vermiculata	Vermiculate snail	Mediterranean	T	1980s
	Otala puncata	White-lipped milk snail	Western Mediterranean	T	-
	Theba pisana	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	*Lauria cylindracea*	Common chrysalis snail	Western Europe, Mediterranean	T	-
Limacidae	*Lehmannia nyctelia*	Striped garden slug	Eastern Europe	T	1939
	Lehmannia valentiana	Three-banded garden slug	Eastern Europe	T	1962
	Limacus flavus	Yellow garden slug	Mediterranean	T	< 1898
	Limax maximus	Giant garden slug	Europe	T	1898
Lymnaeidae	*Lymnaea columella*	Reticulate pond snail	North America	F	1942
	Radix rubiginosa	Rust-coloured pond snail	South East Asia	F	2006
Milacidae	*Milax gagates*	Black keeled slug	Mediterranean	T	< 1873
Muricidae	*Thais blanfordi*	Blanford's whelk	Tropical Indo-Pacific	M	1950
	Thais tissoti		Tropical Indo-Pacific	M	-
Mytilidae	*Mytilus galloprovincialis*	Mediterranean mussel	Mediterranean, Northeastern Atlantic	M	1979
	Perna viridis	Green mussel	South East Asia	M	-
	Semimytilus algosus	Bisexual mussel	Pacific South America	M	2010
Ostreidae	*Crassostrea gigas*	Japanese oyster	Japan, Northwestern Pacific	M	2005
	Ostrea edulis	European oyster	Europe, Mediterranean	M	1946
Oxychilidae	*Aegopinella nitidula*	Smooth glass snail	Europe	T	-
	Oxychilus alliarius	Garlic glass snail	Western Europe	T	-
	Oxychilus cellarius	Cellar glass snail	Europe	T	-
	Oxychilus draparnaudi	Draparnaud's glass snail	Western Europe, Mediterranean	T	< 1908
Physidae	*Aplexa marmorata*	Slender bladder snail	South America	F	1986
	Physa acuta	Sharp-spired bladder snail	South America, Caribbean	F	1954
Planorbidae	*Gyraulus chinensis*	Chinese ram's-horn snail	South East Asia	F	2007
	Helisoma duryi	Dury's Ram's-horn snail	Southeastern USA	F	1964
Teredinidae	*Lyrodus pedicellatus*	Shipworm	Unknown	M	-
	Teredo navalis	Shipworm	Europe, Mediterranean	M	< 1800
Pristilomatidae	*Hawaiia minuscula*	Minute gem	North America	T	-
	Vitrea contracta	Milky crystal snail	Europe, Middle East, Northern Africa	T	-
	Vitrea crystallina	Common crystal snail	Europe	T	-
Subulinidae	*Rumina decollata*	Decollate snail	Mediterranean	T	-
	Subulina octona	Wandering awl snail	Caribbean	T	-
Tergipedidae	*Catriona columbiana*	Columbian nudibranch	North Pacific	M	< 1972
Testacellidae	*Testacella maugei*	Maug's shelled slug	Western Europe, Mediterranean	T	-
Thiaridae	*Tarebia granifera*	Quilted melania	South East Asia	F	1999
Valloniidae	*Vallonia costata*	Ribbed grass snail	Europe, Eastern USA	T	-
	Vallonia pulchella	Smooth grass snail	Europe, eastern North America	T	-
Brachiopoda					
Discinidae	*Discinisca tenuis*	Disc lampshell	Namibian Coast	M	2008
Bryozoa					-
Bugulidae	*Bugula dentata*	Blue dentate moss animal	Indo-Pacific	M	1852
	Bugula flabellata	-	Unknown	M	-
	Bugula neritina	Purple dentate moss animal	Unknown	M	1944
Cryptosulidae	*Cryptosula pallasiana*	-	Europe	M	-
Membraniporidae	*Conopeum seurati*	-	Europe	M	-
Watersiporidae	*Watersipora subtorquata*	Red-rust bryozoan	Caribbean	M	-
Platyhelminthes					
Botryocephalidae	*Botryocephalus acheilognathi*	Fish tapeworm	China	F	1975
Dactylogyridae	*Pseudodactylogyrus anguillae*	Eel gill fluke	China, Japan, Taiwan	F	-
Geoplanidae	*Bipalium kewense*	Spade-headed planarian	South East Asia	T	-
	Kontikia ventrolineata	Kontikia flatworm	Australia	T	-
Gyrodactylidae	*Gyrodactylus kherulensis*	Fish skin fluke	Eastern Asia	F	-
	Gyrodactylus kobayashii	Fish gillworm	Asia	F	-
Cnidaria					
Corynidae	*Coryne eximia*	-	North Atlantic, Pacific	M	-
Campanulariidae	*Gonothyraea loveni*	-	North Atlantic	M	-
	Laomedea calceolifera	-	North Atlantic	M	-
	Obelia bidentata	Double-toothed hydroid	Unknown	M	-
	Obelia dichotoma	Thin-walled obelia	Unknown	M	-
	Obelia geniculata	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	*Craspedacusta sowerbyi*	Freshwater jellyfish	Nearctic, Palearctic	F	1970s
Metridiidae	*Metridium senile*	Plumose anemone	North Atlantic	M	1995
Moerisiidae	*Moerisia maeotica*	-	Black sea region	M	-
Oceanidae	*Pachycordyle navis*	Brackish hydroid	Europe, Mediterranean	M	-
Pennariidae	*Pennaria disticha*	Sea fern hydroid	Unknown	M	1906
Sagartiidae	*Sagartia ornata*	Brooding anemone	Europe, Mediterranean	M	-
Tubulariida	*Pinauay larynx*	-	North Atlantic	M	-
	Pinauay ralphi	-	North Atlantic	M	-
Porifera					
Suberitidae	*Suberites ficus*	Sulphur sponge	Northeastern Atlantic and Mediterranean	M	1998

Source: Picker and Griffiths (2011)