Supplementary Material to

'The Status of Biological Invasions and their Management in South Africa'

[DRAFT FOR PUBLIC COMMENT]

Note to reader

This supplementary material contains additional information chapter by chapter on the methods used and discussion points, as well as additional figures, tables, and text boxes to the draft report (report available at http://dx.doi.org/10.5281/zenodo.17697657)

Comments to be sent to: IAS.report.SANBI@gmail.com By: 1 March 2026

Form for comments: https://tinyurl.com/h7fxmu6u

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For citations in policy documents: SANBI and CIB (2026) Supplementary Material to 'The status of biological invasions and their management in South Africa in 2025 [DRAFT FOR PUBLIC COMMENT]'. South African National Biodiversity Institute (Kirstenbosch) and Centre for Invasion Biology (Stellenbosch): 139. http://dx.doi.org/10.5281/zenodo.18314515

QR code that resolves to the latest available version of the status report (http://dx.doi.org/10.5281/zenodo.7414803)

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Supplementary Material to 'Introductory Chapter: Processes used to construct this report'

S0.1 Independence of the status reports

This status report is intended to be an independent assessment of the status of biological invasions and their management in South Africa. The report aims to inform the development and ongoing adaptation of appropriate policies and control measures, both to reduce the negative impacts of invasive species on ecosystems, the economy, and people, and to retain any benefits of invasive species where possible and desirable. The compilation of the report was overseen by employees of the South African National Biodiversity Institute (SANBI) and the Centre for Invasion Biology (CIB). Inputs (including data, peer-reviewed papers, and unpublished reports) were also obtained from researchers and managers from diverse institutions across South Africa. Funding for the compilation of the report was obtained through the National Department of Forestry, Fisheries, and the Environment (DFFE) as part of SANBI's Medium Term Expenditure Framework. To address potential conflicts of interest, and to try to ensure independence of the report, the following steps were taken:

- Drafts of the status report were widely circulated to contributing authors and other stakeholders, who were invited to submit comments, concerns or additional information, with a dedicated public round of review early in 2026;
- The version sent for public review was also reviewed in depth by two South African and one international expert on biological invasions;
- Comments and concerns raised were captured in a database, along with the drafting team's responses to these comments and concerns. This database is available on request; and
- A Review and Advisory Committee was appointed and oversaw the process taken to compile and review the report, as well as the drafting team's response to the comments and concerns raised by stakeholders, with a view to strengthening the process if necessary for future reports.

S0.2 Editorial conventions

Acronyms: all acronyms are defined at first use in every chapter and are also defined in the captions of tables and figures. Acronyms that are used on multiple occasions or in multiple places in the report are listed at the beginning of the main text of the report.

Currency: South African rands are denoted as ZAR and not R. Similarly, US dollars are denoted as USD, not $.

Naming species: at first use in every chapter and in the captions of tables and figures both the full scientific and vernacular (i.e., common) name are provided when referring to species. The generic names are abbreviated to the initial thereafter. The scientific name comes before the vernacular name, in round brackets [e.g., *Tuta absoluta* (the tomato leaf miner)]. Scientific names are italicised. Names above the generic level are not italicised. Authorities for scientific names are not included in the main text, but are provided in the list of alien taxa, and, as needed, in the supplementary materials. Each taxon is assigned only one vernacular name. The vernacular name used is in English, recognising that more than one English vernacular name may exist and that vernacular names in other South African official languages also exist. Exceptions are made when a non-English vernacular name is predominantly or exclusively used to describe a species (e.g., for *Acacia cyclops*, the vernacular name '*rooikrans*' is used in preference to the English 'red eye'). Vernacular names are not capitalised (e.g., common carp), unless they contain a proper noun (e.g., European shore crab).

Taxonomic backbone: the species names used throughout the report are based on those in the lists of alien taxa and thereby have been checked against a taxonomic backbone (see Appendix 8 for a list of the taxonomic backbones used). In cases where specific permits were issued or there was a legal case, the name presented here is that used in the original case. Wilson (2025) links current names in the regulatory lists to valid scientific names as per the taxonomic backbones. Additional names (e.g., synonyms) that have been frequently used in the past are included in the list of alien taxa under the column 'otherNamesUsed'.

Language: the main text and appendices are written in South African English, and in cases where there is an option, British English is preferred to US English.

Formatting: 1.5 line space and 6pt after paragraphs for main text; figure legends are placed beneath figures and are 1 line space and 0pt before and 6pt after; table legends are placed above tables and are 1 line space and 0pt both before and after paragraphs; references single space hanging indent and left aligned; level 1 headings single space and 18pt before and after; level 2 headings single space and 12pt after. Line numbers included throughout.

Font type: Calibri, bold for level 1 and level 2 headings, and italicised for level 3 headings.

Font size: 12 point for level 1 headings, 11 point for other headings and text, 10 point for tables in the main report and for references, 8 point for large tables in supplementary material.

Quotations: long quotes are italicised and in separate left indented paragraphs. If in the text, double quotation marks are used and text is italicised. Where a specific term is indicated, single quotation marks are used, and the text is not italicised.

Spacing. A single space is used after punctuation marks at the end of sentences.

References. All references for the main text and for the appendices are provided in a single bibliography at the end of the main text. In the bibliography, references with more than ten authors only have the first four authors listed, followed by 'et al.' References are formatted according to the referencing style of Pensoft (e.g., https://neobiota.pensoft.net/about#CitationsandReferences). Where available, URLs and DOIs for the references have been provided to make them easier to trace.

Indicators. Where the full name of an indicator is given in the report it is italicised. The indicator numbers are only provided in subheadings, figures, and tables. Where subheadings of the report are based on indicators, the numbering is as per the numbering of the indicator scheme (Figure 0.2).

Terminology. To assist the reader who may not be familiar with commonly used terms in invasion biology, a glossary of terms is provided at the beginning of the report. The terms used do not entirely align with the definitions in the NEM:BA or the corresponding A&IS Regulations because some terms in the regulations do not align with the terms in the Act, are inconsistent in how they are used, are ambiguous, are not how the terms are generally used, or do not align with international conventions. To list a few examples:

- the term 'control' is defined in the Act but is defined in terms of a second term 'combat' which is not defined. The term 'combat' is therefore avoided and the term 'control' is defined without reference to 'combat';
- the term 'invasive species' is a subset of 'alien species', as such the term 'invasive alien species' is avoided as the word alien is redundant;
- 'Invasive Species Monitoring, Control and Eradication Plans' referred to in the regulations are referred to as 'site management plans'. This is distinct from 'species management programmes', which focus on controlling particular species; and

the definitions for 'risk analysis' and 'risk assessment' are taken from the CBD rather than from the NEM:BA A&IS Regulations

S0.3 Sourcing information

While there is a set workflow for '*Tracking data sources and adding data as published*' (Appendix 2), the process of soliciting information from stakeholders and contributors has not been formally laid out in one place. In general letters were sent out based on the template below, with periodic e-mail reminders as needed.

SANBI
Biodiversity for Life
South African National Biodiversity Institute

DATE

ADDRESS

Dear NAME

REQUEST FOR INFORMATION FROM INSTITUTION FOR COMPILATION OF THE FOURTH NATIONAL STATUS REPORT ON BIOLOGICAL INVASIONS AND THEIR MANAGEMENT

As you may be aware, the South African National Biodiversity Institute (SANBI), in collaboration with the Centre for Invasion Biology (CIB) at Stellenbosch University, is currently in the process of compiling the fourth National Status Report on Biological Invasions in South Africa. This report must be produced by October 2026, as required by regulations under the National Environmental Management: Biodiversity Act (Act 10 of 2004).

To compile a comprehensive report, SANBI relies on inputs from experts and institutions around the country. It would therefore be very useful if you could supply as much of the information listed in the table at the end of this letter as possible. We would like to obtain your inputs as soon as possible, but not later than the end of August 2025, after which we will prepare draft chapters, and circulate them to stakeholders for review. Our aim is to include information up to December 2025.

Please could you let us know, as soon as possible, whether you will be able to provide any of the above information within the required time? Alternatively, you could provide us with contact details of someone in your institution who might be able to assist. Please direct your reply to IAS.report.SANBI@gmail.com. I would like to thank you in advance for your inputs. All inputs received will be appropriately acknowledged in the final status report.

If you have any questions relating to the above, please feel free to contact either Dr Tsungai Zengeya (T.Zengeya@sanbi.org.za) or Prof. John Wilson (jrwilson@sun.ac.za).

Yours sincerely,

SANBI Chief Executive Officer

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Annexure A

TABLE 1: INFORMATION REQUIRED FOR THE COMPILATION OF THE FOURTH NATIONAL STATUS REPORT ON BIOLOGICAL INVASIONS AND THEIR MANAGEMENT

Information required	Description
Organization	Name of the organ of state supplying the information
Contact details	Name of the relevant contact person(s), with email address and phone numbers
Period covered	The period (start and end dates) for which the information is supplied.
Area of undeveloped land for which the organization is responsible	The area in hectares of all state, provincial or municipal-owned undeveloped land being managed by the organization. This includes catchment areas, nature reserves or other protected areas, parks, public open spaces and any other land supporting natural vegetation.
Invasive Species Monitoring, Control and Eradication Plans	The number of plans that have been drawn up to cover the period 1 January 2023 to 31 December 2025 (i.e. the plans should be valid for the period covered by the status report). Confirmation of whether the plans have been submitted to the Minister and to SANBI as required by Section 10 (2) of the Alien and Invasive Species regulations that were promulgated in terms of section 97(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). If possible, please supply electronic copies of these plans.
Money spent	The amount budgeted for, and the amount expended, on all activities related to the control of biological invasions on state-owned land being managed by the organization during the period covered by the status report.
Alien species list	A list of the invasive alien species listed under the NEM:BA regulations that are known to occur in protected areas under the organisation's jurisdiction
Species managed	A list of all invasive alien species that were subjected to control interventions during the period covered by the status report.
Area managed	The proportion of land (as a % of the undeveloped land for which the organization is responsible) on which some form of management intervention to control invasive alien species was implemented during the period covered by the status report.

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The requests that were sent out and whether the data requested was submitted to SANBI was recorded (and is available on request).

S0.4 Scoring of indicators

Values were compared with the properties identify by Vicente et al. (2022) as being important for indicators.

1. Established

Information derived from an indicator which has already been tested and applied in a range of situations and contexts will, in principle, be more reliable than that from an indicator which has been proposed but not yet validated.

> *Established*: the indicator has been proposed, tested, and applied to inform on range of situations.
>
> *Not established*: the indicator is being proposed and defined for the first time and has not yet been tested or applied to any situation.

2. Spatially explicit

Spatially explicit information enables trends to be mapped for all indicators be they pathways, species, sites, or interventions. Linking the data that underpin indicators to specific places makes an indicator more valuable to local, national, or regional management, and possible to disaggregate to application at finer scales.

> *Spatially explicit*: the indicator provides information that can be linked to a specific spatial location (e.g., a site, region, and country) so that its features can be associated with that location.
>
> *Not spatially explicit*: the indicator does not provide information that can be linked to a spatial location.

3. Scalable

Scalability enables the application of the indicator at the relevant spatial extent, a robust indicator should be reproducible at multiple, distinct spatial scales. Scalability allows data collected for indicators at national scale to be meaningfully aggregated for use at international scales (and vice versa).

> *Scalable*: the indicator is calculated through a hierarchy of nested spatial grains, i.e., scalable up or down.

295 *Not scalable*: the indicator is not calculated over different spatial grains and does not provide
296 clear indication on how to calculate it beyond the scale for which it was created.

297 4. Temporal

298 The availability of information that is linked to a date and duration relevant to informing on the status
299 and trends of IAS. The indicator should be designed so that it can be recalculated over time to support
300 the monitoring of IAS-relevant change.

301 *Temporal*: the indicator includes a temporal dimension (is expressed as a trend), being
302 calculated for a particular time, and is periodically updated.

303 *Somewhat temporal*: the indicator is not specifically designed to have a temporal dimension
304 (be expressed as a trend), but it provides clear indication that it can be repeated in future if
305 data are collected for this purpose.

306 *Not temporal*: the indicator is not designed to be recalculated in future nor does it provide
307 clear indication that would allow calculation of a trend.

308 5. Uncertainty appraisal

309 The presentation of measurements of uncertainty for informing on IAS trends and status represents a
310 key aspect of any evaluation approach, with implications for implementation and reproducibility. This
311 provides scientists and decision makers with information on the degree of confidence in the indicator
312 message.

313 *Quantitative uncertainty*: the indicator reports a quantitative measure of uncertainty.

314 *Qualitative uncertainty*: the indicator reports a qualitative measure of uncertainty.

315 *No uncertainty*: no uncertainty measure is reported with the indicator.

316 6. Taxonomic representativeness

317 To address a range of policy or decision-support requirements, the information provided by an
318 indicator should be applicable to a range of IAS taxonomic groups.

319 *Representative*: the indicator is presented as a general indicator that can be, by design, applied
320 to any taxa.

321 *Somewhat representative*: the indicator is designed or applied to a particular taxon or group
322 but provides clear indication that it can be transferred to other taxa.

Not representative: the indicator is specifically designed for a particular taxon or group and it does not clearly indicate whether it can be transferred to other taxa.

7. Invasive alien species (IAS) specificity

Sound measurement of progress toward preventing and controlling IAS requires indicators that use (IAS) species data (Note: this property is not applicable to some indicator types).

IAS specific: the indicator has been calculated using IAS specific data and not proxy data that can be used to infer on IAS. This property is particularly relevant for Pressure indicators.

Not specific: the indicator is proposed and calculated using proxy data on IAS.

8. Reproducible

Reproducibility is essential for any communication, scientific and political goal, as it allows availability, repeatability, standardization, and archiving in support of information harmonisation, integration, use, and transparency.

Reproducible: the data necessary to populate the indicator are accessible and available for public use and indications on how to calculate the indicator are provided.

Somewhat reproducible: data necessary to populate the indicator is not explicitly indicated as accessible, yet indications on how to calculate the indicator and get the necessary data are provided.

Not reproducible: the data are not available for public use nor they contain explicit instructions to calculate it.

S0.5 Tracking change

The process proposed to track change accounts for several reasons why indicator values can change between the reports, including: 1) data collected that are no longer relevant; 2) data collected need to be reinterpreted; 3) there were changes but these do not affect the value of any of the indicators (e.g., some changes in nomenclature); 4) new information is available that indicates the value has changed since the previous report; and 5) new information is available that was not available in previous reports (Table S0.1).

Table S0.1 Different reasons for why values might have changed from one report to the next and proposed actions

Proposed actions are based on how each errors will affect the baseline. If errors are found there should be a process of feedback to the data holders regardless of whether such errors impact on the indicator values.

Reason for difference		Action
1. Data were collected in the previous report but these are not relevant for this report	1.1 There has been a change in the indicators so that the data are no longer relevant	Assess whether the change in the indicator means that data are no longer used in the analysis, suggesting additional changes to the indicators are needed. Previous baseline is obsolete.
	1.2 There were errors in the data, such that they cannot map on to this report	Provide feedback to data holder and find out if data are correctly interpreted. Use a revised baseline if possible.
2. Data were collected in the previous report but need to be reinterpreted for this report	2.1 A change in indicators means that the data used do not align perfectly	Develop a mapping methodology and assess its validity (vs. random) using that to inform confidence levels. Use a revised baseline if possible (potentially by adapting the previous baseline)
	2.2 There has been a change in the data (e.g., a species has split into two taxonomic units, new geographical boundaries, or regulations are developed)	Develop a mapping methodology and clearly indicate the assumptions made. Use a revised baseline if possible (potentially by adapting the previous baseline)
3. Data were collected in the previous report but there was no change in the values for this report	3.1 No new data were found	There is no evidence in support of 'no change'—assess whether the lack of new data affects confidence level and need for monitoring. No change to the baseline.
	3.2 New data are similar to the previous data	There is evidence in support of no change, with confidence levels potentially increasing. No change to the baseline.
	3.3 The new data changes something that does not affect the indicators (e.g., there is a change to the species name, but all the rest of the data stay the same)	No action needed beyond the update. No change to the baseline.
	3.4 New data do not support a change to previous data, but question previous values	Consider improved monitoring and reducing confidence levels in current estimates. Consider whether the baseline needs to be revised.
4. Data collected for this report indicate the value has changed since the previous report	4.1 Data were collected in this report cycle	There has been a genuine change in the value. No change to the baseline.
	4.2 Data were collected prior to this report cycle but not included in past reports	The updated value should be used as the value in the previous report for the purposed of tracking change, i.e., use a revised baseline.
	4.3 See a continuous change over time	Test to see if there is a statistically significant trend.
5. Data collected for this report where no data were available in the previous report	5.1 Data not available previously were collected during this report cycle	Data used to establish a baseline
	5.2 Data were collected prior to this report cycle but not included in previous reports	A baseline is created retrospectively and changes with more recent data can be analysed
	5.3 There is a new indicator	Data used to establish a baseline

Supplementary Material to 'Chapter 1: Pathways'

S1.1 Background notes

The chapter on pathways reports on how alien taxa can be introduced to South Africa and how these taxa can disperse within the country. In the chapter, the term 'introduction pathway' refers to the processes that could facilitate the introduction of alien taxa to the country, while the term 'pathway of dispersal' refers to the processes that could facilitate the movement of alien taxa within the country, including taxa that are native to the country, but moved to a part to the country where they are not native, i.e., native-alien populations sensu Nelufule et al. (2022).

Four indicators were used to evaluate the pathways of introduction and dispersal: 1.1. *introduction pathway prominence*; 1.2. *introduction rates*; 1.3. *within-country pathway prominence*; and 1.4. *within-country dispersal rates*. A high-level indicator (1. *rate of unregulated introduction of new species*) was also evaluated. *Introduction* and *within-country pathway prominence* consider the introduction opportunities made available through the pathways of introduction and dispersal (how active the pathways are socioeconomically), but do not consider the extent to which these opportunities result in introductions. *Introduction rates* considers the importance of each of the pathways for the introduction of new alien organisms, and *within-country dispersal rates* considers the importance of each of the pathways of dispersal for alien organisms and native-alien populations. The high-level indicator assesses the total number of new taxa accidentally or illegally introduced each year (as opposed to *introduction rates*, which assesses the number of alien taxa introduced through each pathway over all time).

S1.2 Updates since the last report

The data used to estimate the indicators were updated by consulting the literature and experts, and obtaining data from the databases of national and international entities. The workflow for the indicator *introduction pathway prominence* has been updated to improve the code, ensure that all links and processes are up to date, and to automate input data collection for the pathways for which data are obtained from the FAOstat and Comtrade databases (Appendix 2: '*Introduction pathway prominence'*). A workflow to check sources for new introductions and process these data has been developed (Appendix 2: '*Workflow to check sources for new introductions*'). This workflow informs the high-level indicator *rate of unregulated introduction of new species*, amongst others. The taxon level data on introduction pathways is available in Appendix 4, but 70% of these data were added to the list of alien taxa (Appendix 6) for the third report (SANBI and CIB, 2023).

S1.3 Estimation of *introduction pathway prominence*

Transport and trade drive alien species introductions. Socio-economic data (e.g., on ship or aircraft arrivals, or the volume of imported goods) can thus be used to estimate the opportunities available for introductions (Hulme 2021).

South Africa has 71 official ports of entry: eight maritime ports, ten airports and 53 land border posts (Figure 4.3). People, goods, and transport vessels enter the country through these ports of entry, providing many opportunities for the introduction of alien taxa. In the previous reports socio-economic information collected from a wide range of sources was used by an expert to classify the size of the pathways into five categories of *introduction pathway prominence*. For this report, the datasets consulted in the previous reports were re-examined to determine if the data had been updated, and these updated datasets, as well as other recently published socio-economic data, were used to estimate *introduction pathway prominence* (Appendix 5). Confidence in the overall assessment as well as that for each pathway was estimated (see Appendix 5 and Table S1.6). The expert that classified the data for the previous reports classified the data for this report. If no new data were collected for a pathway, *introduction pathway prominence* was rated as in the previous report, and confidence was rated as 'Low'. If new data were collected these data were compared to those obtained for the previous report to determine if a change in the assessment was required (specifically the percentage change, the new values, and the values for the different pathways were considered). Appendix 5 provides the socio-economic data used to assess *introduction pathway prominence*, as well as the ratings for each pathway, and below are graphical representations of some of the data used in the assessment. See Table S1.6 for a summary of the values for the indicator for this and the previous report, and Table S1.1 for a summary of changes to the indicator.

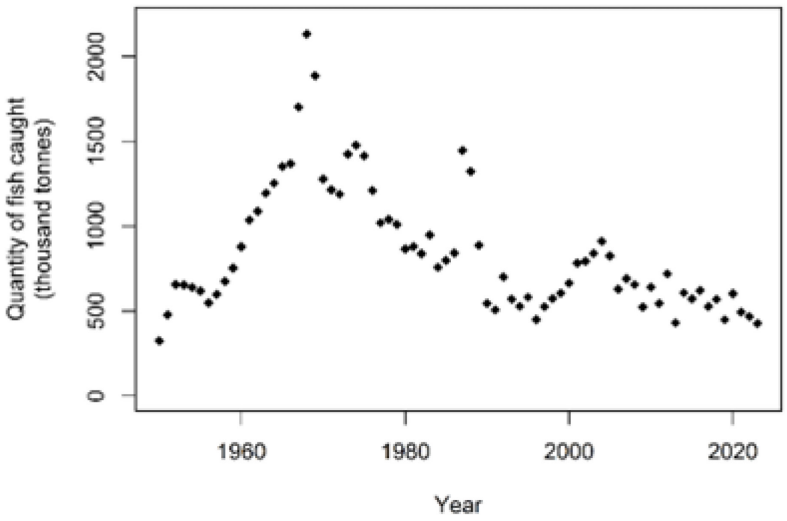


Figure S1.1 The quantity of freshwater and marine fish caught in South Africa (1950–2023)
These data were used to assess the *introduction pathway prominence* of the fishing pathway. Overall, there has been a decline over time, but recently there have been small fluctuations, with a small decline (~14%) between 2021 and 2023. Therefore, the assessment stayed the same ('Moderate'). Data were obtained from the FishstatJ database of the Food and Agricultural Organization of the United Nations (FAO 2025b).

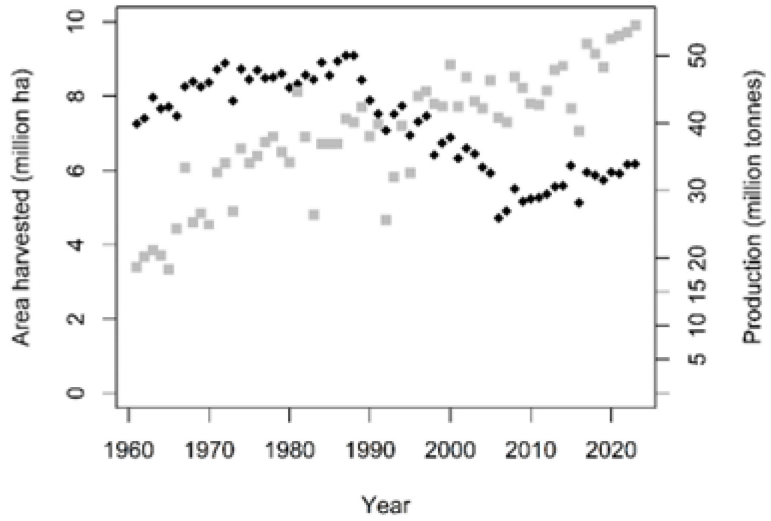
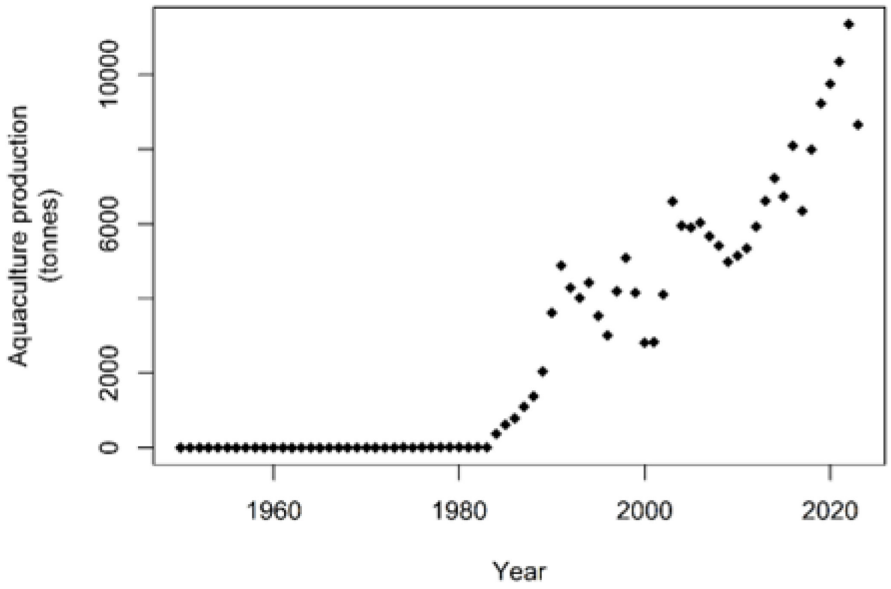
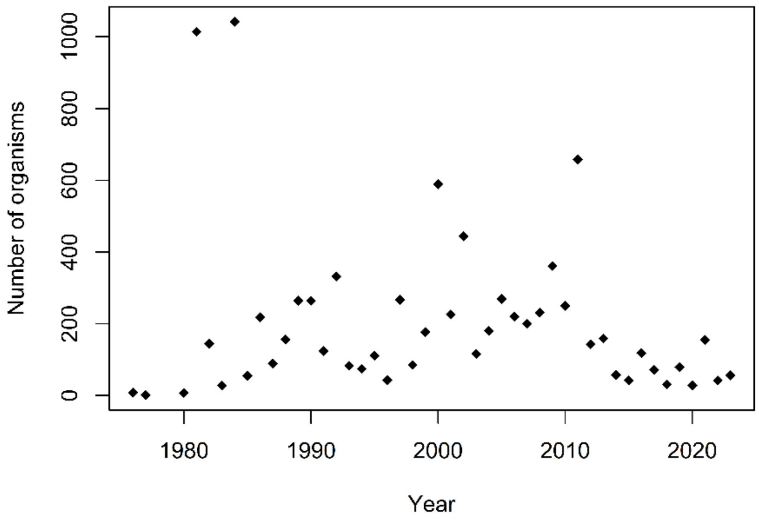


Figure S1.2 The area of crops harvested (in black) and crop production (in grey) in South Africa (1961-2023)
These data were used to assess the *introduction pathway prominence* of the agriculture pathway, and provide an indication of the size of this activity, and thus the introduction opportunities that the activity might result in. The area of crops harvested has declined since the early 1990s, but crop production has increased, with little (~3% increase) recent change (production in 2021 vs 2023) to crop production. Therefore, there was no change to the qualitative assessment for this pathway. Data were obtained from the Food and Agricultural Organization of the United Nations (FAO 2025a).



425

426 **Figure S1.3 Aquaculture production in South Africa (1950-2023)**
427 These data were used to assess the *introduction pathway prominence* of the aquaculture pathway. Aquaculture
428 production has seen recent increases (~40% increase in production 2016 vs. 2022) and the assessment for this
429 pathway was increased from 'Minor' to 'Moderate'. In 2023, there was a decline in production of 16% (in
430 comparison to 2021), however, as this may represent a short-term, temporary decline, the assessment was
431 retained. Data were obtained from the FishstatJ database of the Food and Agricultural Organization of the
432 United Nations (FAO 2025b).
433



434 **Figure S1.4 The number of organisms imported into South Africa for botanical garden or zoo purposes (1976-**
435 **2023)**
436 These data were used to assess the *introduction pathway prominence* of the botanical gardens and zoos
437 pathway. There was a 100% increase in the number imported (2020 vs 2023), but these numbers are in the range
438 of previous values, and so the assessment did not change. Data were obtained from the CITES trade database
439 (UNEP World Conservation Monitoring Centre 2025).

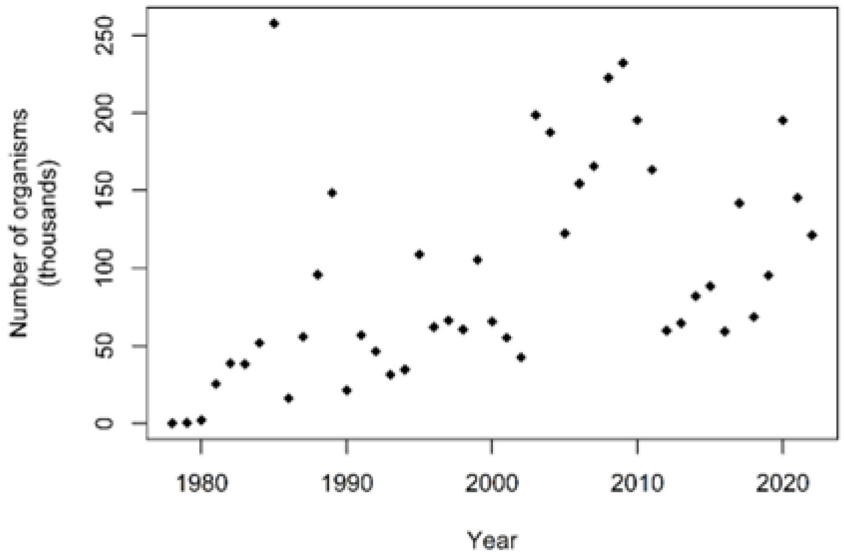


Figure S1.5 The number of organisms imported into South Africa for personal or commercial purposes (1978-2022)

These data were used to assess the *introduction pathway prominence* of the pet pathway. There was a 38% decrease in the number imported (2020 vs 2022), but the numbers are in the range of previous values, and so the assessment did not change. Data were obtained from the CITES trade database (UNEP World Conservation Monitoring Centre 2025).

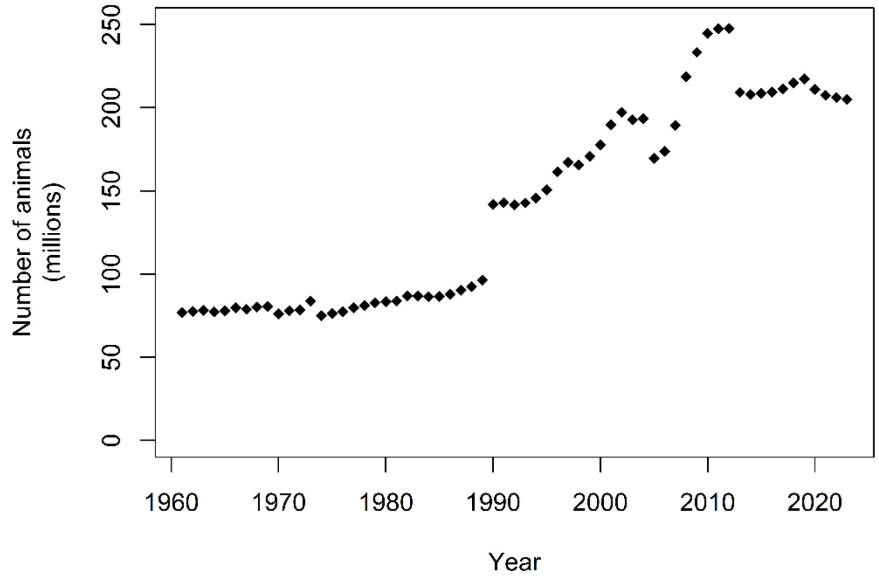
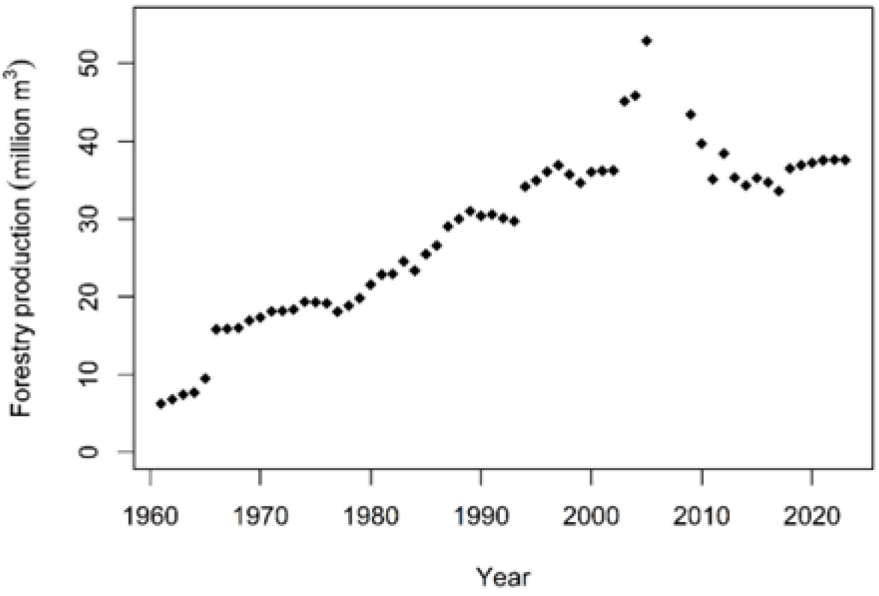


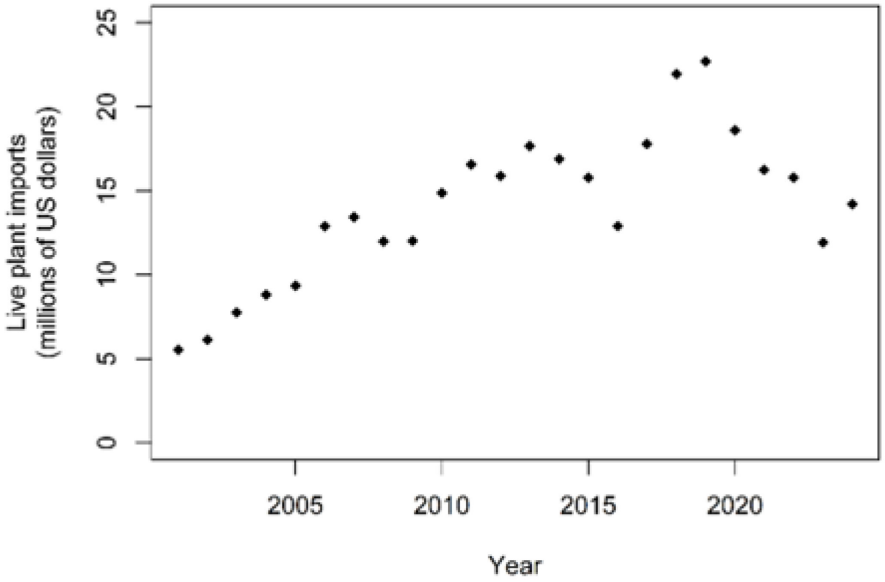
Figure S1.6 The number of animals farmed in South Africa (1961-2023)

These data were used to assess the *introduction pathway prominence* of the farmed animals pathway. In general, the number of animals farmed has increased over time, but recently there has been very little (~1% decrease in 2021 vs 2023) change, and so there was no change to the qualitative assessment for this pathway. Data were obtained from the Food and Agricultural Organization of the United Nations (FAO 2025a).



454

455 **Figure S1.7 Forestry production in South Africa (1961-2023)**
456 These data were used to assess the *introduction pathway prominence* of the forestry pathway. Forestry
457 production has declined since it peaked in 2006, but there has been little, recent change, with a ~0.1% increase
458 in forestry production between 2021 and 2023. Therefore, there was no change to the qualitative assessment
459 for this pathway. Data were obtained from the Food and Agricultural Organization of the United Nations (FAO
460 2025a).



461
462 **Figure S1.8 The value of live plant imports to South Africa (2001–2024)**
463 These data were used to assess the *introduction pathway prominence* of the horticulture, ornamental, nursery
464 material contaminant, contaminant of plants, and parasite of plants pathways. Recent values are close to those
465 reported in previous reports. There was no change to the qualitative assessment for this pathway — it has been
466 rated as 'Moderate' for all reports. Data were obtained from the United Nations Comtrade database (UN-
467 Comtrade 2025). Values were converted to 2017 US dollars.
468

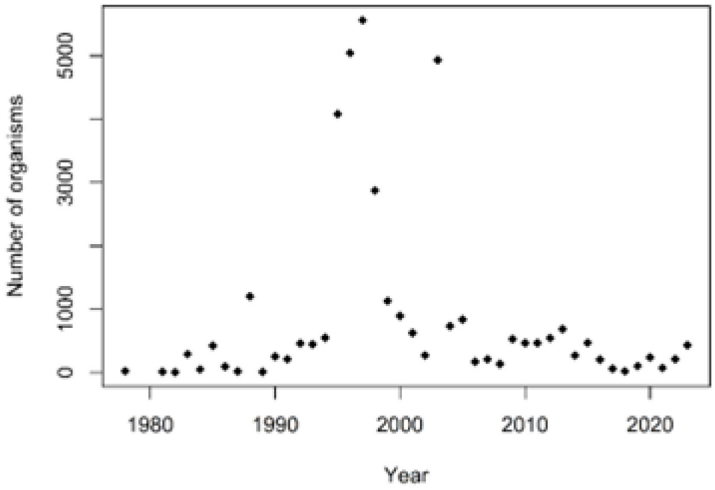


Figure S1.9 The number of organisms imported into South Africa for scientific or breeding purposes (1978-2023)

These data were used to assess the *introduction pathway prominence* of the research pathway. There was a 79% increase in the number of imported organisms (2020 vs 2023), but the numbers are in the range of previous values, and so the assessment did not change. Data were obtained from the CITES trade database (UNEP World Conservation Monitoring Centre 2025).

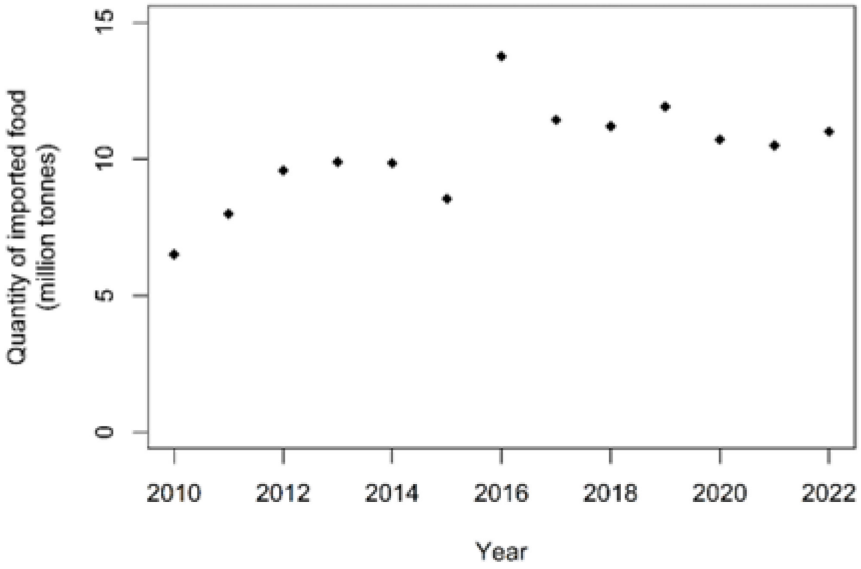


Figure S1.10 The quantity of food imported into South Africa (2010-2022)

These data were used to assess the *introduction pathway prominence* of the food contaminant pathway. There was a recent, small increase of ~3% (imports in 2020 vs 2022), but the assessment was changed from 'Moderate' to 'Major'. This change was due to changes to the baseline. Data were obtained from the Food and Agricultural Organization of the United Nations (FAO 2025a).

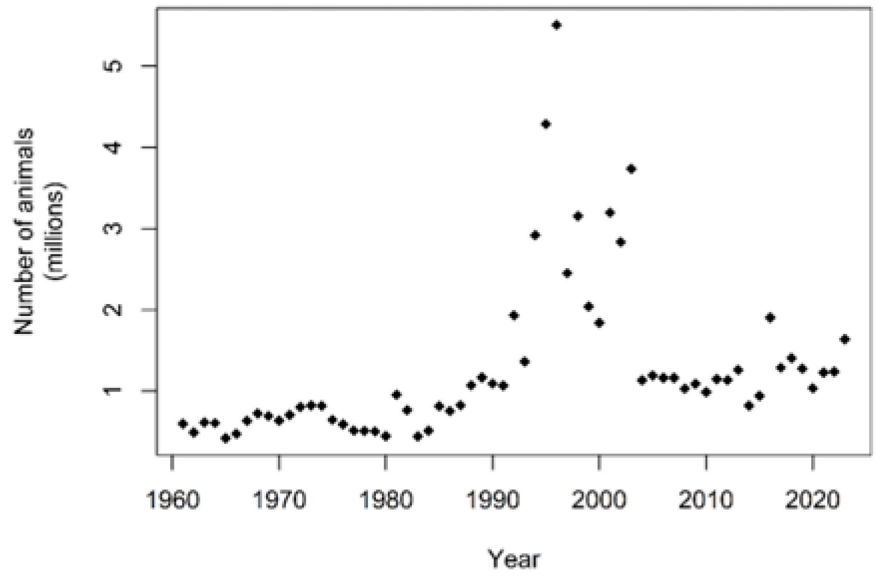


Figure S1.11 The number of animals imported into South Africa (1961-2023)

These data were used to assess the *introduction pathway prominence* of the contaminant of animals and parasite of animals pathways. There was no change to the qualitative assessments for these pathways, as while there was a 33% increase in imports between 2021 and 2023, the values were comparable to those reported in previous reports. Data were obtained from the Food and Agricultural Organization of the United Nations (FAO 2025a).

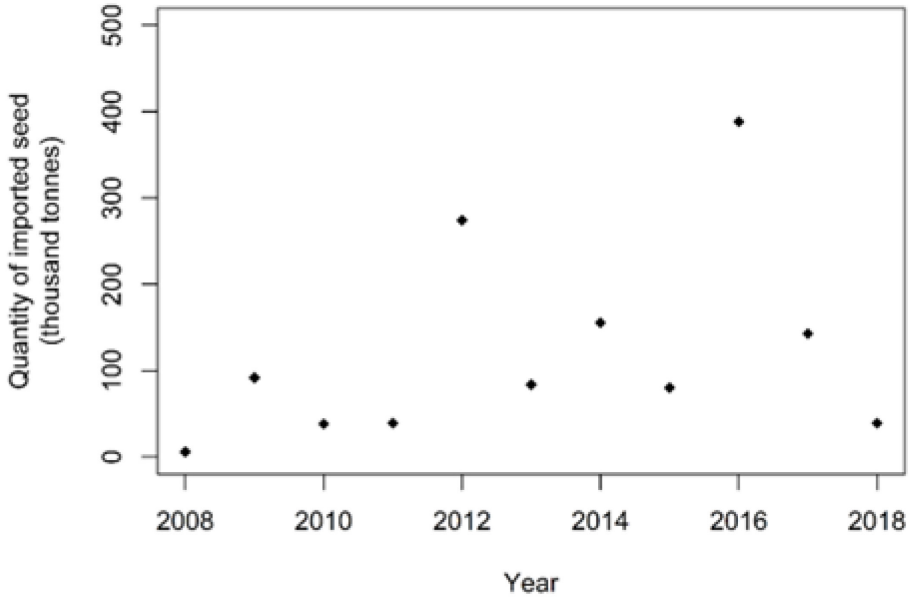


Figure S1.12 The volume of agronomic seeds imported into South Africa (2008-2018)

These data were used to assess the *introduction pathway prominence* of the seed contaminant pathway. No update from the previous report. Therefore, no change to the qualitative assessment for this pathway. Data were obtained from the South African Department of Agriculture Forestry and Fisheries (DALRRD 2020).

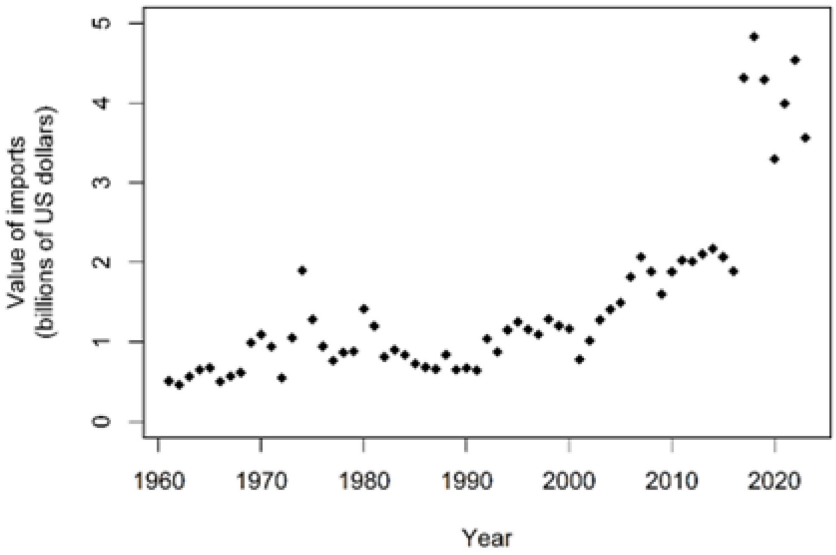


Figure S1.13 The value of forestry products imported into South Africa (1961-2023)
These data were used to assess the *introduction pathway prominence* of the timber trade contaminant pathway. The value of forestry products imported increased steadily for many years and more rapidly since 2017, but recently there was a decrease (imports in 2022 vs 2023) of ~22%. There was no change to the qualitative assessment, as this pathway still provides 'Major' opportunities for introductions. Data were obtained from the Food and Agricultural Organization of the United Nations (FAO 2025a) and were converted to 2017 US dollars.

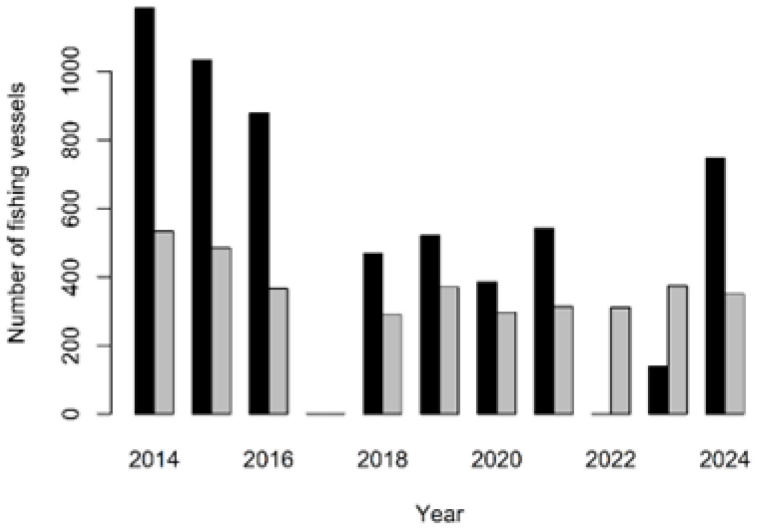


Figure S1.14 The number of South African (in black) and foreign (in grey) fishing vessels visiting South African ports (2014-2024)
These data were used to assess the *introduction pathway prominence* of the fishing equipment pathway. In 2024 there were 1096 fishing vessels in South African waters, in comparison to 855 vessels in 2021, this represents an increase of ~28%. There was no change to the qualitative assessment ('Moderate'), as the values are similar to previous values. These data were obtained from the Transnet National Ports Authority (2017, 2019, 2023, 2025). Data for 2017 were not obtained, and no data for South African vessels were obtained for 2022.

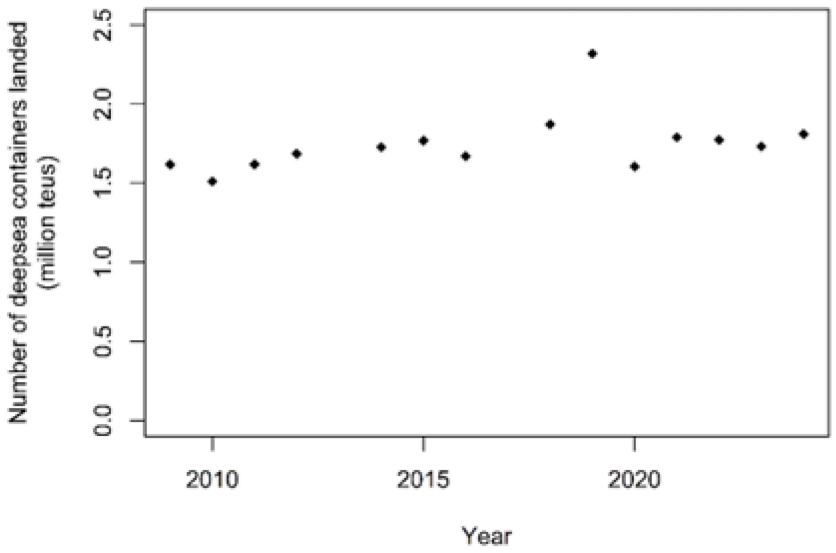


Figure S1.15 The number of deep sea containers landed at South African ports (2009-2024)
These data were used to assess the *introduction pathway prominence* of the container and bulk cargo pathway. There was a recent (data for 2022 vs 2024), slight increase (of ~2%) in the number of containers landed, and the assessment was retained as 'Major'. These data were obtained from the Transnet National Ports Authority (2017, 2019, 2023, 2025). Data for 2017 were not obtained.

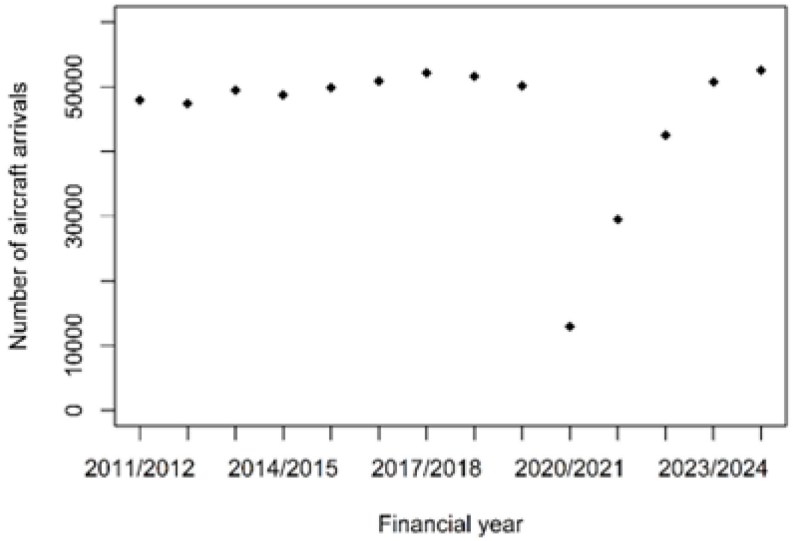


Figure S1.16 The number of scheduled aircraft arriving in South Africa from international and regional destinations each financial year from 2011/2012 to 2024/2025
These data were used to assess the *introduction pathway prominence* of the airplane pathway. The number of aircraft remained consistent up until the 2020/2021 financial year, and then declined, due to the travel restrictions related to COVID-19. Numbers have returned to pre-pandemic levels, and there was no change to the qualitative assessment for this pathway, as it still provides 'Moderate' opportunities for introductions. These data were obtained from Airports Company South Africa (2025). The South African financial year starts on 1 April and ends on 31 March.

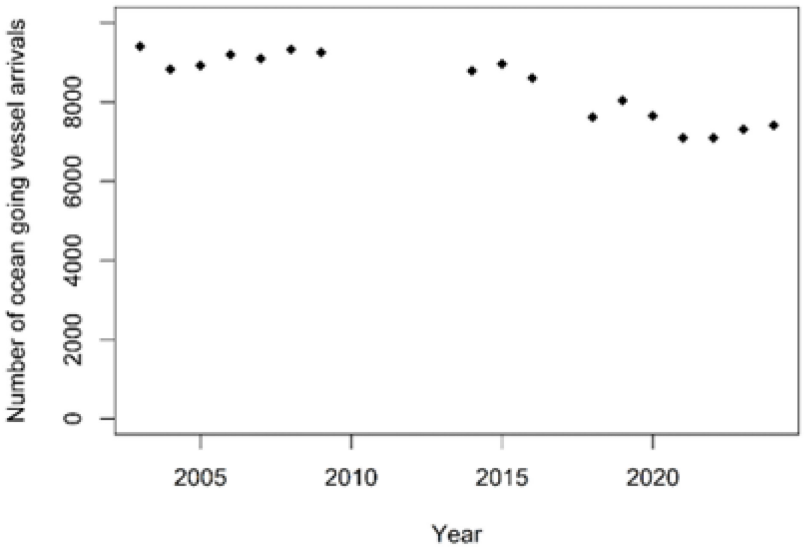


Figure S1.17 The number of ocean-going vessels arriving at South African ports (2003-2024)
These data were used to assess the *introduction pathway prominence* of the ship excluding ballast water or hull fouling, hull fouling, and ballast water pathways. The number of vessels declined slightly in the years since 2005, but recently increased by ~5% (data for 2022 vs 2024), and so there was no change to the qualitative assessments for these pathways. These data were obtained from Transnet National Ports Authority (2017, 2019, 2023, 2025), and do not include the fishing vessel data presented in Figure S1.14. Data for 2010-2012 and 2017 were not obtained.

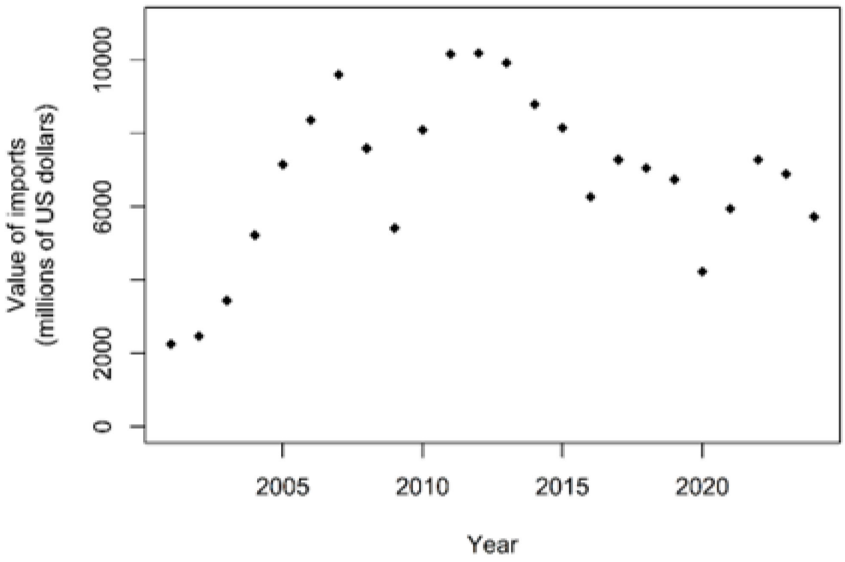
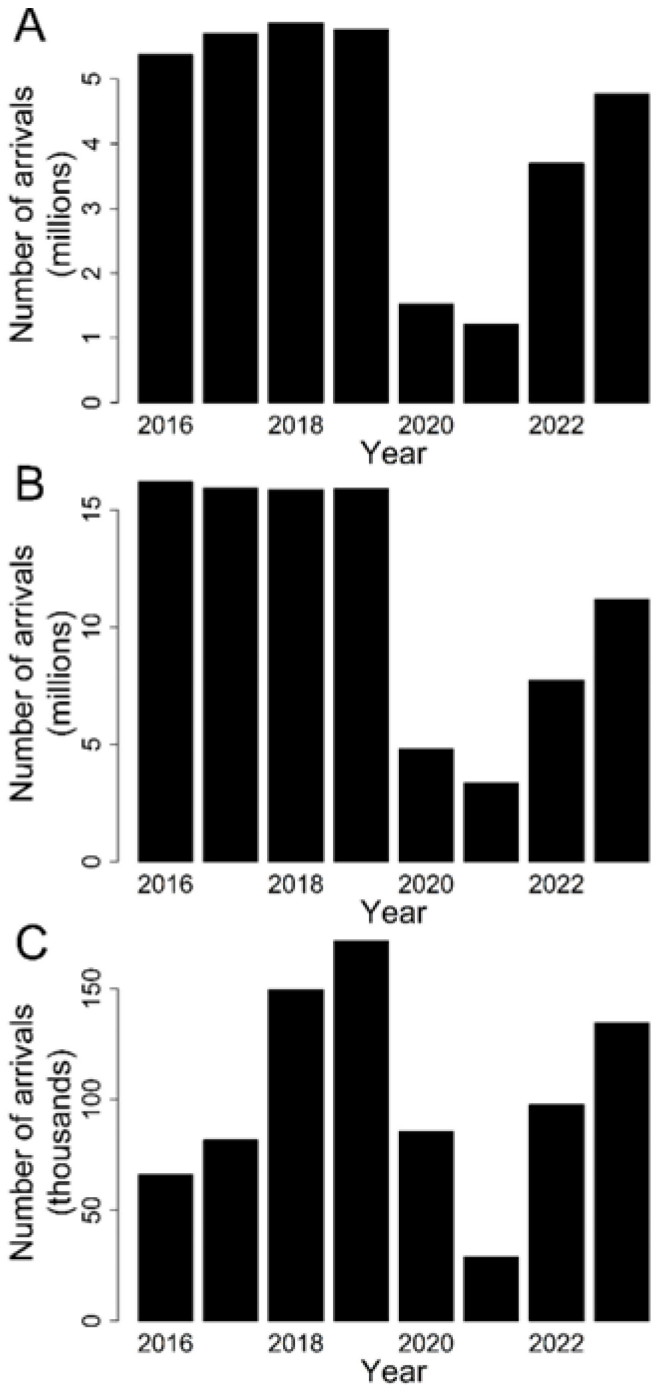


Figure S1.18 The value of vehicles imported into South Africa (2001-2024)
These data were used to assess the *introduction pathway prominence* of the machines and equipment pathway. The decline in 2020 and more recent resurgence was likely a result of events surrounding COVID-19, and although there was a 21% decline in the value of vehicle imports (2022 vs 2024), the assessment did not change as the values are in the range of previous values. Data were obtained from the United Nations Comtrade database (UN-Comtrade 2025). Values have been converted to 2017 US dollars.



542
543 **Figure S1.19 The number of people arriving in South Africa by (A) air, (B) road and (C) sea transport (2016-**
544 **2023)**
545 These data were used to assess the *introduction pathway prominence* of the people and luggage, and land
546 vehicles pathways. The number of people entering South Africa has increased after the major declines in 2020
547 and 2021 due to travel restrictions related to COVID-19, with the total numbers increasing by ~39% over recent
548 years (data for 2022 vs 2023), and the number entering via road transport increasing by 44%. The numbers for
549 2023 (~ 16 million people) were not yet back to pre-COVID levels (~21 million people). These pathways provide
550 'Major' opportunities for introductions, with no change to this assessment. Data were obtained from Statistics
551 South Africa (2025).
552

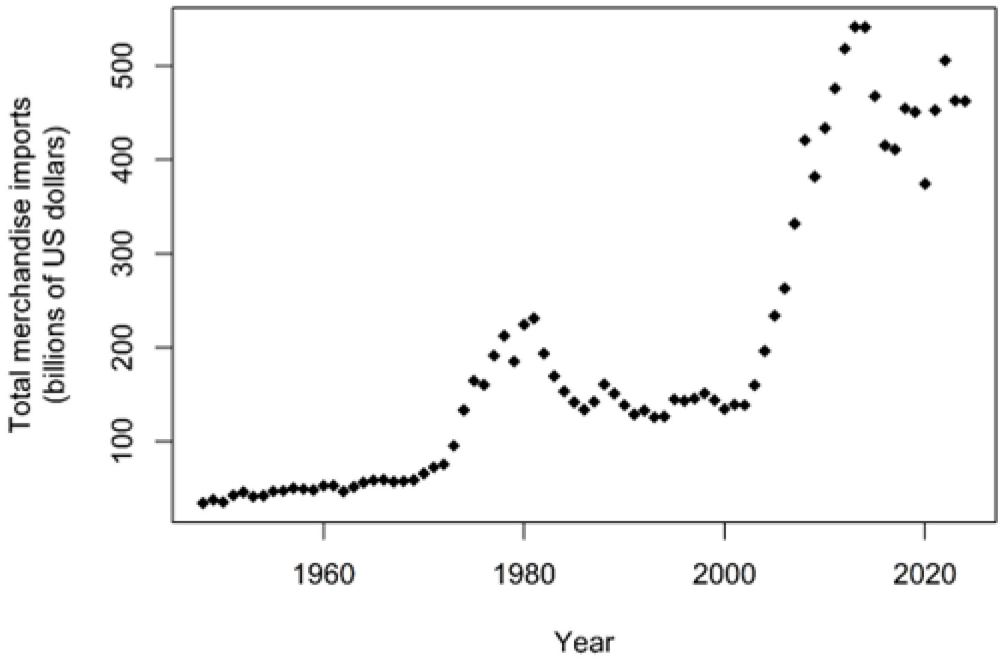


Figure S1.20 The value of merchandise imports to mainland African countries, excluding South Africa (1948-2024)

These data give an indication of the amount of goods, and transport vessels entering other African countries, and thus the opportunities for introductions to these countries. As these introduction opportunities would translate into opportunities for alien organisms to spread naturally into South African these data were used to assess the *introduction pathway prominence* of the unaided pathway. There was a recent (data for 2022 vs 2024), small decrease (~8%) in the value of merchandise imports, and so there was no change to the qualitative assessment for this pathway. Data were obtained from the World Trade Organisation (2025). Values were converted to 2017 US dollars.

S1.4 Changes made to *introduction pathway prominence*

Changes to *introduction pathway prominence* were tracked using the process detailed in Table S0.1. See Table S1.1 for a summary of the types of changes that were made. For 42 pathways there was no change to *introduction pathway prominence* - for 17 of these pathways, no new data were collected; for nine pathways, new data supported the previous assessment; and for 16 pathways the new data changed something that did not affect the assessment (e.g., confidence levels). For one pathway, an error was made in the calculations in the third report (SANBI and CIB, 2023); this error has been corrected, but the change in the values did not impact the assessment (*introduction pathway prominence* for this pathway did not change). For one pathway, new data resulted in the baseline being revised. Therefore, there were no changes to the indicator due to data collected since the third report (i.e., no 'true' change to *introduction pathway prominence* for any pathway).

Table S1.1 A summary of the type of changes made to the data for the indicator *introduction pathway prominence* for South Africa (2023–2025)

Reason for difference	Number of changes
Data were collected in the third report but these are not relevant for the fourth report	1
Data were collected in the third report but need to be reinterpreted for the fourth report	1
Data were collected in the third report but there was no change in the values for the fourth report	42
Data collected for the fourth report indicate the value has changed since the third report	0
Data collected for the fourth report where no data were available in the third report	0
Grand Total	**44**

S1.5 Estimation of *introduction rates*

For this report updates of the datasets used in the previous reports, when available, and information from the literature were used to update the data. Experts were contacted to obtain updates of datasets previously utilised. Papers, books and reports published in 2023, 2024, and 2025 were used to update the data, and in some cases literature or information from experts from before 2023 was used to fill data gaps. See Appendix 4 for full details of the sources used.

As in the previous report, and to align with Darwin Core terms (dwc: pathway), the introduction pathways were classified using the framework proposed by the CBD (CBD 2014) without the structural changes implemented by Harrower et al. (2018). The CBD framework comprises six main categories and 44 sub-categories (CBD 2014). The guidelines for the CBD framework produced by Harrower et al. (2018) were followed when making classifications, and confidence in these classifications was estimated using the method outlined in Appendix 8. This method is based on the recommendations of Harrower et al. (2018), and was that used in the previous report. All changes made to the data are presented in Table S1.2.

As in the previous reports the earliest date of introduction/first record was used in instances where multiple introduction events occurred or if, due to uncertainty, a period of time was given. Confidence in date of first record was estimated for each taxon using the method detailed in Appendix 8. This is the same method used in the previous report (SANBI and CIB 2023).

As in the previous reports, taxa introduced through more than one pathway were assigned to multiple pathway categories, and consequently the number of taxa across the pathways is greater than the total number of taxa included in the analysis. Excluded from the analysis were hybrid taxa, dubious records [e.g., the mollusc *Vertigo antivertigo* which has only been found as a subfossil (Herbert 2010)], taxa that have not yet escaped or been released from confinement, and those whose native range extends into South Africa (native-alien populations). Taxa for which the native range is uncertain were excluded unless currently believed to be alien to the whole of South Africa. Taxa which were listed as

603 alien but for which no information on native range was provided were assumed to be alien and were
604 included in the analyses. Note that for records added for the previous report and onwards, nativity
605 was checked in the literature.

606 Appendices 4 and 5 provide the data used to assess *introduction rates* and estimates of confidence,
607 and Table S1.6 provides a summary of the values for the indicator for this and the previous report.

608 **S1.6 Changes made to *introduction rates***

609 Changes to *introduction rates* were tracked using the process detailed in Table S0.1. See Table S1.2 for
610 a summary of the types of changes made, and Table S1.3 for details on how these changes influenced
611 the indicator. For the majority of the taxa (2258 taxa), there was no change to the pathways previously
612 reported (Table S1.2), but for 119 taxa, new data were collected that led to a change in the indicator.
613 For 108 of these taxa, either the data that led to the change were available before the production of
614 the previous report, but were not included in that report, or the taxon had been recorded before the
615 production of the previous report, but this information has only become available subsequently. These
616 changes were considered when calculating a revised baseline. Eleven new taxa were recorded since
617 December 2022, these introductions were regarded as a genuine change. In addition, a new biocontrol
618 agent was released after December 2022, but this release was reported erroneously in the previous
619 report. This error was corrected (i.e., the baseline was revised). For one other taxon, an error was
620 corrected, and for 4 taxa the new data resulted in changes (e.g., to confidence) that did not impact
621 the indicator.

622 Notably, for 9 of the 16 pathways for which new introductions have been recorded, all the 'new'
623 introductions were recorded prior to 2023—forestry; live food or bait; ornamental plants; pets; public
624 gardens, zoos or aquaria; contaminants of animals; contaminants of plants; timber trade contaminant;
625 packing material stowaway. This highlights the delay between introductions, and records reporting of
626 those introductions.

627 **Table S1.2 A summary of the type of changes made to the data for the indicator *introduction rates* for South**
628 **Africa, 2023–2025.**

Reason for difference	Number of changes
Data were collected in the third report but these are not relevant for the fourth report	2
Data were collected in the third report but need to be reinterpreted for the fourth report	0
Data were collected in the third report but there was no change in the values for the fourth report	2258
Data collected for the fourth report indicate the value has changed since the third report	119
Data collected for the fourth report where no data were available in the third report	0
Grand Total	**2379**

629

Table S1.3 Details of how the changes made to the data for *introduction rates* have influenced the indicator. Presented are the *introduction rates* (i.e., number of taxa introduced through the pathways over all time) as reported in the previous report, and the revised baseline due to the incorporation of data that were available in 2022 or earlier, or introductions that occurred before December 2022, but for which the data were not available for the previous report. Also presented are the *introduction rates* for the pathways presented in this report based on changes to *introduction rates* since December 2022, as calculated based on the revised baseline. The values given for biological control include the agents released against invasive plants up until the end of 2025, and agents released against invertebrate pests up until 2008 (were included in the previous report). It is the intention that, if data can be accessed, all biocontrol agents will be reported in future (with the appropriate revised baseline).

Pathway of Introduction		*Introduction rates* reported as of Dec 2022 (SANBI and CIB 2023)	Revised baseline	*Introduction rates* reported in this report	Change
Release	Biological control	278	277	281	4
	Stabilisation and barriers	95	90	90	0
	Fishery in wild	17	17	17	0
	Hunting	34	34	34	0
	Aesthetic release	10	10	10	0
	Conservation in wild	3	3	3	0
	Release for use	9	9	9	0
	Other release	0	0	0	0
Escape	Agriculture	113	113	113	0
	Aquaculture	15	15	15	0
	Botanical gardens & zoos	5	8	8	0
	Pet	56	114	114	0
	Farmed animals	16	16	16	0
	Forestry	39	41	41	0
	Fur farms	1	1	1	0
	Horticulture	301	297	297	0
	Ornamental	277	275	275	0
	Research	21	22	22	0
	Live food and live bait	2	3	3	0
	Other escape	1	1	1	0
Contaminant	Nursery material contaminant	14	14	15	1
	Bait contaminant	15	15	15	0
	Food contaminant	15	15	15	0
	Contaminant of animals	9	13	13	0
	Parasite of animals	36	36	36	0
	Contaminant of plants	26	30	30	0
	Parasite of plants	30	36	41	5
	Seed contaminant	40	46	47	1
	Timber trade contaminant	14	41	41	0
	Habitat material contaminant	6	6	6	0
Stowaway	Fishing equipment	0	0	0	0
	Container & bulk cargo	13	13	13	0
	Airplane	3	3	3	0
	Ship excluding ballast water or hull fouling	26	26	26	0
	Machinery & equipment	1	1	1	0
	People & luggage	0	0	2	2
	Packing material	4	23	23	0
	Ballast water	62	61	62	1
	Hull fouling	79	79	80	1
	Land vehicles	1	1	1	0
	Other stowaway	2	2	2	0
Corridor	Canals & artificial waterways	0	0	0	0
	Tunnels &bridges	0	0	0	0
Unaided	Natural dispersal	15	15	15	0

S1.7 Estimation of *within-country pathway prominence*

In the previous reports, *within-country pathway prominence* was not assessed as socio-economic data related to the pathways of dispersal could only be obtained for a few pathways. This was again the case. See Appendix 5 and below for the data that were collected, and Table S1.6 for a summary of the values for the indicator for this and the previous reports.

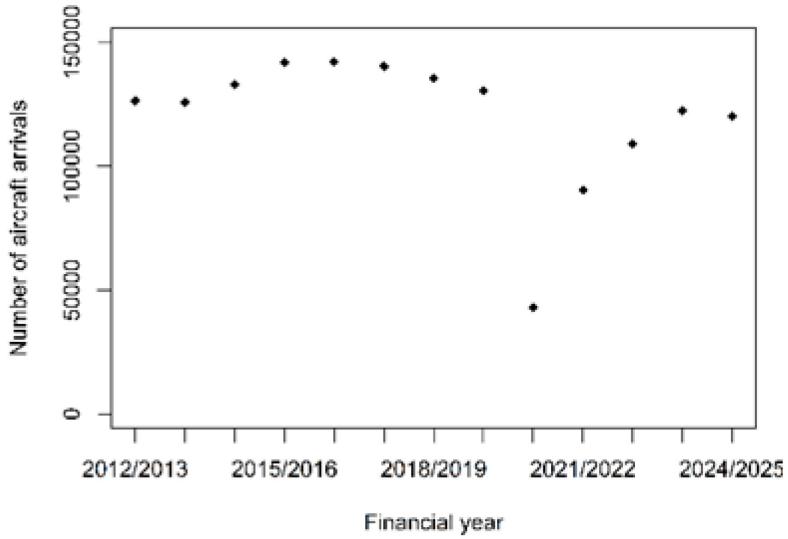


Figure S1.21 The total number of scheduled aircraft arriving at South African airports from domestic destinations every financial year from 2012/2013 to 2024/2025

These data were collected for the airplane pathway. The controls put in place to prevent the spread of COVID-19 caused a massive decline in the 2020/2021 financial year, but in 2021/2022 the numbers had begun to recover and by 2023/2024 the number of arrivals was comparable to that before the pandemic. These data were obtained from Airports Company South Africa (2025). The South African financial year starts on 1 April and ends on 31 March.

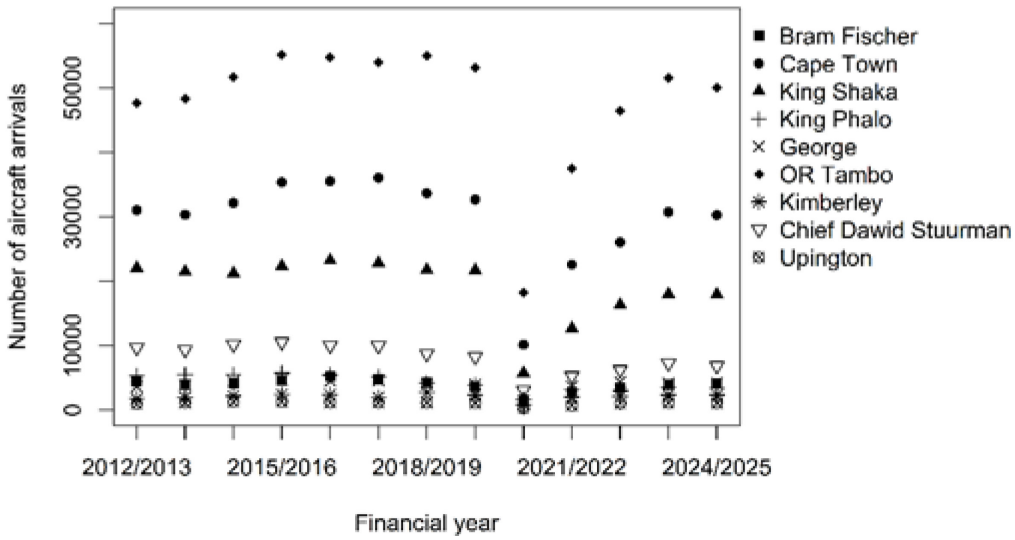


Figure S1.22 The number of scheduled aircraft arriving at each major South African airport from domestic destinations every financial year from 2012/2013–2024/2025

These data were collected for the airplane pathway. Lanseria International airport is not included (as a private airport it is not part of ACSA), but it has the fourth highest passenger numbers. These data were obtained from Airports Company South Africa (2025). The South African financial year starts on 1 April and ends on 31 March.

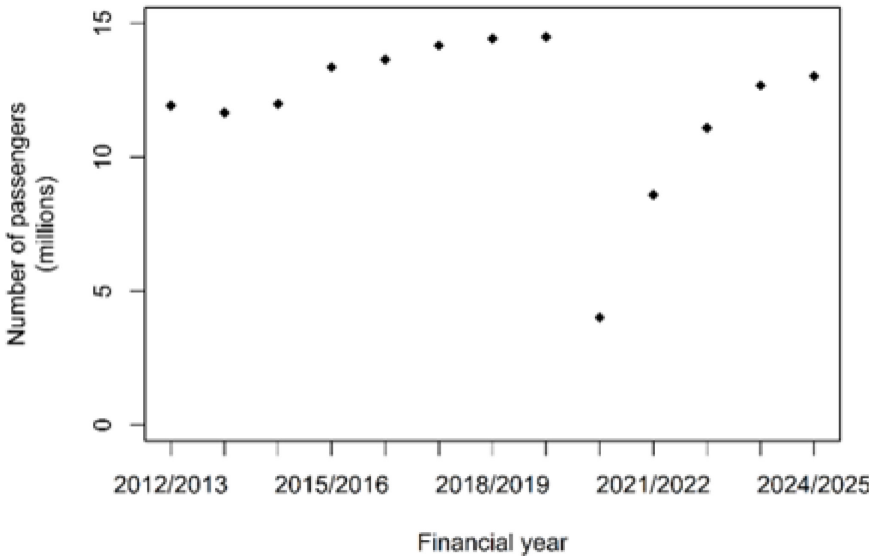


Figure S1.23 The number of passengers arriving at South African airports from domestic destinations every financial year from 2012/2013–2024/2025

These data were collected for the people and luggage pathway. The number of people traveling between South African airports declined (decreased by 23%; data for 2022/2023 vs 2019/2020), due to the controls put in place to prevent the spread of COVID-19, and the numbers have subsequently recovered and are comparable to those before the pandemic. These data were obtained from Airports Company South Africa (2025). The South African financial year starts on 1 April and ends on 31 March.

S1.8 Estimation of *within-country dispersal rates*

As in the previous reports, data on *within-country dispersal rates* has not yet been collated country-wide for taxa that are alien to the country. Therefore, *within-country dispersal rates* was not assessed. See Appendix 5 for the data that were collated through a review of the literature published between January 2023 and December 2025 and Table S1.6 for a summary of the values for the indicator for this and the previous reports.

S1.9 Estimation of high-level indicator—*rate of unregulated introduction of new species*

There were 40 known unregulated introductions of new taxa to South Africa between 2016 and 2025, an average of four per year (Figure 1.2B in the main report).

The data used to determine *introduction rates* were used to calculate the number of unregulated introductions of new taxa introduced to South Africa each year during the last decade. The average rate of introduction for the decade was calculated. This indicator includes all known new alien taxa introduced to South Africa in the last decade, except biological control agents. See Table S1.6 for a summary of the values for the indicator for this and the previous report. Changes to the high-level indicator were tracked using the process detailed in Table S0.1. See Table S1.5 for a summary of the types of changes made. For the majority of taxa (2261 taxa), there was no change to the date of first record (Table S1.5), but for 116 taxa, new data were collected that led to a change in the indicator.

For 105 of these taxa, either the data that led to the change were available before the production of the previous report, but were not included in that report, or the taxon had been recorded before the production of the previous report, but this information has only become available subsequently. These changes were considered when calculating a revised baseline. Eleven new taxa were recorded since December 2022, and only these introductions were regarded as a genuine change. For two taxa, an error was corrected, one of these taxa was a biological control agent that was reported in the last report to have been released in 2022, but which was released in 2023, and thus is also a new introduction. These changes were considered when calculating the revised baseline. Important to note that the decade assessed in the previous report (2013-2022) differs from that assessed in this report (2016-2025).

Table S1.5 A summary of the type of changes made to the data for the high-level indicator *rate of unregulated introduction of new species* for South Africa, 2023 – 2025.

Reason for difference	Number of changes
Data were collected in the third report but these are not relevant for the fourth report	2
Data were collected in the third report but need to be reinterpreted for the fourth report	0
Data were collected in the third report but there was no change in the values for the fourth report	2261
Data collected for the fourth report indicate the value has changed since the third report	116
Data collected for the fourth report where no data were available in the third report	0
Grand Total	2379

S1.10 Trends in indicators for pathways

Table S1.6 A summary of the values for the indicators for reporting on the status of the introduction and dispersal pathways in South Africa (2023–2025)
The values presented for the previous report have been revised based on data that were available in 2022 or earlier but that were not included in that report, or for introductions that occurred in 2022 or earlier, but which have been subsequently reported. The high-level indicator *rate of unregulated introduction of new species*, was calculated for the previous report for the period 2013-2022, and for the period 2016-2025 for this report.

Indicator		2022 value (revised baseline)	2025 value	Confidence	Notes
1. *Rate of unregulated introduction of new species*	Number of unregulated introductions of new species per year	4.3 per year	4 per year	Low	The date of introduction is not available for many alien taxa in South Africa. There are also delays between the introduction of a taxon, when it is detected, and the publication of a report of the introduction
1.1 *Introduction pathway prominence*	1.1.1 Five categories demonstrating the size of each pathway	Not known: 7 pathways Pathway not present: 1 pathway Minor: 6 pathways Moderate: 16 pathways Major: 14 pathways	Not known: 7 pathways Pathway not present: 1 pathway Minor: 6 pathways Moderate: 16 pathways Major: 14 pathways	Medium	Evaluation by one expert
1.2. *Introduction rates*	1.2.1. The total number of alien taxa introduced through each pathway over all time	0 taxa: 5 pathways 1 – 50 taxa: 31 pathways 51 – 100 taxa: 3 pathways > 100 taxa: 5 pathways	0 taxa: 4 pathways 1 – 50 taxa: 32 pathways 51 – 100 taxa: 3 pathways > 100 taxa: 5 pathways	Low	Pathway of introduction data are not available or have not been collated for many alien taxa in South Africa
1.3. *Within-country pathway prominence*	1.3.1. Five categories demonstrating the size of each pathway	Data not available	Data not available	Not Applicable	Data were only collected for a few pathways
1.4. *Within-country dispersal rates*	1.4.1. The total number of alien taxa dispersing through each pathway over all time	Data not available	Data not available	Not Applicable	Pathway of dispersal data have not been collated for alien taxa at a country level. Examples were collected for 31 of the 44 pathways. Data for native-alien populations have not been updated yet.

705 **Table S1.7 Current status, confidence, trends, and outlook for pathway indicators**

Indicator	Trend[1]	Confidence	Desired trend	Current status and trend	Outlook
1. *Rate of unregulated introduction of new species*	→	Low	↘	Over the last decade (2016–2025) approximately four new taxa were introduced per year either accidentally or intentionally but illegally. This is similar to previous estimates.	The rate of introduction of unregulated taxa is expected to increase with trade and travel, unless pathways are identified, prioritised, and managed. New approaches to estimate rates of introduction are being developed and trialled internationally for help measure progress towards target 6 of the GBF (McGeoch et al. 2023; Buba et al. 2024; Leihy et al. 2025).
1.1 *Introduction pathway prominence*	→	Medium	not applicable	14 introduction pathways play a Major role socio-economically. There have been no changes to this during the period 2023–2025. Increases for some pathways represent a return to the levels of activity experienced prior to the COVID 19 pandemic	Unless trends in travel and trade are tracked and interventions to respond to such changes are put in place, new harmful alien species will continue to be introduced. If, however, effective biosecurity measures are in place, the new biological invasions caused by increases in travel and trade will be reduced.

[1] → no change; ↗ an increase; ↘ a decrease

Indicator	Trend[1]	Confidence	Desired trend	Current status and trend	Outlook
1.2 *Introduction rates*	→	Low	not applicable (for regulated taxa) ↘ (for unregulated taxa)	For regulated taxa: during 2023–2025, four new taxa were legally introduced for biological control. For unregulated taxa: during 2023–2025, one new taxon was introduced as a nursery material contaminant, one through hull fouling or ballast water, three as parasites on plants; two as either parasites on plants or with people and their luggage; and one as a seed contaminant. However, several taxa introduced and recorded prior to 2023 were reported for the first time during 2023-2025. These taxa were likely introduced through seven different introduction pathways. As such there is no strong evidence that the number of taxa introduced through the different pathways has changed greatly.	In many cases regulated taxa (for which the risks have been analysed and found to be acceptable) are expected to be a net benefit to the country, and in the case of biological control, assist with the control of biological invasions. Stringent processes are in place to minimise the risk that such introductions result in harmful invasions. Unless pathways are identified, prioritised and managed, potentially harmful alien taxa will continue to be accidentally and illegally introduced.
1.3 *Within-country pathway prominence*	not assessed		not applicable	Many pathways are likely playing a role socio-economically within the country, but the extent of this role and how it has changed recently is not known. Within-country activity has returned to pre-pandemic levels, and thus so too have opportunities for alien species to be moved within the country. Several pathways are providing opportunities for alien plant movements, while South Africa's important role breeding animals for the international pet trade is providing opportunities for the movement of animals.	Internal trade and transport are expected to increase over time. Trends in these pathways need to be tracked to ensure interventions are in place where they are needed. If this is not done harmful taxa will continue to spread, native taxa will be introduced to places outside of their native ranges and possibly cause negative impacts, and valuable assets will be put at risk.

Indicator	Trend[1]	Confidence	Desired trend	Current status and trend	Outlook
1.4 *Within-country dispersal rates*	not assessed		not applicable (for regulated taxa) ↘ (for unregulated taxa)	Alien taxa and native-alien populations taxa are dispersing within the country through at least 31 pathways. National-scale data have yet to be collated, but research indicates within-country movement is occurring through natural dispersal (e.g., self-propelled, and mediated by vertebrate vectors), human-mediated dispersal (e.g., with contaminated soil and plants, though biofouling on ships or boats, and the formal and informal plant trade), and through a mix of both mechanisms.	Unless pathways that facilitate the within-country dispersal of taxa are identified, prioritised and managed, the spread of these taxa will increase, and so there will be increases in both the rate of expansion of currently invasive taxa, and in the likelihood that alien taxa will find a suitable part of the country in which to become invasive. Native-alien populations likely differ in their impacts to other alien populations, and to inform pathway management, there is a need to improve our understanding of the extent of this problem, and how these populations are being introduced.

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Supplementary Material to 'Chapter 2: Species'

Background notes

This chapter provides an assessment of alien species that are known to occur in South Africa. It provides an update on the *number and status of alien species* that were published in the previous report. The indicators used are *number and status of alien species* (i.e., whether they are known to be present in South Africa and their stage of invasion); the *extent of alien species* (at national, provincial, biome or other scales); the *abundance of alien species* (in terms of their cover, biomass or population sizes); and the *impact of alien species* (the degree to which alien species have impacts). See Appendix 1 for further details. Data for updating the indicators were obtained from various sources and these include: research papers and reviews, books and academic theses, published following the release of the previous status report; and databases and atlases of alien species occurring in the country.

S2.1 *Number and status of alien species*

The species was recently revised (see Zengeya et al. 2025) and now includes 6198 taxa, of which there is evidence that 3825 taxa are present, the presence of 1642 taxa is doubtful and 714 taxa are recorded as absent (Table S2.2). Over half of the taxa that are present are plants (2315 taxa), confirming the assertion that South Africa is a hotspot for plant invasions. Only a few of the taxa that are present were assessed as cryptogenic (28 taxa), or are native to some part of South Africa (257 taxa). Taxa that were assessed as absent were mostly animals (310 invertebrates and 165 vertebrates) and plants (211 taxa). Most of these taxa are either biocontrol agents that were released to control invasive plants but that did not establish, taxa listed as prohibited in at least one version of NEM:BA A&IS Lists, or are taxa included in previous status reports but there is no evidence that they are present. Doubtful taxa were mostly plants (1289 taxa) (presumed to be in cultivation, but there is uncertainty if they are present). A fraction (13%) of the taxa that are present are listed under the NEM:BA A&IS Regulations of 2020. These are mostly plants (366 taxa) and animals (122 taxa). Some of the listed taxa were assessed as either absent (14 taxa) or their occurrence is doubtful (58 taxa).

Table S2.1. The number and occurrence status of alien taxa in South Africa as of December 2022.
Regulatory listing is as per the NEM:BA A&IS Regulations of 2020 and is grouped in two categories using the following descriptors: Listed—taxa listed under various categories ('1a', '1b', '2', '3', and 'context-specific'); 2) Not listed—taxa that are not currently listed; and 3) Uncertain—for taxa where it is uncertain if they are listed or not (e.g., the identity of the taxon is at a higher level than the regulatory listing). Occurrence status was grouped into four categories using the following descriptors: 1) absent—a reasoned analysis of the evidence suggests the taxon is not present in South Africa; 2) present—there is evidence to document the presence of the taxon in South Africa as of December 2025; 3) doubtful—there is some evidence of the taxa having been present in South Africa, but there is doubt over the evidence or whether it is still present, including taxonomic or geographic imprecision in the records; and 4) not evaluated (NE)—there was no specific attempt to ascertain if the taxon is present in (or has been present in) South Africa as part of compiling the list. *Incertae sedis* refers to taxa whose broad taxonomic relationships are unknown or undefined.

Taxa	Regulatory listing	Occurrence status			
		absent	doubtful	present	NE
Animalia	Listed	11	39	122	3
	Not listed	464	304	1263	1
	Uncertain	0	0	2	0
Bacteria	Listed	0	0	0	0
	Not listed	0	0	4	0
Chromista	Listed	3	0	1	0
	Not listed	3	0	12	0
Fungi	Listed	0	2	2	0
	Not listed	20	4	103	0
Incertae sedis	Listed	0	0	0	0
	Not listed	1	0	0	0
Plants	Listed	0	17	366	13
	Not listed	211	1276	1948	12
	Uncertain	0	0	1	1
Protozoa	Listed	0	0	1	0
	Not listed	1	0	0	0
	Total	714	1642	3825	17

The list of alien species in South Africa is the result of a process to consolidate and standardise information on the presence of alien species in South Africa from various sources. Some of these sources are maintained by their respective authors, but others are static one-off publications. These sources record the presence of alien species in South Africa, including: taxa in captivity or under cultivation; taxa with native-alien populations [sensu Nelufule et al. (2022)]; and some taxa which are not present but that are either regulated or for which risk analyses or risk assessments have been conducted. The workflow of the processes used to create the checklist is documented in Appendix 4. [Note: The process to update the list of alien taxa is on-going; this will result in a revised baseline where some taxa are removed from the list because their taxonomic names were invalid or there was evidence to suggest the taxon is not present in South Africa, additional taxa are added to the list. These additions include taxa from data sources that were partly added to previous reports such as some plants known to be in cultivation (Glen 2002) and in horticulture (Hoy et al. 2021); data sources that

were not included in the previous report (e.g., list of taxa in the medicinal plant trade, alien invertebrates, bamboo species, interception data at ports of entry, animals in zoological gardens and fish species in the aquarium trade) and taxa recorded in data sources that were published after 2022 (see Table S2.2 for a full list of key sources used to update the checklist).]

Table S2.2. List of key sources that were used to update the list of alien taxa that are known to occur in South Africa as of December 2025

Progress made to incorporate details is indicated as either completed, partial or to be completed for this report.

Source	Reference	Progress
Barcode of Life	www.boldsystems.org	Partial
Horticultural plants	Hoy et al. 2021	Partial
Tree species in arboreta	Cheek et al. 2022	Partial
Cultivated plants	Glen 2002	Partial
Species with native-alien populations	Nelufule et al. 2023	Partial
Citizen science platforms	iNaturalist	Partial
Alien bamboo species	Canavan et al. 2021	For this report
Alien invertebrates	Charlene Janion-Scheepers, University of Cape Town	For this report
Interception data at ports of entry	Saccaggi et al. 2021	For this report
Herbarium records and other species databases that may contain information on alien taxa	BODATSA	For this report
List of animals in the zoological garden collections of South Africa		For this report
List of fish species from publications in the aquarium trade		For this report
Species in botanical gardens	Mokotjomela et al. 2023	For this report
Alien species in medicinal plant trade	Williams et al. 2021a, 2021b; Williams et al. 2022	For this report
Ports surveys (marine)		For this report

Table S2.3. Recommendations for developing national lists of alien species as per Zengeya et al. (2025b), and how these recommendations were implemented in this report

Recommendation	What was done in this report	Reference
1. Structure data and make them available	The list of alien taxa for South Africa is freely available in an accessible form (Excel).	Appendix 6
2. Use data standards and metadata	Extensive metadata were produced for the lists of alien taxa, aligning to Darwin Core terminology where possible.	Appendix 8
3. List data sources and levels of confidence	A single consolidated file of all sources used in the alien taxa lists was produced. For most data fields in the alien list, an additional column outlining the sources from which the information was derived and another column specifying the qualitative level of confidence in the scoring. Guidelines for scoring level of confidence are outlined in the metadata.	Appendices 6–8
4. Take a modular approach	Each indicator is split into different complexities of information such that simpler levels can usually be derived from more complicated levels (details provided in the factsheets).	Appendix 1

Recommendation	What was done in this report	Reference
5. Document workflows	Various workflows are outlined to specify how information was collated, curated, and interpreted in terms of the indicators.	Appendix 2, Section 0.4
6. Integrate with reporting requirements	Processes to align the indicators in this report with those needed to report on Target 6 of the GBF are being developed. The indicator framework was revised to make the links to broader non-biological invasions indicators explicit. More work is still needed, however, needed in the context of various developing monitoring frameworks.	Box 1.1, Section 0.2, Chapter 5
7. Commit dedicated resources	Funding for the report is received from the DFFE as well as via several projects (e.g., B-cubed).	Box 2.2, Section 0.1.5
8. Learn by doing	Examples of how the process of developing South Afirca's list of alien taxa has evolved over time was recently reviewed	Zengeya et al. (2025)

S2.3 *Extent of alien species*

This report uses a relatively new method of data synthesis called species occurrence cubes (https://b-cubed.eu), which aggregate occurrence data along multiple dimensions (spatial, taxonomic, and temporal) across different datasets (Groom et al. 2025). Here, we processed and downloaded data for alien taxa on the list for which occurrence data were available in GBIF. A total of 1 045 919 distribution records up to 2025 were downloaded from GBIF for 3 072 alien taxa that are known to occur in South Africa. The workflow and scripts downloading and analysis the spatial data are provided in Appendix 2. [on going analysis includes assessing the distribution records on based phyla (e.g., plants, animals, Bacteria, Chromista, Fungi), basis of the record (e.g., 'MaterialSample', 'HumanObservation'), and occurrence datasets (Southern African Bird Atlas Project 2, iNaturalist)

Table S2.4 Alien taxa that have shown the greatest increase in range (QDGCs occupied) in South Africa 2023–2025

The common name is as per the list of alien taxa (column: vernacularName, noting several taxa do not yet have common names added, a brief description is added for ease of reference)

Taxon	Vernacular Name	End of 2022	End of 2025	Increase
Melia azedarach	seringa (a tree)	293	382	89
Agave americana	century plant	159	255	96
Tagetes minuta	khaki weed	325	434	109
Argemone ochroleuca	white-flowered Mexican poppy	242	376	134
Opuntia ficus-indica	Mission prickly pear (cactus)	365	499	134

S2.4 *Abundance of alien species*

Two sources of data were used to estimate the abundance of terrestrial plants in the previous reports: a 1998 report to the Water Research Commission (Versfeld et. al. 1998); and the National Invasive Alien Plant Survey (NIAPS) (Kotzé et al. 2010). A major limitation of the Versfeld et al. (1998) survey was that it was based on expert knowledge, data sources of different spatial scales were combined,

and the accuracy of the final results was not assessed. These concerns still hold and so the estimates have a low degree of confidence associated with them. The objective of NIAPS was to establish a scientific rigorous and practical implementable monitoring system of major invasive plant species at a national level. The NIAPS approach and survey results were initially published as a report (Kotzé et al. 2010) and spatial distribution data were made available to the public the same year on the Working for Water Planning website (https://sites.google.com/site/wfwplanning/assessment) and the SANBI's Biodiversity Geographic Information System website (http://bgis.sanbi.org/Projects/Detail/162). However, the previous status reports have noted that NIAPS had partial coverage that did not include large proportions of the country, and the methodology on which the survey was based was not adequately documented. There have been some recent developments, for example, a recent analysis of the National Invasive Alien Plant Survey has shown that the level of invasions is increasing in important water catchments, and in most terrestrial biomes in South Africa (Kotzé et al. 2025, Tables S3.5-3.6).

S2.5 *Impact of alien species*

Table S2.5. Alien taxa known to occur in South Africa for which environmental impacts have been recorded in South Africa or in their global distributional range
This is either in terms of an impact mechanism documented in van Wilgen et al. (2022) or in the other sources used; expert opinion of the impact severity based on Zengeya et al. (2017); or the impact severity assessed based on documented evidence using the Environmental Impact Classification for Alien Taxa (EICAT; Blackburn et al. 2014) and The Global Impacts Dataset of Invasive Alien Species (GIDIAS; Bacher et al. 2025). Details of the impact and the source for this information still need to be consolidated and incorporated into the list of alien taxa (cf. the workflows in Appendix 2). NE is not evaluated. The magnitude of impacts recorded in GIDIAS follows EICAT impact magnitudes: level to which a native species is suffering from the IAS: 0-no impact detected; 1-decreased performance of individuals of the native species; 2-reduced population size of native species; local or global extinction of native species
[work in progress]

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Acacia adunca	Not recorded			Data deficient				
Acacia baileyana	Competition| Changes to ecosystem functioning	Some	Major					
Acacia cultriformis	Not recorded			Data deficient				
Acacia cyclops	Competition | Changes to ecosystem functioning	Severe	Major	Massive				
Acacia dealbata	Competition | Changes to ecosystem functioning | Indirect impacts through species interactions | Poisoning/toxicity	Severe	Major	Major			Minor	
Acacia decurrens	Competition | Chemical, physical or structural impact on ecosystem	Severe	NE				Major	
Acacia elata	Not recorded			Data deficient				
Acacia fimbriata	Not recorded			Data deficient				
Acacia implexa	Not recorded			Data deficient				
Acacia longifolia	Competition |Chemical, physical or structural impact on ecosystem| Indirect impacts through interactions with other species	Severe	Major					
Acacia mearnsii	Competition | Changes to ecosystem functioning | Indirect impacts through species interactions | Threats to safety| Poisoning/toxicity	Severe	Major	Major			Major	
Acacia melanoxylon	Competition |Poisoning/toxicity| Changes to ecosystem functioning	Severe	Minimal concern	Major			Major	
Acacia paradoxa	Competition |Chemical, physical or structural impact on ecosystem			Major				
Acacia pycnantha	Competition						Major	
Acacia saligna	Competition| Changes to ecosystem functioning| Indirect impacts through species interactions	Severe	Major	Major				
Acacia stricta	Not recorded			Data deficient				
Acarapis woodi	Parasitism			Moderate				
Acer buergerianum	Transmission of diseases						Moderate	
Acer negundo	Competition| Poisoning/toxicity | Chemical, physical or structural impact on ecosystem						Moderate	

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Acridotheres tristis	Predation |Competition |Indirect impacts through interactions with other species | Hybridisation			Minimal Concern	2		Moderate	
Adalia bipunctata	Not recorded			Data deficient				
Addax nasomaculatus	Competition| Hybridisation | Transmission of disease | Grazing/herbivory/browsing						Minimal Concern	
Aepyceros melampus petersi	Transmission of disease | Hybridisation | Grazing/herbivory/browsing			Moderate			Minimal Concern	
Agapornis personatus	Transmission of disease| Competition | Hybridisation | Grazing/herbivory/browsing			Minimal Concern			Minor	
Agapornis roseicollis	Competition|Grazing/herbivory/browsing|Transimission of disease						Minor	
Agave sisalana	Competition | Chemical, physical or structural impact on ecosystem | Poisoning/toxicity			Minimal Concern			Moderate	
Ageratina adenophora	Competition | Poisoning/toxicity| Chemical, physical or structural impact on ecosystem						Major	
Ageratum conyzoides	Indirect impacts through species interactions	NE	NE					
Agrostis stolonifera	Not recorded	Severe	NE					
Ailanthus altissima	Competition | Transmission of disease | Poisoning/toxicity|Chemical, physical or structural impact on ecosystem |Interaction with other alien species						Major	
Alnus glutinosa	Competition | Hybridisation |Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species						Moderate	
Ammophila arenaria	Competition	Major	Moderate					
Ammotragus lervia	Competition | Grazing/herbivory/browsing | Hybridisation | Transmission of disease| Chemical, physical or structural impact on ecosystem						Moderate	
Amylostereum areolatum	Parasitism				NA			
Anas platyrhynchos	Hybridisation | Competition | Chemical, physical or structural impact on ecosystem | Interaction with other alien species| Predation	NE	NE		2		Major	
Anredera cordifolia	Not recorded	Major	NE					
Antilope cervicapra	Grazing/herbivory/browsing | Competition						Minor	
Apiosoma piscicola	Parasitism				1			
Araujia sericifera	Competition | Poisoning/toxicity | Indirect impacts through interactions with other species						Moderate	
Argulus japonicus	Parasitism				1			
Armillaria mellea	Parasitism				NA			
Arundo donax	Indirect impacts through species interactions	Major	Major					
Asphodelus fistulosus	Poisoning/toxicity| Competition | Chemical, physical or structural impact on ecosystem						Moderate	
Atriplex lindleyi inflata	Competition			Minor				

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Atriplex nummularia nummularia	Competition | Chemical, physical or structural impact on ecosystem			Moderate				
Aulographina eucalypti	Parasitism				NA			
Avena barbata	Competition	NE	Moderate					
Avena fatua	Competition	NE	Minor					
Axis axis	Bio-fouling or other direct physical disturbance| Competition | Transmission of disease| Grazing/herbivory/browsing| Chemical, physical or structural impact on ecosystem						Moderate	
Axis porcinus	Competition | Transimission of disease|Grazing/herbivory/browsing | Indirect impacts through interactions with other species						Minor	
Azolla filiculoides	Not recorded	Major	NE					
Azolla pinnata	Not recorded	Major	NE					
Bactrocera dorsalis	Grazing/herbivory/browsing				NA			
Bemisia tabaci	Competition						Moderate	
Biancaea decapetala	Not recorded	Major	NE					
Blastopsylla occidentalis	Grazing/herbivory/browsing				NA			
Bos frontalis	Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem | Transmission of disease						Minimal Concern	
Boselaphus tragocamelus	Predation |Poisoning/toxicity | Grazing/herbivory/browsing| Competition| Transmission of disease						Minor	
Cabomba caroliniana	Not recorded	Major	NE					
Campuloclinium macrocephalum	Not recorded	Major	NE					
Capra hircus	Not recorded	Major	NE					
Carausius morosus	Not recorded			Data deficient				
Cardiospermum grandiflorum	Chemical, physical or structural impact on ecosystem | Poisoning/toxicity | Indirect impacts through interactions with other species | Competition			Major			Moderate	
Casuarina cunninghamiana	Competition |Chemical, physical or structural impact on ecosystem| Hybridisation						Moderate	
Cenchrus purpureus	Competition						Minor	
Cenchrus setaceus	Competition |Interaction with other alien species | Hybridisation | Chemical, physical or structural impact on ecosystem	Negligible	Data Deficient				Major	
Centrochelys sulcata	Not recorded			Data deficient				
Ceratocystis fimbriata	Parasitism				NA			
Cervus elaphus	Transmission of disease |Grazing/herbivory/browsing| Competition |Bio-fouling or other direct physical disturbance | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species						Moderate	

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Cervus nippon	Competition | Transmission of diseases |Bio-fouling or other direct physical disturbance | Indirect impacts through interactions with other species | Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem						Moderate	
Cestrum laevigatum	Not recorded	Major	NE					
Chelydra serpentina	Grazing/herbivory/browsing | Predation						Minor	
Cherax cainii	Not recorded			Data deficient				
Cherax destructor	Not recorded			Data deficient				
Cherax quadricarinatus	Poisoning/toxicity | Chemical, physical or structural impact on ecosystem | Transmission of disease	Severe	Data Deficient		NA		Major	
Cherax tenuimanus	Not recorded			Data deficient				
Chilo partellus	Competition |Grazing/herbivory/browsing				2			
Chilodonella hexasticha	Parasitism	NE	NE		1			
Chilodonella piscicola	Parasitism	NE	NE		1			
Chondrilla juncea	Competition | Chemical, physical or structural impact on ecosystem						Moderate	
Chromolaena odorata	Competition | Poisoning/toxicity | Changes to ecosystem functioning|Indirect impacts through species interactions	Severe	Major	Major				
Cinara cronartii	Grazing/herbivory/browsing				NA			
Cinara cupressi	Grazing/herbivory/browsing						Moderate	
Cistus ladanifer	Poisoning/toxicity | Competition | Chemical, physical or structural impact on ecosystem			Moderate			Moderate	
Clarias gariepinus	Competition| Predation				2			
Columba livia	Competition | Hybridisation | Transmission of disease | Predation			Moderate	NA		Moderate	
Coreopsis lanceolata	Competition | Hybridisation | Transmission of disease						Moderate	
Cornu aspersum	Not recorded	Severe	NE					
Cortaderia jubata	Chemical, physical or structural impact on ecosystem | Competition | Indirect impacts through interactions with other species			Minimal Concern			Major	
Cortaderia selloana	Chemical, physical or structural impact on ecosystem | Competition | Indirect impacts through interactions with other species						Major	
Corvus splendens	Predation				2			
Crassostrea gigas	Competition | Predation | Hybridisation | Transmission of disease| Parasitism | Poisoning/toxicity | Bio-fouling | Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem | Interaction with other alien species						Major	
Cryptophlebia leucotreta	Grazing/herbivory/browsing				NA			
Cryptostegia grandiflora	Not recorded	Major	NE					
Cryptostegia madagascariensis	Not recorded	Major	NE					
Ctenarytaina eucalypti	Grazing/herbivory/browsing				NA			

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Ctenopharyngodon idella	Competition | Transmission of disease | Grazing/herbivory/browsing				2			
Cygnus atratus	Competition | Transmission of disease | Chemical, physical or structural impact on ecosystem | Grazing/herbivory/browsing| Hybridisation			Minimal Concern			Moderate	
Cylindropuntia fulgida var. mamillata	Not recorded	Major	NE					
Cylindropuntia imbricata	Not recorded	Major	NE					
Cylindropuntia leptocaulis	Not recorded	Major	NE					
Cylindropuntia pallida	Competition | Indirect impacts through interactions with other species	Major	NE				Major	
Cylindropuntia spinosior	Competition	Major	NE				Moderate	
Cyprinus carpio	Transmission of disease				1			
Cytisus scoparius	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species						Moderate	
Dama dama	Competition | Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem			Moderate			Moderate	
Deroceras invadens	Not recorded	Severe	Data Deficient					
Desmodium uncinatum	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem						Moderate	
Diplocyclos palmatus	Not recorded	Major	NE					
Dolichandra unguis-cati	Not recorded	Severe	Data Deficient					
Duranta erecta	Competition |Poisoning/toxicity | Chemical, physical or structural impact on ecosystem						Moderate	
Duttaphrynus melanostictus	Competition | Predation | Poisoning/toxicity	Major	NE				Moderate	
Echinodorus cordifolius	Not recorded	Major	NE					
Echinodorus tenellus	Not recorded	Major	NE					
Echium plantagineum	Not recorded	Severe	Data Deficient					
Echium vulgare	Not recorded	Major	NE					
Elaphurus davidianus	Not recorded			Data deficient				
Elodea canadensis	Not recorded	Moderate	NE					
Elodea densa	Not recorded	Major	NE					
Equus asinus	Hybridisation |Grazing/herbivory/browsing	NE	NE		1			
Equus caballus	Grazing/herbivory/browsing				NA			
Erythricium salmonicolo	Parasitism				NA			
Erythrostemon gilliesii	Not recorded	Major	NE					

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Eucalyptus camaldulensis	Competition| Poisoning/toxicity| Chemical, physical or structural impact on ecosystem | Indirect impacts through species interactions|	Severe	Major	Moderate				
Eucalyptus diversicolor	Indirect impacts through species interactions	Negligible	NE					
Eucalyptus grandis	Changes to ecosystem functioning | Indirect impacts through species interactions	Negligible	NE					
Eucalyptus lehmannii	Indirect impacts through species interactions	NE	NE					
Eucalyptus saligna	Changes to ecosystem functioning| Indirect impacts through species interactions	NE	NE					
Eugenia uniflora	Competition |Interaction with other alien species						Moderate	
Euwallacea fornicatus	Disease transmission | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species | Parasitism	NE	NE				Moderate	
Fairmaniella leprosa	Parasitism				NA			
Felis catus	Predation	Major	NE		2			
Festuca rubra	Not recorded	Major	NE					
Ficopomatus enigmaticus	Changes to ecosystem functioning	Some	NE					
Frankliniella occidentalis	Grazing/herbivory/browsing				NA			
Fusarium circinatum	Parasitism |Chemical or physical or structural impact on ecosystem				1			
Fusarium euwallaceae	Disease transmission	NE	NE					
Gambusia affinis	Competition | Predation | Indirect impacts through interactions with other species						Major	
Glyceria maxima	Competition	Major	Major					
Hakea drupacea	Indirect impacts through species interactions	NE	NE					
Hakea gibbosa	Not recorded	Major	NE					
Hakea sericea	Competition	Severe	Moderate					
Harrisia bonplandii	Not recorded	Major	NE					
Harrisia martinii	Not recorded	Major	NE					
Harrisia pomanensis	Not recorded	Major	NE					
Harrisia tortuosa	Not recorded	Major	NE					
Hesperocyparis arizonica	Indirect impacts through species interactions	NE	NE					
Himalayan Tahr	Grazing/herbivory/browsing				NA			
Hippotragus equinus	Not recorded	Major	NE					
Holocryphia eucalypti	Parasitism				NA			
Hordeum murinum	Not recorded	Data Deficient	Data Deficient					
Hydrilla verticillata	Not recorded	Major	NE					
Hydrochoerus hydrochaeris	Transmission of disease						Minimal Concern	

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Hydrocleys nymphoides	Competition | Chemical, physical or structural impact on ecosystem						Moderate	
Hylastes angustatus	Grazing/herbivory/browsing				NA			
Hylurgus ligniperda	Grazing/herbivory/browsing				NA			
Hypericum perforatum	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem	Negligible	NE					
Ichthyophthirius multifilis	Parasitism	Major	NE		1			
Iguana iguana	Competition | Predation | Transmission of disease | Grazing/herbivory/browsing						Minor	
Ipomoea carnea subsp. fistulosa	Not recorded	Major	NE					
Ipomoea indica	Not recorded	Major	NE					
Ipomoea purpurea	Not recorded	Major	NE					
Iris pseudacorus	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem	Negligible	NE				Major	
Jatropha curcas	Not recorded	Some	NE					
Jatropha curcas	Competition | Transmission of diseases | Chemical, physical or structural impact on ecosystem						Moderate	
Kalanchoe tubiflora	Competition | Hybridisation | Indirect impacts through interactions with other species | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem						Moderate	
Kirramyces epicoccoides	Parasitism				NA			
Kobus ellipsiprymnus crawshayi	Hybridisation | Transmission of disease						Minor	
Kobus ellipsiprymnus defassa	Hybridisation | Transmission of disease						Minor	
Kobus leche kafuensis	Transmission of disease | Hybridisation						Minor	
Kobus leche leche	Transmission of disease						Minor	
Kobus vardonii	Hybridisation | Transmission of disease						Minimal Concern	
Kunzea ericoides	Competition | Poisoning/toxicity	Major	NE				Moderate	
Lantana camara	Changes to ecosystem functioning| Indirect impacts through species interactions	Severe	Major					
Lasiodiplodia theobromae	Parasitism				NA			
Lepidium draba	Not recorded	Major	NE					
Leptospermum laevigatum	Not recorded	Major	NE					
Lernea cyprinacea	Parasitism				1			
Leucaena leucocephala	Not recorded	Major	NE					
Lilium formosanum	Competition | Poisoning/toxicity	Negligible	NE				Minor	
Linepithema humile	Indirect impacts through species interactions	Severe	Major					

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Liriomyza huidobrensis	Grazing/herbivory/browsing				NA			
Liriomyza trifolii	Grazing/herbivory/browsing				NA			
Lolium multiflorum	Competition	Negligible	Minor					
Ludwigia peruviana	Not recorded	Major	NE					
Lymantria dispar	Grazing/herbivory/browsing						Major	
Lythrum salicaria	Hybridisation | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem | Competition |Indirect impacts through interactions with other species			Moderate			Minimal Concern	
Macaca fascicularis	Not recorded	Major	NE					
Macrochelys temminckii	Bio-fouling or other direct physical disturbance | Chemical, physical or structural impact on ecosystem						Minor	
Melaleuca hypericifolia	Competition	Negligible	NE	Minor				
Melia azedarach	Impacts on human health	Some	NE					
Micropterus dolomieu	Predation	Severe	Major					
Micropterus dolomieu	Competition | Predation | Transmission of diseases | Chemical, physical or structural impact on ecosystem			Major	2			
Micropterus floridanus	Chemical, physical or structural impact on ecosystem						Moderate	
Micropterus floridanus	Predation | Transmission of diseases			Major				
Micropterus floridanus x Micropterus salmoides	Not recorded			Data deficient				
Micropterus punctulatus	Competition |Predation |Transimission of diseases			Moderate	2			
Micropterus salmoides	Competition | Predation| Transmission of diseases | Chemical, physical or structural impact on ecosystem	Major	Major	Major	2			
Micropterus spp.	NA				NA			
Mimosa pigra	Not recorded	Major	NE					
Molothrus bonariensis	Not recorded	Major	NE					
Morbillivirus species	Toxicity	NE	NE					
Morelia spilota	Transmission of disease | Parasitism | Poisoning/toxicity						Minimal Concern	
Murraya paniculata	Not recorded			Data deficient				
Mus musculus	Competition| Predation | Transmission of disease| Grazing/herbivory/browsing| Chemical or physical or structural impact on ecosystem	Major	NE		1			
Mycobacterium bovis	Disease transmission	NE	NE					
Myocastor coypus	Competition | Predation | Transmission of diseases |Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem | Interaction with other alien species	Some	NE				Major	
Myrtillocactus geometrizans	Not recorded			Data deficient				

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Mytilus galloprovincialis	Competition | Changes to ecosystem functioning| Indirect impacts through species interactions | Hybridisation |Parasitism|Biofouling|Grazing/herbivory/browsing	Major	NE	Massive			Moderate	
Nassella tenuissima	Not recorded	Major	Data Deficient					
Nassella trichotoma	Not recorded	Major	Data Deficient					
Nasturtium officinale	Competition | Chemical, physical or structural impact on ecosystem						Moderate	
Neltuma glandulosa	Competition| Changes to ecosystem functioning| Indirect impacts through species interactions| Reductions in material or immaterial assets	Severe	Major					
Neltuma velutina	Not recorded	Severe	Major					
Nephrolepis cordifolia	Competition | Chemical, physical or structural impact on ecosystem			Minor			Moderate	
Nephrolepis exaltata	Competition						Minor	
Nerium oleander	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem						Minor	
Nicotiana glauca	Not recorded	Major	NE					
Nymphoides peltata	Competition | Hybridisation | Chemical, physical or structural impact on ecosystem						Moderate	
Oncorhynchus mykiss	Predation |Chemical or physical or structural impact on ecosystem| Competition|	Major	Major		2			
Oncorhynchus mykiss	Competition | Predation | Transmission of disease			Major				
Opuntia ficus-indica	Reductions in material or immaterial assets	Some	NE					
Opuntia stricta	Indirect impacts through species interactions	Some	NE					
Opuntia stricta	Competition			Moderate				
Oreochromis niloticus	Competition | Hybridisation | Grazing/herbivory/browsing	Major	Massive	Massive	2			
Orthotomicus erosus	Grazing/herbivory/browsing				NA			
Oryctolagus cuniculus	Competition |Grazing/herbivory/browsing				2			
Oryx dammah	Competition | Hybridisation | Transmission of diseases | Parasitism | Grazing/herbivory/browsing						Moderate	
Ovis aries	Competition | Transmission of disease |Grazing/herbivory/browsing |Chemical, physical or structural impact on ecosystem						Moderate	
Oxyura jamaicensis	Competition | Hybridisation | Transmission of disease						Moderate	
Pacifastacus leniusculus	Competition | Predation | Transmission of disease | Chemical, physical or structural impact on ecosystem						Major	
Parkinsonia aculeata	Not recorded	Major	NE					

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Parthenium hysterophorus	Competition |Toxicity| Transmission of disease |Poisoning/toxicity | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species | Reductions in material or immaterial assets	Some	NE	Major			Major	
Paspalum quadrifarium	Competition | Hybridisation | Chemical, physical or structural impact on ecosystem	Some	NE				Moderate	
Passer domesticus	Predation				2			
Passer domesticus indicus	Competition				1			
Penaeus indicus	Transmission of disease						Minimal Concern	
Phakopsora myrtacearum	Parasitism				NA			
Phenacoccus manihoti	Grazing/herbivory/browsing				NA			
Phyllostachys aurea	Competition | Chemical, physical or structural impact on ecosystem						Moderate	
Phytolacca dioica	Not recorded	Major	NE					
Phytophthora cinnamomi	Parasitism				NA			
Pinus elliottii	Indirect impacts through species interactions	Major	NE					
Pinus halepensis	Not recorded	Major	NE					
Pinus patula	Changes to ecosystem functioning |Indirect impacts through species interactions	Major	NE					
Pinus pinaster	Competition | Threats to safety	Major	NE					
Pinus radiata	Competition| Changes to ecosystem functioning| Indirect impacts through species interactions| Threats to safety	Major	NE					
Pinus roxburghii	Indirect impacts through species interactions	Some	NE					
Pissodes nemorensis	Grazing/herbivory/browsing				NA			
Pistia stratiotes	Not recorded	Major	NE					
Pontederia crassipes	Competition	Major	NE					
Populus alba	Competition | Chemical, physical or structural impact on ecosystem			Moderate				
Populus deltoides	Changes to ecosystem functioning	NE	NE					
Populus species	Changes to ecosystem functioning	NE	NE					
Populus x canescens	Competition | Chemical, physical or structural impact on ecosystem			Moderate				
Procambarus clarkii	Competition | Predation |Transmission of disease | Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species	Severe	Data Deficient				Major	
Prostephanus truncates	Grazing/herbivory/browsing				NA			
Pseudodactlogyrus acheilognathi	Not recorded	Severe	Data Deficient					
Pseudodactlogyrus anguillae	Not recorded	Severe	Data Deficient					

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Psidium cattleianum	Competition | Poisoning/toxicity | Indirect impacts through interactions with other species	Some	NE				Moderate	
Psittacula krameri	Competition | Predation| Transmission of disease | Grazing/herbivory/browsing | Interaction with other alien species	Negligible	NE	Minimal Concern	2		Moderate	
Pueraria montana var. lobata	Competition | Hybridisation | Transmission of disease | Chemical, physical, or structural impact on ecosystem	Major	NE				Major	
Pycnonotus cafer	Competition |Predation | Hybridisation | Transmission of disease | Interaction with other alien species	Negligible	NE				Moderate	
Pyracantha angustifolia	Transmission of disease | Poisoning/toxicity | Competition | Chemical, physical or structural impact on ecosystem| Indirect impacts through interactions with other species			Moderate			Moderate	
Pythium splendens	Parasitism				NA			
Python bivittatus	Predation| Transmission of disease | Indirect impacts through species interactions | Hybridisation			Minimal Concern			Massive	
Python natalensis x Python molurus	Not recorded			Data deficient				
Quambalaria eucalypti	Parasitism				NA			
Ralstonia solanacearum	Parasitism				NA			
Rattus norvegicus	Competition | Predation | Chemical, physical or structural impact on ecosystem	Major	NE				Major	
Rattus rattus	Competition | Predation | Transmission of disease | Indirect impacts through interactions with other species | Grazing/herbivory/browsing	Major	NE		NA		Massive	
Rattus tanezumi	Not recorded			Data deficient				
Rhinella marina	Competition | Predation |Transmission of disease |Poisoning/toxicity |Indirect impacts through interactions with other species | Hybridisation			Minimal Concern			Moderate	
Ricinus communis	Competition |Hybridisation |Poisoning/toxicity | Chemical, physical or structural impact on ecosystem| Transmission of diseases |Interaction with other alien species	Some	NE	Minor			Moderate	
Robinia pseudoacacia	Competition | Chemical, physical or structural impact on ecosystem | Interaction with other alien species	Some	NE				Massive	
Rosa rubiginosa	Competition | Chemical, physical or structural impact on ecosystem			Moderate			Major	
Rubus bergii	Hybridisation		NE					
Rubus cuneifolius	Hybridisation	Some	NE					
Rusa unicolor	Competition | Hybridisation | Transmission of disease | Parasitism |Poisoning/toxicity | Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species						Moderate	
Sagartia ornata	Predation	NE	NE					

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Sagittaria platyphylla	Competition | Hybridisation | Chemical, physical or structural impact on ecosystem	Negligible	NE					
Salmo trutta	Competition | Predation | Transmission of disease | Chemical, physical or structural impact on ecosystem	Major	Major	Major	1			
Salvinia molesta	Not recorded	Major	NE					
Sasaella ramosa	Competition	Negligible	NE				Moderate	
Schinus molle	Competition	NE	NE					
Schyzocotyle acheilognathi	Parasitism	NE	NE					
Schyzocotyle acheilognathi	Parasitism				1			
Sciurus carolinensis	Grazing/herbivory/browsing				NA			
Sclerophrys gutturalis	NA				NA			
Selenicus undatus	Competition | Chemical, physical, or structural impact on ecosystem | Hybridisation			Minimal concern			Moderate	
Semimytilus algosus	Indirect impacts through species interactions	Some	NE					
Senna bicapsularis	Competition | Transmission of disease | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem	Negligible	NE				Moderate	
Sicalis flaveola	Competition				1			
Soehrensia spachiana	Not recorded	Major	NE					
Solanum mauritianum	Competition | Chemical, physical or structural impact on ecosystem | Poisoning/toxicity |Indirect impacts through species interactions	Major	NE	Major				
Sorghum halepense	Competition | Transmission of disease |Poisoning/toxicity | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species| Hybridisation			Moderate			Moderate	
Spartium junceum	Competition | Poisoning/toxicity| Chemical, physical or structural impact on ecosystem			Moderate				
Sphaeropteris cooperi	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem | Interaction with other alien species						Major	
Spodoptera frugiperda	Grazing/herbivory/browsing				NA			
Spondyliaspis cf. plicatuloides	Grazing/herbivory/browsing				NA			
Sturnus tristis	Predation				NA			
Sturnus vulgaris	Predation				NA			
Sus scrofa	Competition| Hybridisation | Predation | Transmission of disease | Grazing/herbivory/browsing | Chemical, physical or structural impact on ecosystem | Indirect impacts through interactions with other species	Major	NE	Major	1		Massive	
Syzygium australe	Not recorded			Data deficient				
Syzygium cumini	Competition						Minor	
Syzygium jambos	Not recorded	Negligible	NE					

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (EICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Tamarix chinensis	Competition	Negligible	NE					
Tamarix ramosissima	Competition	Major	NE					
Tamarix species	Hybridisation	NE	NE					
Tarebia granifera	Competition	Major	NE					
Teratosphaeria zuluense	Parasitism				NA			
Tetrapygus niger	Not recorded			Data deficient				
Theba pisana	Herbivory	Major	NE					
Tithonia diversifolia	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem	Some	NE				Moderate	
Trachymela tincticollis	Grazing/herbivory/browsing				NA			
Trogoderma granarium	Not recorded	Major	NE					
Tuta absoluta	Grazing/herbivory/browsing				NA			
Ulex europaeus	Competition | Poisoning/toxicity | Chemical, physical or structural impact on ecosystem						Moderate	
Verbena bonariensis	Not recorded	Major	NE					
Verbena brasiliensis	Not recorded	Major	NE					
Verbena rigida	Not recorded	Major	NE					
Vespula germanica	Not recorded	Negligible	NE					
Vespula germanica	Competition | Predation | Grazing/herbivory/browsing | Interaction with other alien species			Minimal concern			Moderate	
Vitex trifolia	Not recorded	Major	NE					
Xanthium spinosum	Not recorded	Major	NE					
Xanthium strumarium	Not recorded	Major	NE					
Xenopus laevis	Hybridisation |Competition |Predation	Major	NE		1			

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Table S2.6. Alien taxa known to occur in South Africa for which socio-economic impacts have been recorded in South Africa or in their global distributional range

This is either in terms of an impact mechanism documented in van Wilgen et al. (2022) or in the other sources used; expert opinion of the impact severity based on Zengeya et al. (2017); or the impact severity assessed based on documented evidence using the Socio-Economic Impact Classification for Alien Taxa (SEICAT; Bacher et al. 2018) and The Global Impacts Dataset of Invasive Alien Species (GIDIAS; Bacher et al. 2025). GIDIAS severity levels reported here are: 1-activities affected by the IAS are more difficult, but all people still participate in these activities; and 2: some people stop activities affected by the IAS. Details of the impact and the source for this information still need to be consolidated and incorporated into the list of alien taxa (cf. the workflows in Appendix 2). NE is not evaluated.

[work in progress]

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Acacia dealbata	Safety| Material and immaterial assets		Minor	Minor				
Acacia decurrens			Minimal Concern					
Acacia longifolia	Safety | Social, spiritual and cultural relations |Health		Minor	Minor			Minor	
Acacia mearnsii	Safety | Material and immaterial assets| Social, spiritual and cultural relations		Minor	Major				
Acacia melanoxylon	Safety | Social, spiritual and cultural relations						Minor	
Acacia saligna	Social, spiritual and cultural relations | Material and immaterial assets			Minor			Minor	
Acarapis woodi	Agriculture | Animal production			Minimal Concern			Moderate	
Acer buergerianum	Safety						Minimal Concern	
Acer negundo	Safety | Material and immaterial assets | Health | Social, spiritual and cultural relations						Minor	
Acridotheres tristis	Health | Material and immaterial assets | Social, spiritual and cultural relations			Minor			Minor	
Addax nasomaculatus	Safety						Minimal Concern	
Agapornis personatus	Material and immaterial assets						Minor	
Agapornis roseicollis	Material and immaterial assets | Health						Minor	
Agave sisalana	Material and immaterial assets						Moderate	
Ageratina adenophora	Agriculture |Animal production | Forestry						Major	
Ailanthus altissima	Agriculture | Animal production |Infrastructure and administration |Health						Moderate	
Alnus glutinosa	Health						Minor	
Ammotragus lervia	Safety | Material and immaterial assets |Health						Minor	
Anas platyrhynchos	Infrastructure and administration| agriculture |Human social life			Minimal Concern			Minimal Concern	

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Antilope cervicapra	Materials and immaterial assets						Minimal Concern	
Araujia sericifera	Materials and immaterial assets						Minor	
Asphodelus fistulosus	Material and immaterial assets| Health						Moderate	
Axis axis	Safety | Material and immaterial assets |Health						Minor	
Axis porcinus	Material and immaterial assets | Health						Minor	
Bemisia tabaci	Material and immaterial assets			Major				
Bos frontalis	Safety | Material and immaterial assets						Minimal Concern	
Boselaphus tragocamelus	Material and immaterial assets						Minimal concern	
Carausius morosus	Human social life			Minor				
Cardiospermum halicacabum	Material and immaterial assets			Minimal Concern				
Casuarina cunninghamiana	Material and immaterial assets | Health			Minor				
Cenchrus setaceus	Infrastructure and administration |Animal Production			Major			Minor	
Centrochelys sulcata	Health						Minor	
Cervus elaphus	Safety| Material and immaterial assets| Health						Minor	
Cervus nippon	Safety| Material and immaterial assets| Health						Minor	
Chelydra serpentina	Health						Minor	
Cherax quadricarinatus	Material and immaterial assets						Moderate	
Chondrilla juncea	Agriculture						Massive	
Chondrilla juncea	Infrastructure and administration |Human and Social Life Animal |production						Minimal Concern	
Chromolaena odorata	Material and immaterial assets | Health |Safety			Moderate				
Cinara cupressi	Forestry | Infrastructure and administration			Major				
Cistus ladanifer	Material and immaterial assets | Health			Minor			Minor	
Columba livia	Material and immaterial assets| Safety |Health			Minor			Moderate	
Coreopsis lanceolata	Infrastructure and administration						Minimal Concern	
Cortaderia jubata	safety | Material and immaterial assets |Health |Social, spiritual and cultural relations			Minor			Minor	
Cortaderia selloana	Safety| Material and immaterial assets| Health |Social, spiritual and cultural relations						Minor	
Crassostrea gigas	Animal production |Mariculture/aquaculture| Infrastructure and administration| Human health |Human social life						Moderate	
Cygnus atratus	Safety |Material and immaterial assets |Health| Social, spiritual and cultural relations						Minor	

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Cylindropuntia pallida	Safety |Material and immaterial assets| Social, spiritual and cultural relations						Minimal Concern	
Cylindropuntia spinosior	Safety |Material and immaterial assets| Social, spiritual and cultural relations						Moderate	
Cytisus scoparius	Material and immaterial assets |Social, spiritual and cultural relations						Moderate	
Duranta erecta	Material and immaterial assets | Health						Minor	
Eucalyptus camaldulensis	safety |Health |Social, spiritual and cultural relations						Minor	
Eugenia uniflora	Agriculture | Human health						Minimal Concern	
Euwallacea fornicatus | Fusarium euwallaceae	Material and immaterial assets | Health |Social, spiritual and cultural relations						Moderate	
Gambusia affinis	Health						Minimal Concern	
Hydrochoerus hydrochaeris	Material and immaterial assets| Health						Minor	
Hydrocleys nymphoides	Safety |Material and immaterial assets |Social, spiritual and cultural relations						Minor	
Hypericum perforatum	Material and immaterial assets |Health						Moderate	
Iguana iguana	Safety | Material and immaterial assets						Minor	
Iris pseudacorus	Animal production |Infrastructure and administration |Human health						Moderate	
Jatropha curcas	Agriculture |Animal production| Human health						Moderate	
Kalanchoe tubiflora	Material and immaterial assets | Health						Moderate	
Kobus leche kafuensis	Material and immaterial assets						Minor	
Kobus leche leche	Material and immaterial assets						Minor	
Kunzea ericoides	Material and immaterial assets						Moderate	
Lilium formosanum	Infrastructure and administration			Moderate				
Lymantria dispar	Material and immaterial assets | Health						Moderate	
Lythrum salicaria	Material and immaterial assets						Minimal Concern	
Macrochelys temminckii	Health						Minimal Concern	
Micropterus dolomieu	Material and immaterial assests						Minor	
Micropterus floridanus	Material and immaterial assests						Minor	
Micropterus punctulatus	Material and immaterial assests						Minor	
Micropterus salmoides	Material and immaterial assests						Minor	
Morelia spilota	Safety						Minimal Concern	
Murraya paniculata	Material and immaterial assets			Minor				

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Myocastor coypus	Agriculture Moderate| Animal production| Mariculture/aquaculture |Infrastructure and administration |Human health						Major	
Mytilus galloprovincialis	Mariculture/aquaculture |Infrastructure and administration						Major	
Nasturtium officinale	Health			Minor				
Nephrolepis cordifolia	Material and immaterial assets						Minor	
Nephrolepis exaltata	Health						Minor	
Nerium oleander	Animal production | Human health			Major				
Nymphoides peltata	Social, spiritual and cultural relations						Minor	
Opuntia stricta	Safety | Social, spiritual and cultural relations			Minor				
Opuntia stricta	Material and immaterial assets | Health						Minor	
Oreochromis niloticus	Mariculture/aquaculture						Minimal Concern	
Oryctolagus cuniculus	Material and immaterial assets;				2			
Ovis aries	Material and immaterial assets						Minimal Concern	
Oxyura jamaicensis	Material and immaterial assets | Health						Minimal Concern	
Pacifastacus leniusculus	Material and immaterial assets						Minor	
Parthenium hysterophorus	Material and immaterial assets | Health			Major			Major	
Paspalum quadrifarium	Animal production						Minimal Concern	
Phyllostachys aurea	Material and immaterial assets			Minor				
Populus alba	Material and immaterial assets | Health |Safety			Minor			Minor	
Populus x canescens	Safety | Health						Minor	
Procambarus clarkii	Material and immaterial assets | Health						Moderate	
Psidium cattleianum	Agriculture						Minor	
Psittacula krameri	Agriculture |Human social Life			Major			Minor	
Pueraria montana var. lobata	Safety |Material and immaterial assets| Social, spiritual, and cultural relations						Moderate	
Pycnonotus cafer	Agriculture |Infrastructure and administration |Human health						Major	
Pyracantha angustifolia	Material and immaterial assets | Social, spiritual and cultural relations			Moderate				
Python bivittatus	Safety |Material and immaterial assets| Health						Moderate	
Rattus norvegicus	Health |Material and immaterial assets			Moderate			Minor	
Rattus rattus	Material and immaterial assets | Health						Major	
Rattus tanezumi	Material and immaterial assets |Health |Social, spiritual and cultural relations						Major	
Rhinella marina	Safety| Health |Social, spiritual and cultural relations |Material and immaterial assets						Moderate	

scientificName	Impact mechanism	South Africa				Global		
		Impact severity (expert opinion)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)	Impact severity (SEICAT)	Impact severity (RAAT)	Impact severity (GIDIAS)
Ricinus communis	Agriculture |Animal production |Forestry						Minor	
Robinia pseudoacacia	Animal production			Minor				
Robinia pseudoacacia	Forestry |Human health| Human social life						Moderate	
Rosa rubiginosa	Material and immaterial assets			Moderate				
Rusa unicolor	Safety | Material and immaterial assets| Health| Social, spiritual and cultural relations						Minor	
Sagittaria platyphylla	Agriculture |Mariculture/aquaculture |Infrastructure and administration| Human social life						Moderate	
Sasa ramosa	Agriculture |Forestry						Minor	
Sclerophrys gutturalis	Health;				1			
Senna bicapsularis	Animal production| Human health| Forestry						Minor	
Solanum mauritianum	Material and immaterial assets | Health			Minor				
Sorghum halepense	Material and immaterial assets | Health| Safety			Moderate			Minor	
Spartium junceum	Health			Minimal concern				
Sphaeropteris cooperi	Human health						Minimal concern	
Sus scrofa	Safety | Material and immaterial assets| Health |Social, spiritual and cultural relations				1		Major	
Syzygium cumini	Social, spiritual and cultural relations						Minimal Concern	
Tithonia diversifolia	Social, spiritual and cultural relations |Material and immaterial assets			Minor			Moderate	
Ulex europaeus	Safety |Material and immaterial assets						Minor	
Vespula germanica	Agriculture | Animal production| Infrastructure and administration| Human health |Human social life			Minor			Massive	
Xenopus laevis	Material and immaterial assets;				1			

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824 **S2.6.** Trends in indicators for species

825 **Table S2.7 Current status, confidence, trends, and outlook for species indicators**

Indicator	Trend	Confidence	Desired trend	Current status and trend	Outlook
2. *Number of invasive species that have 'Major impacts*	↗	low (many taxa still need to be assessed)	↘	National assessments using IUCN's EICAT framework show significant impacts, with 19 species been assessed as causing Major or Massive impacts. Complementary assessments using risk analyses and findings from the IPBES IAS Assessment confirm that these species cause widespread harm across multiple sectors of society. However, as only few taxa have been formally assessed, the need for more studies and assessments on the impact of invasive species has been highlighted as a research priority for South Africa.	The number of invasives that have 'Major' impacts will increase as more impact assessments are conducted. The formal assessment of the impact of alien species provides the rationale for regulation and management, can improve compliance and implementation of intervention measures, and assist to resolve conflicts. However, impact assessments are hampered by a lack of reliable data for most species. If this situation persists, regulations will continue to be vulnerable to legal challenges. It is very difficult to control invasive species with 'Major' impacts in a way that will reduce such impacts to 'Moderate' or 'Minor', but this has arguably been achieved by biological control for over 30 invasive taxa. Ongoing investment in biological control will likely result in more such successes. If alien species that currently have 'Moderate' or 'Minor' impacts are prevented from increasing in abundance and extent to the point where they have 'Major' impacts or, where feasible, such species are eradicated from South Africa, then significant returns on investment might also be made.
2.1. *Number and status of alien species*	↗	High	↘ (for invasive species)	The number and status of alien species in South Africa was recently updated and the list now includes over 6000 taxa, of which over 3500 are present outside of captivity or cultivation and a third are invasive.	South Africa faces a substantial invasion debt because most alien species are not yet invasive and new alien species continue to arrive. The number of alien species recorded in the country will increase if more effort is spent on detection, even for well-studied groups like plants. The updated list of alien taxa contained in this report represents a step towards a national registry of alien species in the country. It captures the current state of knowledge of the status of each alien species in a manner that allows for the information to be easily reviewed and updated. This promises to provide the foundational biodiversity information that is essential for managers and policymakers.

Indicator	Trend	Confidence	Desired trend	Current status and trend	Outlook
2.2. *Extent of alien species*	↗	medium	↘	The majority of alien species have limited distribution but many of these are increasing in extent.	The majority of alien species are localised and only a few are widespread. However, the potential for them to increase their distribution is large and the extent of most species will continue to increase unless effective control is put in place.
2.3. *Abundance of alien species*	↗	Medium	↘	There is limited data to estimate the abundance of alien species in South Africa. The only available data are mainly from the National Invasive Alien Plant Survey (2008–2023) on selected invasive plant taxa in water catchments and terrestrial biomes. Data from the survey indicate that most of the taxa have increased in cover despite mechanical and chemical control efforts, but there were decreases in cover for taxa under biological control.	Understanding trends in abundance is important if the effectiveness of management interventions is to be monitored, and the magnitude of future impacts predicted.
2.4. *Impact of alien species*	↗	low	↘	Previous reports noted that 19 species had been reported to cause 'Major' or 'Massive' impacts using the IUCN's EICAT scheme. This situation has not changed and there is a for more studies and assessments on the impact of invasive species. Complementary assessments using risk analyses and findings from the IPBES IAS Assessment confirm that these species cause widespread harm across multiple sectors of society.	This remains a major gap where detailed research is needed. Unless the impacts of invasive species can be quantified, attempts to regulate them will remain contentious in many cases.

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Supplementary Material to 'Chapter 3: Sites'

S3.1 *Alien species richness*

Alien species richness can be tracked at a range of scales, e.g., for the country as a whole, or at increasingly finer scales for subdivisions of the country. While it is important to get an accurate inventory of the distribution of alien species across the country [not least as this is essential to estimate the invasion threat that South Africa faces, i.e., invasion debt (Rouget et al. 2016)], such inventories only exist for small areas and for particular taxa [e.g., efforts to compile comprehensive lists of alien plants in a small town (McLean et al. 2018) and in National Parks (Baard and Kraaij 2019; Cheney et al. 2019)]. Therefore, species richness can only be reliably estimated for invasive species. The introduction status of alien species (i.e., whether they were only found in captivity or cultivation, had established, or were invasive) was not updated in this report and estimates provided are for broad scale alien species richness.

Alien species richness was calculated for large administrative regions (provinces of mainland South Africa), as well as for large biogeographical regions (i.e., biomes of mainland South Africa). The richness of freshwater alien species was calculated for the primary water catchment as defined by the DWA (2013), and the marine ecoregions as defined by Sink et al. (2011) were used for marine species. The list of alien taxa on which the estimates of richness are based has been carefully checked, and only taxa for which a reliable record and a collection date are available have been included. This has resulted in a new baseline from which change can be tracked (e.g., more care has been taken to ensure that the listing of species as invasive is based on sound information, resulting in the removal of some species from the inventory of invasive species recorded in the previous reports). Additional species have also been added to the list, and these additions may either reflect genuine changes (i.e., the species is a new arrival), or they might be species that have been present for some time, but that have been overlooked.

Table S3.1. Alien species richness per province for different taxa based on occurrence data from GBIF and SAPIA

The totals for each group are not the same as the total for South Africa because: 1) taxa are in multiple provinces; 2) data might be available at the country level but not at a provincial level; and 3) not all data available on alien species present in South Africa have been incorporated into GBIF or SAPIA.

Province	Fungi	Plants	Vertebrates	Total
Eastern Cape	18	915	81	1014
Free State	5	514	61	580
Gauteng	18	826	86	930
KwaZulu-Natal	17	1092	100	1209
Limpopo	9	774	73	856
Mpumalanga	13	792	76	881
Northern Cape	2	400	63	465
North-West	4	502	63	569
Western Cape	54	1063	103	1220

Table S3.2. Alien species richness per biome for different taxa based on GBIF occurrence data

The totals for each group are not the same as the total for South Africa because: 1) taxa are in multiple biomes; 2) data might be available at the country level but not at a biome level; and 3) not all data available on alien species present in South Africa have been incorporated into GBIF.

Biome	Fungi	Plants	Vertebrates	Total
Albany Thicket	6	613	72	691
Desert	0	46	23	69
Fynbos	54	1065	104	1223
Forest	10	189	42	241
Grassland	28	1076	102	1206
Indian Ocean Coastal Belt	6	822	85	913
Nama-Karoo	0	349	50	399
Savanna	21	1209	107	1337
Succulent Karoo	21	349	53	423

Table S3.3. Alien species richness in protected areas managed by SANParks

The numbers per protected area are broken down into the number that are listed under the A&IS Regulations, unlisted species, and native-alien species (species that are native to a part of South Africa but have been introduced and are alien in other parts of the country).

Protected Area	listed	non-listed	native-alien	Total
Groenkloof	0	0	0	0
Meerkat	17	3	0	20
Grasslands	13	13	0	26
Kalahari Gemsbok	11	15	2	28
Mokala	17	8	4	29
Richtersveld	13	17	0	30
Marakele	29	7	1	37
Namaqua	17	19	2	38
Karoo	26	16	4	46
Tankwa Karoo	21	24	3	48
Mapungubwe	36	28	0	64
West Coast	33	35	8	76
Augrabies Falls	31	50	3	84
Camdeboo	66	30	9	105
Mountain Zebra	35	58	12	105
Golden Gate Highlands	58	52	0	110
Agulhas	54	63	3	120
Bontebok	60	83	21	164
Addo Elephant	75	135	27	237
Garden Route	112	228	11	351
Table Mountain	181	436	34	651
Kruger	142	587	20	749

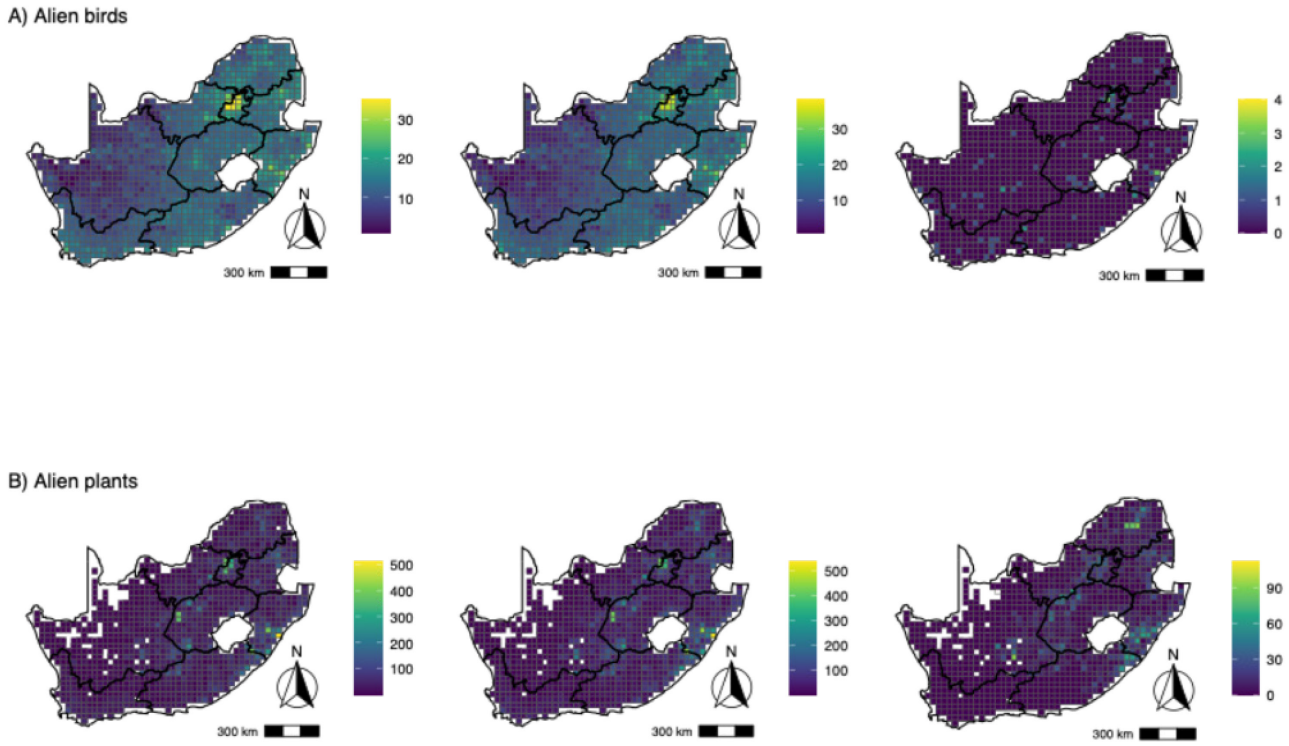

Figure S3.1. Alien species richness for up to the end of 2022, up to the end of 2025, and the change 2023–2025 for A) birds and B) plants

A map of invasive animal species richness was presented in the first report (SANBI and CIB, 2018) based on Picker and Griffiths (2017), but no update of these data was available and so this is not presented here.

S3.2 *Relative invasive abundance*

Table S3.4. Alien species richness in areas managed by the City of Cape Town as of September 2025

These included protected areas, conservation areas, biodiversity value sites (mountain catchment area, green belts, parks, stewardship sites, road verges, waterbodies outside protected areas) and other land uses (open land owned by the City of Cape Town in residential areas, streets)

Group	Proclaimed protected areas	Conservation area	Biodiversity value sites	Other land uses
Grasses, annuals, vines	61	60	36	46
Trees and shrubs	79	77	141	130
Terrestrial invertebrates	8	7	8	3
Amphibian				1
Birds			2	1

Table S3.5. Alien species richness in areas managed by the City of Ekurhuleni

The city is divided into six distinct management regions (A–F), with 'other areas' designating sampling sites that do not clearly fall into any specific region.

Group	A	B	C	D	E	F	Other areas
Grasses, annuals, vines	7	6	4	4	6	1	
Trees and shrubs	12	7	4	6	6	5	
Terrestrial invertebrates							2
Fishes							2
Birds							3
Mammals							2
Total	19	13	8	10	12	6	9

Table S3.6. Changes in the extent of invasion (condensed ha) of 14 alien plant taxa in nine terrestrial biomes in South Africa from successive surveys done in 2008 and 2023

A condensed hectare (mean % cover × area occupied) is the equivalent area occupied at a canopy cover of 100% (i.e., 50% cover on 10 ha = 5 condensed ha). Based on data from Kotzé et al. (2025)

Biome	Taxon	Extent in 2008	Extent in 2023	Change
Albany Thicket	*Acacia cyclops*	6791	4600	-2191
	Acacia saligna	3126	1759	-1367
	Acacia spp.	23658	30483	6825
	Arundo donax	2576	3053	477
	Cactaceae	35847	23411	-12436
	Eucalyptus spp.	8377	7796	-581
	Lantana camara	166	527	361
	Melia azederach	651	230	-421
	Neltuma (=*Prosopis*) spp.	817	947	130
	Pinus spp.	3703	3051	-652
	Populus spp.	805	554	-251
	Solanum mauritianum	1019	877	-142
Desert	*Neltuma* (=*Prosopis*) spp.	1780	1109	-671
Forest	*Acacia* spp.	936	1656	720
	Eucalyptus spp.	273	339	66
	Pinus spp.	639	556	-83
Fynbos	*Acacia cyclops*	57955	59632	1677
	Acacia saligna	50133	41702	-8431
	Acacia spp.	60825		-60825
	Arundo donax	1256	1030	-226
	Cactaceae	3767	1226	-2541
	Eucalyptus spp.	26624	51563	24939
	Hakea spp.	22047	18601	-3446
	Neltuma (=*Prosopis*) spp.	1371	960	-411
	Pinus spp.	43008	57259	14251
	Populus spp.	2846	6451	3605
	Solanum mauritianum	282	799	517
Grassland	*Acacia* spp.	294774	347814	53040
	Arundo donax	922	878	-44
	Cactaceae	4618	6761	2143
	Chromolaena odorata	5976	2278	-3698
	Eucalyptus spp.	121941	111826	-10115
	Lantana camara	3032	2107	-925
	Melia azederach	4360	3915	-445
	Neltuma (=*Prosopis*) spp.	1131	1375	244
	Pinus spp.	38742	26792	-11950

Biome	Taxon	Extent in 2008	Extent in 2023	Change
	Populus spp.	29922	28448	-1474
	Solanum mauritianum	7228	8877	1649
Indian Ocean Coastal Belt	*Acacia* spp.	8615	9265	650
	Arundo donax	696	1060	364
	Chromolaena odorata	11541	29024	17483
	Eucalyptus spp.	13626	26600	12974
	Lantana camara	7355	10612	3257
	Melia azederach	1696	4963	3267
	Pinus spp.	1116	2014	898
	Solanum mauritianum	7855	10346	2491
Nama Karoo	*Arundo donax*	1152	1692	540
	Cactaceae	4002	2886	-1116
	Eucalyptus spp.	2749	6210	3461
	Neltuma (=*Prosopis*) spp.	65861	80845	14984
	Pinus spp.	288	528	240
	Populus spp.	4026	3847	-179
Savanna	*Acacia cyclops*	207	9	-198
	Acacia saligna	679	468	-211
	Acacia spp.	114051	138469	24418
	Arundo donax	2139	2299	160
	Cactaceae	10887	7766	-3121
	Chromolaena odorata	57316	45831	-11485
	Eucalyptus spp.	69042	79738	10696
	Lantana camara	27040	26572	-468
	Melia azederach	20394	19342	-1052
	Neltuma (=*Prosopis*) spp.	10272	11619	1347
	Pinus spp.	9351	8774	-577
	Populus spp.	5227	4838	-389
	Solanum mauritianum	26837	26567	-270
Succulent Karoo	*Acacia cyclops*	468	181	-287
	Acacia saligna	597	525	-72
	Acacia spp.	419	217	-202
	Arundo donax	1383	946	-437
	Eucalyptus spp.	775	1497	722
	Neltuma (=*Prosopis*) spp.	13320	9917	-3403
	Populus spp.	772	1263	491

889 **Table S3.7. Changes in the extent of invasion (condensed ha) of 14 alien plant taxa in six primary catchments**
890 **in South Africa from surveys in 2008 and 2023**
891 A condensed hector (mean % cover × area occupied) is the equivalent area occupied at a canopy cover of 100%
892 (i.e., 50% cover on 10 ha = 5 condensed ha). Based on data from Kotzé et al. (2025)

Primary catchment	Taxon	Extent in 2008	Extent in 2023	Change
Berg	*Acacia cyclops*	36421	36836	415
	Acacia saligna	35851	35720	-131
	Acacia spp.	4659	10678	6019
	Arundo donax	556	309	-247
	Eucalyptus spp.	12956	24958	12002
	Hakea spp.	202	3516	3314
	Neltuma (=*Prosopis*) spp.	13320	9917	-3403
	Pinus spp.	10282	16330	6048
	Populus spp.	578	1713	1135
Breede	*Acacia cyclops*	10539	8130	-2409
	Acacia saligna	5045	3243	-1802
	Acacia spp.	17771	28063	10292

Primary catchment	Taxon	Extent in 2008	Extent in 2023	Change
	Arundo donax	253	380	127
	Eucalyptus spp.	5421	9993	4572
	Hakea spp.	6418	6643	225
	Pinus spp.	9237	9703	466
	Populus spp.	661	1327	666
Buffels	*Acacia cyclops*	552	362	-190
	Neltuma (=*Prosopis*) spp.	1829	337	-1492
Bushman's	*Acacia cyclops*	1799	2401	602
	Acacia saligna	444	358	-86
	Acacia spp.	7529	12042	4513
	Arundo donax	249	284	35
	Cactaceae	2242	2713	471
	Eucalyptus spp.	3746	3515	-231
	Pinus spp.	946	1746	800
	Solanum mauritianum	106	138	32
Fish	*Acacia* spp.	9736	17873	8137
	Arundo donax	1557	1968	411
	Cactaceae	13291	9744	-3547
	Eucalyptus spp.	1695	3641	1946
	Neltuma (=*Prosopis*) spp.	2216	2472	256
	Pinus spp.	1738	3733	1995
	Solanum mauritianum	96	122	26
Gamtoos	*Acacia cyclops*	694	75	-619
	Acacia saligna	623	134	-489
	Acacia spp.	9803	3499	-6304
	Arundo donax	237	453	216
	Cactaceae	4152	2254	-1898
	Eucalyptus spp.	193	906	713
	Hakea spp.	1538	1060	-478
	Neltuma (=*Prosopis*) spp.	3889	1920	-1969
	Pinus spp.	1880	3174	1294
	Populus spp.	1041	949	-92
Gouritz	*Acacia cyclops*	2038	1562	-476
	Acacia saligna	3349	165	-3184
	Acacia spp.	8717	10356	1639
	Arundo donax	907	1094	187
	Cactaceae	94	554	460
	Eucalyptus spp.	2412	2782	370
	Hakea spp.	4177	3683	-494
	Neltuma (=*Prosopis*) spp.	747	936	189
	Pinus spp.	1082	3534	2452
	Populus spp.	1542	2383	841
Kei	*Acacia* spp.	44829	60054	15225
	Arundo donax	200	281	81
	Cactaceae	683	1007	324
	Eucalyptus spp.	5827	5536	-291
	Lantana camara	2184	2180	-4
	Neltuma (=*Prosopis*) spp.	1239	763	-476
	Pinus spp.	4670	3533	-1137
	Solanum mauritianum	762	857	95
Keiskamma	*Acacia cyclops*	1005	642	-363
	Acacia saligna	1271	1211	-60
	Acacia spp.	27617	44215	16598
	Arundo donax	597	424	-173
	Cactaceae	352	499	147

Primary catchment	Taxon	Extent in 2008	Extent in 2023	Change
	Eucalyptus spp.	4614	3637	-977
	Lantana camara	177	604	427
	Melia azederach	737	220	-517
	Pinus spp.	3209	2571	-638
	Populus spp.	102	52	-50
	Solanum mauritianum	1713	1740	27
Komati	*Acacia* spp.	21797	21084	-713
	Chromolaena odorata	3969	1695	-2274
	Eucalyptus spp.	12637	21519	8882
	Lantana camara	3041	4552	1511
	Melia azederach	1130	441	-689
	Pinus spp.	4605	7306	2701
	Populus spp.	356	511	155
	Solanum mauritianum	3799	3744	-55
Kromme	*Acacia cyclops*	5627	11621	5994
	Acacia saligna	2708	890	-1818
	Acacia spp.	17122	25876	8754
	Eucalyptus spp.	4427	8017	3590
	Hakea spp.	9769	3716	-6053
	Pinus spp.	18980	21242	2262
	Populus spp.	404	433	29
	Solanum mauritianum	235	637	402
Limpopo	*Acacia* spp.	16363	15575	-788
	Arundo donax	959	447	-512
	Cactaceae	6371	2748	-3623
	Chromolaena odorata	1336	32	-1304
	Eucalyptus spp.	24186	18588	-5598
	Lantana camara	711	129	-582
	Melia azederach	12046	5062	-6984
	Neltuma (=*Prosopis*) spp.	12	6	-6
	Pinus spp.	2255	1174	-1081
	Populus spp.	4026	3417	-609
	Solanum mauritianum	3450	625	-2825
Mfolozi	*Acacia* spp.	45578	47851	2273
	Arundo donax	591	1285	694
	Chromolaena odorata	43935	37977	-5958
	Eucalyptus spp.	17207	17996	789
	Lantana camara	5917	4676	-1241
	Melia azederach	3512	7569	4057
	Pinus spp.	3905	3532	-373
	Populus spp.	430	482	52
	Solanum mauritianum	3662	4898	1236
Mkomazi	*Acacia* spp.	26656	30338	3682
	Arundo donax	567	744	177
	Chromolaena odorata	13328	19612	6284
	Eucalyptus spp.	16951	26624	9673
	Lantana camara	7296	9981	2685
	Melia azederach	1478	5979	4501
	Pinus spp.	4300	1493	-2807
	Populus spp.	107	232	125
	Solanum mauritianum	11869	14202	2333
Mzimvubu	*Acacia* spp.	115552	159687	44135
	Arundo donax	107	257	150
	Chromolaena odorata	6279	11823	5544
	Eucalyptus spp.	24447	35046	10599

Primary catchment	Taxon	Extent in 2008	Extent in 2023	Change
	Lantana camara	13809	15738	1929
	Melia azederach	1341	2415	1074
	Pinus spp.	10313	4534	-5779
	Populus spp.	622	366	-256
	Solanum mauritianum	14051	16866	2815
Olifants (North)	*Acacia* spp.	45148	41994	-3154
	Arundo donax	603	422	-181
	Cactaceae	1787	817	-970
	Chromolaena odorata	4604	3200	-1404
	Eucalyptus spp.	26948	21906	-5042
	Lantana camara	2698	372	-2326
	Melia azederach	1949	1741	-208
	Pinus spp.	4187	3554	-633
	Populus spp.	2994	2587	-407
	Solanum mauritianum	463	788	325
Olifants (South)	*Acacia cyclops*	108	265	157
	Acacia saligna	876	1343	467
	Acacia spp.	1049	983	-66
	Arundo donax	968	332	-636
	Eucalyptus spp.	1086	3111	2025
	Neltuma (=*Prosopis*) spp.	11290	9707	-1583
	Pinus spp.	1488	1959	471
	Populus spp.	461	1090	629
Orange	*Acacia* spp.	5147	6765	1618
	Arundo donax	724	1026	302
	Cactaceae	1440	2394	954
	Eucalyptus spp.	8844	16204	7360
	Melia azederach	394	438	44
	Neltuma (=*Prosopis*) spp.	72306	88861	16555
	Pinus spp.	3025	4470	1445
	Populus spp.	9911	12258	2347
Sundays	*Acacia cyclops*	943	224	-719
	Acacia spp.	1192	1589	397
	Arundo donax	614	792	178
	Cactaceae	21783	10630	-11153
	Eucalyptus spp.	2039	1559	-480
	Neltuma (=*Prosopis*) spp.	1768	2580	812
	Pinus spp.	202	1091	889
	Populus spp.	760	621	-139
Swartkops	*Acacia cyclops*	5097	2228	-2869
	Acacia saligna	4141	1333	-2808
	Acacia spp.	3626	3700	74
	Cactaceae	4717	3999	-718
	Eucalyptus spp.	2004	4133	2129
	Pinus spp.	1245	1447	202
Tugela	*Acacia* spp.	51170	48912	-2258
	Cactaceae	1813	1109	-704
	Chromolaena odorata	1336	2781	1445
	Eucalyptus spp.	11530	11845	315
	Lantana camara	1641	1482	-159
	Melia azederach	2685	3277	592
	Pinus spp.	3386	1558	-1828
	Populus spp.	1251	2009	758
	Solanum mauritianum	3000	2717	-283
Vaal	*Acacia* spp.	22172	21742	-430

Primary catchment	Taxon	Extent in 2008	Extent in 2023	Change
	Arundo donax	316	216	-100
	Cactaceae	692	3115	2423
	Eucalyptus spp.	53851	43987	-9864
	Melia azederach	1793	1166	-627
	Neltuma (=*Prosopis*) spp.	4751	1995	-2756
	Pinus spp.	5907	1399	-4508
	Populus spp.	14800	11557	-3243

S3.3 *Impact of invasions*

Data analysis approaches for surface water runoff reductions

The sections below detail efforts to replicate the values reported by van Wilgen et al. (2008) (hereafter referred to as 'the 2008 study') on the impacts of invasions on surface water runoff across five biomes: Fynbos, Savanna, Grassland, Nama Karoo, and Succulent Karoo. The process followed is summarised in a workflow (Fig. S3.2). Issues with the data and gaps in the methods are also highlighted below.

Figure S3.2 A workflow for the approach used to calculate the impacts of invasive plants (IAPs) on surface water runoff (SWR)
The diagram includes input data and expected intermediate outputs, and is based on a figure in Seebens et al. (2020). For further details on the input data see Table S3.7. SAPIA is the Southern African Plant Invaders Atlas.

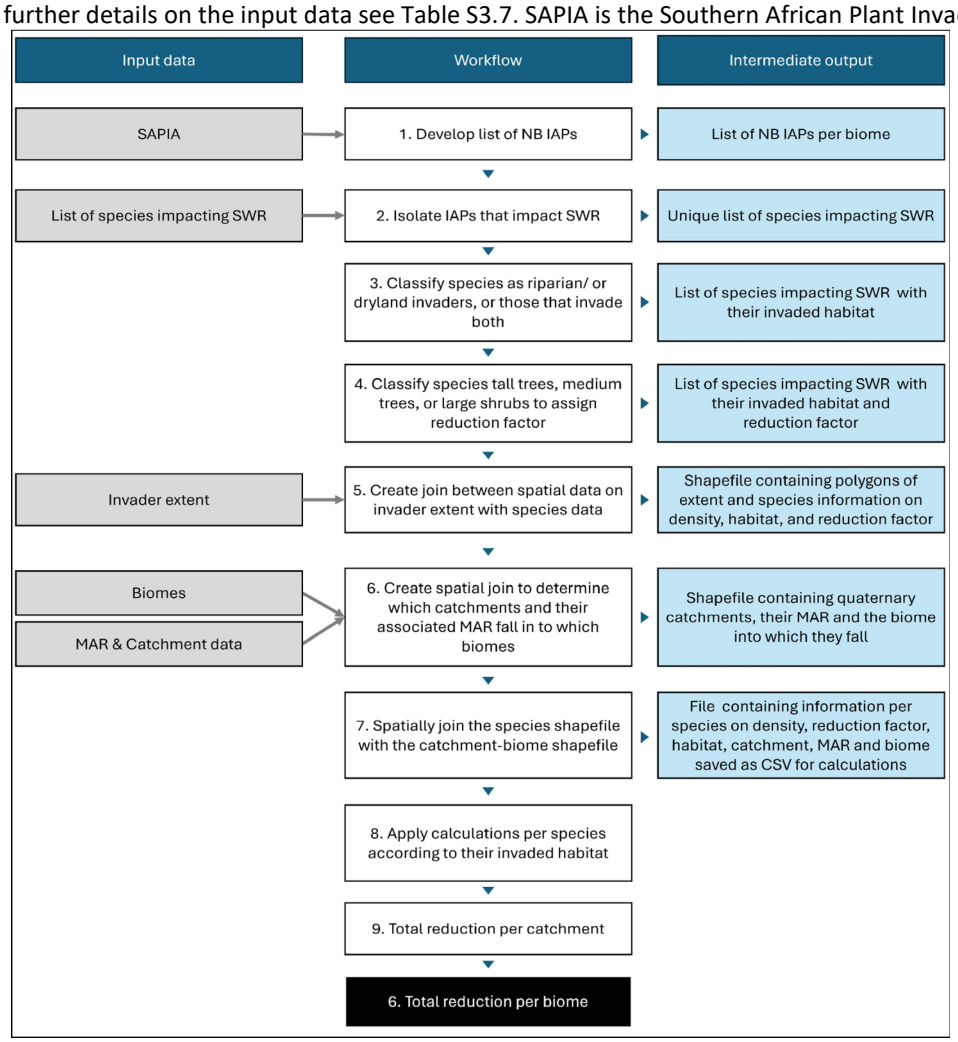

Table S3.8 A detailed description of the input data required for calculations on the impacts on surface water runoff, issues with these data, and approaches used to deal with these issues

Under 'Obtained from', DLM's hard drive, refers to data from David Le Maitre that are backed up at the CSIR, access was granted through Sarah Davies.

Data Name	Description	Purpose	Source	Obtained from	Meta-data	Issues	Approach in addressing issue
Biomes	Map of the biomes of South Africa	Definition of biome boundaries	Low & Rebelo (1996)	DLM's hard drives	NA	Data contained no spatial index and CRS	Spatial index created and reprojected to provide CRS in QGIS. The resultant file was saved and used for future analysis.
Southern African Plant Invaders Atlas (SAPIA)	Map of invasive alien plants in South Africa per Quarter Degree Grid cell (QDGC)	Isolate species that occur in >10% of the QDGCs per biome	Henderson (1998)	DLM's hard drives	Yes	No issues were detected with these data, however, the years for which the SAPIA data were extracted was not specified.	The data from DLM was used here rather than re-downloading the list of plants from SAPIA as no dates were provided and we needed to ensure the same list as that in the 2008 study.
List of species that impact surface water runoff	Isolated from the SAPIA list and classified in terms of their invaded habitat and their growth form	A species is classed as a tall tree, medium tree, or a large shrub to assign them a reduction factor (78%, 60%, and 23% accordingly). The species is then further classed as an invader of riparian/ dryland habitats or both which then determines which calculation of reduction applies (see Supplementary A1.1).	van Wilgen et al. (2008) & Le Maitre et al 2000	Table 3 in van Wilgen et al. (2008)	NA	1. The lists of species identified as 'important invaders per biome were highly inconsistent. For example, there are 16 species listed for Fynbos, 12 for Grasslands, 4 for Savanna, but only 1 species for each of the Karoo biomes. Additionally, a species deemed an important invader in one biome was not necessarily considered important in another, even when the Versfeld data indicated its presence. If a species was not identified as important in a particular biome according to Table 3 in the 2008 study, it was excluded from the calculations. 2. It is unclear whether DLM grouped major invaders into categories, such as 'wattles' or 'eucalypts,' for the purpose of the calculations, or if they were treated as individual species as listed in Table 3 of the 2008 study. Personal notes from DLM's hard drives state, 'still deciding on whether to lump these or not,' but no final decision is recorded in the notes or the study's methods.	The species lists were retained as specified in Table 3 of the 2008 study. Some calculations produced overestimates (See Fig. A1.2), and including more species would have further increased these estimates. Additionally, the number of species that would be added if a standardised list of important invaders were applied per biome is not significant enough to account for cases where our estimates were far lower than those in the 2008 study. Therefore, it was concluded that other factors likely had a greater impact on the estimates, and the species lists were retained as specified in the 2008 study.
Invader Extent	Maps on extent of invasive species	To determine the cover of each species on the list	Versfeld et al. (1998)	DLM's hard drives; a second set of the data were obtained from Andrew Wannenburgh	No	1. DLM data – the Versfeld files on DLMs hard drives were numerous and contained spatial data, and species data in excel format. It was unclear (due to the number of different files) whether the data had been manipulated or changed in any way and no metadata could be found. As such we requested the original Versfeld data from Andrew Wannenburgh – this was supplied per province (whereas DLM had various single files for the whole country) and contained only spatial files with no species files or information. 2. The distributions and occurrences of invaders in Versfeld are presented in NBALs. It is unclear how these NBALs were assigned or what units were applied (e.g., for area). In the species data, each species is associated with an NBAL, and in the spatial data, each polygon has an NBAL. A significant issue is that the NBAL names are not unique to each polygon—multiple polygons can have the same name. This made it challenging to perform spatial joins and to determine which species information (species name and density) corresponded to which polygon. I consulted individuals involved in the Versfeld study, but they were unaware of how to link the species data (Excel) to the spatial data (polygons). Additionally, we do not know how DLM joined these files or what assumptions and decisions were made during the process.	1. The spatial files from Andrew Wannenburgh were used to verify the country-scale Versfeld shapefile (the one we selected which seemed most intact) on DLM's hard drives. This confirmed that DLM had not altered or removed any data, as the information aligned. Therefore, we used DLM's files for further analysis. No species data were found in the files from Andrew Wannenburgh. 2. As it was not clear on how DLM joined the spatial and species data for analysis in the study, we joined the species and Versfeld data in two ways, using a one-to-one spatial join (i.e., one species was assigned to one NBAL) [used in Approach 1 and 2, see below]; and a many-to-many spatial join (i.e., all possible combinations of species and NBALs [used in Approach 3].

Data Name	Description	Purpose	Source	Obtained from	Meta-data	Issues	Approach in addressing issue
Mean Annual Runoff (MAR)	Mean Annual Runoff (MAR)	Estimates of mean annual run-off per quaternary	Schulze et al. (1997)	DLM's hard drives, the wr2012 study (https://waterresourceswr2012.co.za/about/)- all files	No	The catchment data on DLM's hard drives included a spatial layer with the catchment name, area, and MAR for each catchment. This indicates that the Schulze et al. (1997) data were joined with the quaternary catchment data (listed here below). There were no issues with how these data were joined, as MAR in Schulze et al. (1997) is provided per quaternary catchment. However, there are no metadata for the MAR or catchment data, making it difficult to determine the units for MAR [in $mmMm^3$] and the area of the catchment.	We downloaded the wr2012 data (more recent) to compare the datasets and try and identify the units of measurement. The comparison between DLMs catchment file and wr2012 showed that area in DLMs data seemed to be in square meters (m^2), and MAR in Mm3. There were some consistencies in MAR between the two data sets and some inconsistencies, i.e., some MAR numbers for some catchments were the same and others were different. As such we ran a different set of calculations using the wr2012 data [Approach 2] and compared that to our calculations using DLMs data [Approach 1] Note: due to the lack of metadata for both datasets the most likely units were assumed but could not be 100% confirmed.
Quaternary Catchments	Quaternary Catchment boundaries	Scale at which MAR impacts were assessed	South African Department of Water Affairs and Forestry	DLM's hard drives, the wr2012 study	NO file	As above – MAR and catchment data are one	As above

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Methods and method uncertainties

To prepare the data for calculations, spatial and tabular datasets had to be joined (Fig. S3.2 – steps 5, 6, and 7 in the workflow). Specifically, the Versfeld species data (Excel) and Versfeld spatial data needed to be joined to link species names and densities to polygons of occurrence (NBALs) across the country. The resultant Versfeld file (now containing species and spatial data) needed to be joined with catchment data (including mean annual runoff (MAR)) to determine which NBALs were associated with which catchments and what the virgin MAR was for those catchments. The resultant Versfeld-Catchment file then needed to be joined with the biome data to determine which NBALs and catchments fell into which biomes. This was necessary because the impact was calculated at a catchment scale first and then summed per biome to provide a total impact per biome. The final joined file (i.e., Versfeld + Catchment/MAR + Biomes) needed to contain essential information, including species name, species density, NBAL name, NBAL area, catchment name, catchment area, MAR, and biome name so that the calculations (Fig. S3.2) could be applied.

It was unclear how these data these data were joined in the original study - the methods followed were included in the 2008 study, were not documented in the author's notes, and was unknown to the authors consulted. However, the joined files underpin all the calculations, so various options were tested to assess their effects on the outcomes.

Approach 1

a. *Versfeld spatial (DLM) & Versfeld species (DLM) join:* one-to-one, i.e., a single species was assigned to a single NBAL.
b. *Resultant file (Versfeld file) & Catchment data (DLM) join*: One-to-many, i.e., rows were repeated for unique information - if an NBAL intersected two catchments, the NBAL's information was duplicated for each catchment.
c. *Resultant file (Versfeld-Catchment file) & Biomes (DLM) joined*: One-to-one, i.e., the largest overlap determined which biome a catchment belonged to.

Approach 2

The join types were applied as above using the same data except the catchment data (including MAR) from the wr2012 study were used rather than the catchment data used in the 2008 study.

Approach 3

a. *Versfeld spatial (DLM) & Versfeld species (DLM) join:* many-to-many, i.e., all combinations of species and NBALs were created.
b. *Resultant file (Versfeld file) & Catchment data (DLM) join*: one-to-one (using the intersect with the greatest overlap), i.e., a single NBAL was assigned to a single catchment.
c. *Resultant file (Versfeld-Catchment file) & Biomes (DLM)*: one-to-one join.

Calculations

Input variables

- *virginMAR*: virgin runoff for the catchment (in millions of m cubed)
- *redFac*: reduction factor after the 2008 study dependent on size class of the species, i.e., tall tree (78%), medium tree (60%), tall shrub (23%). Precent was converted to a decimal (e.g., 0.78) for the calculations.
- *areaNBAL*: area of NBAL in m^2. NBALS are polygons or lines of invasion from the Versfeld data.
- *catchArea:* area of catchment in m^2.
- *spDens*: density of species after Versfeld which is provided as a percentage canopy cover. This percentage was converted to a decimal (e.g., 50% to 0.5) for the calculation.
- *portionInvaded*: the portion of the catchment that is invaded per species was calculated and the result used in the final calculation

  portionInvaded = (areaNBAL*spDens)/catchArea

- *additional_use* - accounts for the following statement from Le Maitre et al. (2013): 'van Wilgen et al. (2008) assumed that 1% of each quaternary was riparian and that riparian invaders in these settings would use 500 mm/yr more than the MAR in that quaternary.' It is important to note that this was not clearly described in van Wilgen et al. (2008). To account for additional use in the riparian calculations, we converted the 500 mm to meters (0.5 m), multiplied it by the catchment area to calculate the volume in cubic meters, and then divided by 1 million to express the result in millions of cubic meters. This conversion ensured that all units were consistent throughout the calculations.

  additional_use = ((500/1000) * catchArea)/1000000

Final calculations:

There was a unique calculation per species dependent on whether it was classified as a riparian or dryland invader, or as an invader in both riparian and dryland settings. This 'habitat type' classification was taken from the 2008 study to ensure consistency.

- Dryland invader reduction

  reduction = (virginMAR*redFac) * portionInvaded

- Riparian invader reduction

  reduction = (virginMAR+additional_use*redFac) * portionInvaded

- Dryland & Riparian invader reduction

  reduction = (0.99* Dryland species reduction) + (0.01* Riparian species reduction)

Note: It was assumed that 1% of each catchment was riparian. Therefore, reductions for invaders of both dryland and riparian habitats were calculated as 1% riparian use and 99% dryland use. In Le Maitre et al. (2013), the 2008 study is referenced, stating that 1% of each quaternary was assumed riparian, and riparian invaders would reduce surface water runoff by 500 mm more than the MAR of the catchment. However, the 2008 study specifically refers to riparian zones covering 1% of each grid cell – this does not align with how the calculations were done for current invaders, which were performed at the quaternary catchment scale, not at the grid cell scale. The 2008 study also mentions usage being 500 mm more than the vegetation replaced, not 500 mm more than the virgin MAR of

the catchment. Given that David le Maitre did all the calculations for the 2008 study, we relied on his 2013 report for the calculations.

Results

The estimates obtained per approach varied greatly across biomes (Fig. S3.3). The outcomes were also inconsistent between biomes. For example, in Approach 3, there was a higher usage estimate for Fynbos, Savanna, and Grassland in comparison to the estimate under Approaches 1 and 2, while the estimate for the Karoo biome remained relatively stable and comparable to estimates from Approaches 1 and 2. In Approach 1, the estimate for Fynbos was close to the estimate in the 2008 study. However, estimates for the remaining four biomes were significantly lower than those from the 2008 study. None of the approaches came close to replicating the estimates in the 2008 study.

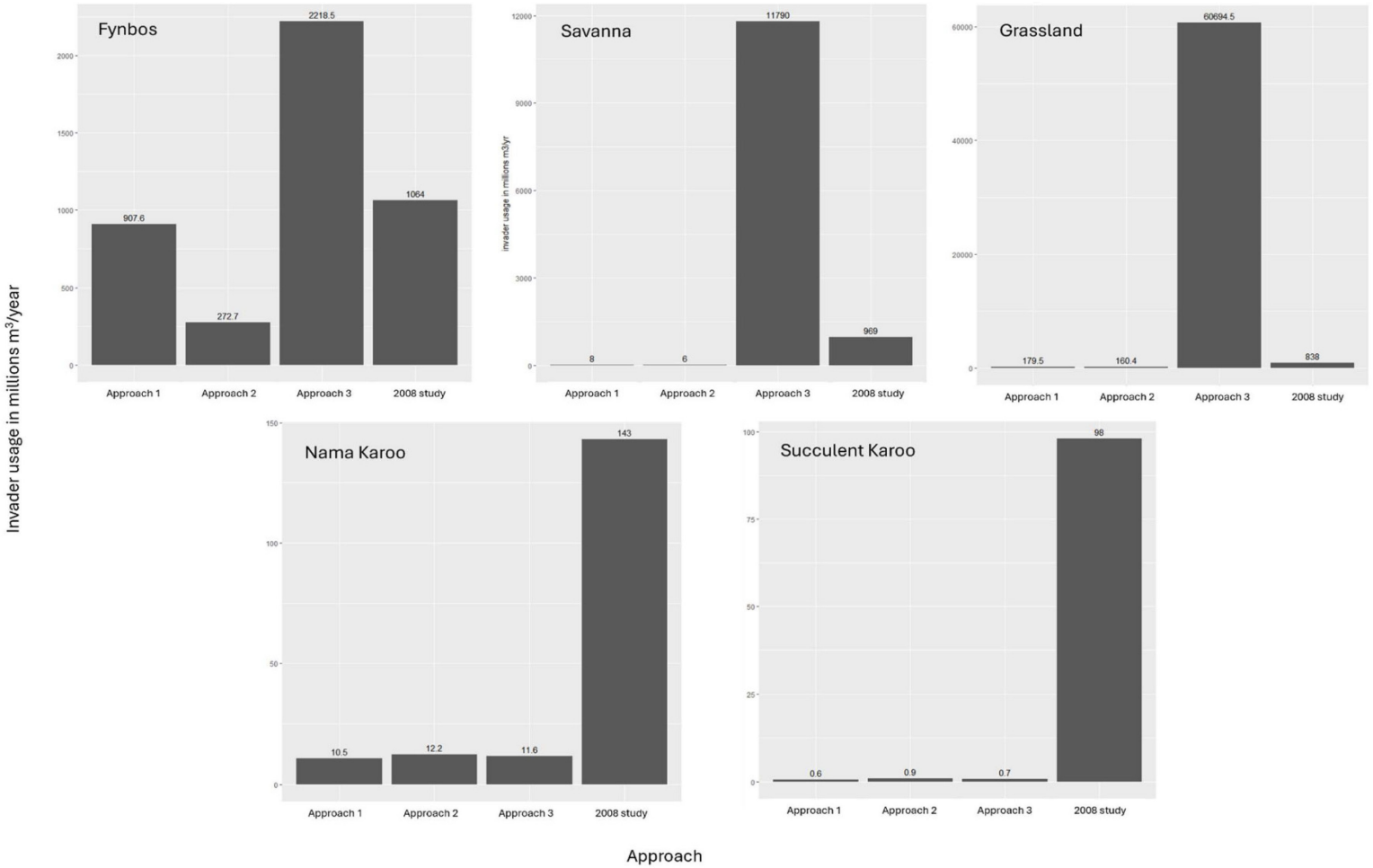

Figure S3.3. Additional surface water use by invaders per biome, per approach

The results from each approach are compared to the estimates obtained in the 2008 study which only considered these five biomes.

S3.4 Trends in indicators for sites

Table S3.10 Current status, confidence, trends, and outlook for species indicators

Indicator	Trend	Confidence	Desired trend	Current status	Outlook
3. *Extent of areas that suffer 'Major' impacts from invasions*	Not reassessed	NA	↘	Biological invasions continue to cause 'Major' impacts on biodiversity, ecosystem services and human livelihoods by reducing South Africa's water resources, degrading pasturelands and exacerbating fires. These estimates, however, have not been recently revised.	If control efforts focus on priority sites (e.g., sites that provide water to South Africa's towns and cities – Strategic Water Source Areas) then there will be significant returns on investment. However, without agreement on priorities, there is a substantial risk that control could remain ineffective, and the area that suffers from 'Major' impacts will continue to grow. Estimates of the full magnitude of impacts require more accurate assessments of the extent of invasions. This, in turn, requires effective mapping of the areas invaded and monitoring of spread. Such monitoring is currently lacking, and without which effective prioritisation is not possible.
3.1. *Alien species richness*	↗	low	↘ (for invasive species)	Significant increases were seen in various provinces and biomes, although without active surveillance this might be an artefact of more records being submitted to the citizen science platform iNaturalist.	The development of a robust and reliable monitoring methodology should be seen as a priority, because in the absence of reliable information on species richness and relative abundance, neither the magnitude of impacts nor the effectiveness of management can be properly assessed.

Indicator	Trend	Confidence	Desired trend	Current status	Outlook
3.2. *Relative invasive abundance*	↗	low	↘	There are a few country-wide estimates for the relative abundance of invasive species. Estimates were only available for protected areas managed by SANParks and CapeNature, and there have been no major changes in the relative abundance of invasive plants in these areas. The National Invasive Alien Plant Survey (2008–2023) also provided estimates for changes in the *relative invasive abundance* of selected plant species in terrestrial biomes and water catchment areas in South Africa. Most of the taxa in the biomes and water catchment areas have increased in cover despite mechanical and chemical control efforts, but there were decreases in cover for taxa under biological control.	Achieving consistency in tracking relative abundance in protected areas could be facilitated by the inclusion of a standardised monitoring protocol in the criteria for the preparation of management plans which were developed by the DFFE in terms of the A&IS Regulations. It is expected that existing invasions will densify unless managed. The costs of control and the impacts caused often increase dramatically with the level of invasion.
3.3. *Impacts of invasions*	not reassessed	NA	↘	Several studies have provided estimates for impacts of invasions at particular sites that indicate that biological invasions cause 'Major' impacts on biodiversity and ecosystems services, by among other things, reducing water resources, degrading pasture lands and exacerbating fires. However, these evaluations are often piecemeal or are limited by major assumptions.	Impacts are likely to increase as invasive species continue to spread and as control efforts are scaled back in response to fiscal constraints. This underscores the importance of refocussing control efforts on agreed priority sites and taking steps to improve control effectiveness. Impacts of invasions on sites have been quantified using different approaches and metrics over time and it is not yet possible to compare values with previous reports. There is therefore a need to develop systematic processes for evaluating the combined impacts of invasions at a given site.

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Supplementary Material to ‘Chapter 4: Interventions’

S4.1 ***Quality of regulatory framework***

Risk analyses sent to the DFFE by SANBI up to end December 2025 are shown in Table S4.1. These recommendations have no legal basis, and all are due to be scrutinised by the Risk Analysis Review Committee (RARC). The RARC will consider the recommendations with a view to potentially changing the A&IS Lists. The RARC may, of course, decide on a different regulatory listing, category, and prohibitions/exemptions to those recommended by a given risk analysis, not least as additional information might come to light that will require a risk analysis to be revised. While all the risk analyses have a digital object identifier, none of them are in the public domain (this is due to be discussed again once the RARC has had an opportunity to review the recommendations and comment on them). It is unclear the extent to which RARC deliberations will be put in the public domain. The regulatory name and listing are as they were on the date of submission of the risk analysis to DFFE. The column headings are intended to align with those used in the list of alien taxa compiled as part of the national status report. Updated from Wilson and Kumschick (2024).

Table S4.1. Risk analyses submitted by the South African National Biodiversity Institute (SANBI) to the Department of Forestry, Fisheries and the Environment (DFFE) following review by the Alien Species Risk Analysis Review Panel (ASRARP) as at end of 2025

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Acacia adunca A.Cunn. ex G.Don	1a	none	as listed	1a	none	none	26 March 2022	no	10.5281/zenodo.6386256
Acacia cyclops A.Cunn. ex G.Don	1b	none	as listed	1b	none	none	26 April 2024	no	10.5281/zenodo.11072848
Acacia dealbata Link	2	none	as listed	1b	use for community livelihood purposes exempt	none	30 September 2020	no	10.5281/zenodo.4060202
Acacia decurrens Willd. and hybrids, varieties and selections	2	Exempted for an existing plantation	*Acacia decurrens* Willd.	1b	none	none	23 April 2021	no	10.5281/zenodo.4715071
Acacia elata A. Cunn. ex. Benth	1b	none	as listed	1b	none	none	2 December 2024	no	10.5281/zenodo.14258040
Acacia fimbriata A.Cunn. ex G.Don	1a	none	as listed	1a	none	none	30 March 2022	no	10.5281/zenodo.6396178
Acacia implexa Benth.	1a	none	as listed	1a	none	none	30 March 2022	yes, by 2027	10.5281/zenodo.6395967
Acacia longifolia (Andrews) Willd.	1b	none	as listed	1b	none	none	19 June 2023	no	10.5281/zenodo.8055217
Acacia mearnsii De Wild. and hybrids, varieties and selections	2	Exempted for an existing plantation	*Acacia mearnsii* De Wild.	2	use for community livelihood purposes exempt	none	23 April 2021	no	10.5281/zenodo.4715075
Acacia melanoxylon R.Br. and hybrids, varieties and selections	2	Exempted for an existing plantation.	*Acacia melanoxylon* R.Br.	2	none	none	19 Mar 2025	no	10.5281/zenodo.15053251
Acacia paradoxa DC. (= *A. armata* R.Br.)	1a	none	*Acacia paradoxa* DC.	1a	none	none	26 February 2021	no	10.5281/zenodo.4564539
Acacia podalyriifolia A.Cunn. ex G.Don	1b	none	as listed	1b	none	none	11 November 2025	no	10.5281/zenodo.17578176
Acacia pycnantha Benth.	1b	none	as listed	1b	none	none	24 April 2024	no	10.5281/zenodo.11058434
Acacia saligna (Labill.) H.L.Wendl.	1b	none	as listed	1b	none	none	28 March 2025	no	10.5281/zenodo.15102129
Acacia stricta (Andrews) Willd.	1a	none	as listed	1a	none	none	30 March 2020	yes, by 2025	10.5281/zenodo.3732943

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Acarapis woodi (Rennie, 1921)	1b	none	as listed	1b	none	none	15 March 2019	no	10.5281/zenodo.4751650
Acer buergerianum Miq.	various	none	as listed	1b	trees >50m outside of riparian areas exempt	none	31 March 2023	no	10.5281/zenodo.7788943.
Acer negundo L.	various	none	as listed	1b	none	none	31 March 2023	no	10.5281/zenodo.7788996
Acridotheres tristis (Linnaeus, 1766)	3	none	as listed	1b	none	none	18 Mar 2025	no	10.5281/zenodo.15045703
Addax nasomaculatus (de Blainville, 1816)	2	none	*Addax nasomaculatus* (Blainville, 1816)	do not list	NA	none	12 February 2021	no	10.5281/zenodo.4536863
Aepyceros melampus petersi Bocage, 1879	2	none	*Aepyceros melampus* (Lichtenstein, 1812) subsp. *petersi* Bocage, 1879	1b	none	none	4 March 2021	no	10.5281/zenodo.4500976
Agave sisalana Perrine	2	none	as listed	2	none	none	5 December 2022	no	10.5281/zenodo.7400737
Ageratina adenophora (Spreng.) R.M.King & H.Rob. (= *Eupatorium adenophorum* Spreng.)	1b	none	*Ageratina adenophora* (Spreng.) R.M.King & H.Rob.	1b	none	none	19 December 2019	no	10.5281/zenodo.3585576
Ageratina riparia (Regel) R.M.King & H.Rob. (= *Eupatorium riparium* Regel)	1b	none	*Ageratina riparia* (Regel) R.M.King & H.Rob.	1b	none	none	20 August 2025	no	10.5281/zenodo.16909335
Ailanthus altissima (Mill.) Swingle	1b	none	as listed	1b	none	none	24 March 2020	no	10.5281/zenodo.3725649
Ammotragus lervia (Pallas, 1777)	2	none	as listed	2	none	none	16 January 2023	no	10.5281/zenodo.7540171
Anas platyrhynchos (Mallard)	2	none	*Anas platyrhynchos* (Linnaeus, 1758)	1b	exemptions outlined in an appendix	none	19 March 2020	no	10.5281/zenodo.3716165
Antilope cervicapra (Linnaeus, 1758)	2	none	as listed	2	none	none	1 March 2022	no	10.5281/zenodo.6319816
Araujia sericifera Brot.	1b	none	as listed	1b	none	none	22 April 2024	no	10.5281/zenodo.11034540

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon	3	none	*Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon (1845)	1b	none	none	3 December 2025	no	10.5281/zenodo.17804284
Atriplex inflata F.Muell. (= *A. lindleyi* Moq. subsp. *inflata* (F.Muell.) Paul G.Wilson)	1b	none	*Atriplex lindleyi* Moq. subsp. *inflata* (F.Muell.) Paul G.Wilson	1b	none	none	19 May 2023	no	10.5281/zenodo.7950942
Atriplex nummularia Lindl. subsp. *Nummularia*	2	none	*Atriplex nummularia* Lindl. subsp. *nummularia*	2	none	none	19 May 2023	yes, by 2028	10.5281/zenodo.7950772
Axis axis (Erxleben, 1777)	2	none	as listed	2	none	none	30 March 2021	no	10.5281/zenodo.4647068
Axis porcinus (Zimmermann, 1780)	2	none	as listed	2	none	none	28 June 2021	no	10.5281/zenodo.5036222
Bemisia tabaci (Gennadius,1889)	1b	none	*Bemisia tabaci* sensu lato	1b	none	none	11 January 2022	no	10.5281/zenodo.5837360
Bos frontalis Lambert, 1804	2	none	as listed	delist	NA	none	6 March 2024	no	10.5281/zenodo.10784527
Boselaphus tragocamelus (Pallas, 1766)	2	none	as listed	2	none	none	18 March 2022	no	10.5281/zenodo.6367289
Bryophyllum delagoense (Eckl. & Zeyh.) Schinz (= *B. tubiflorum* Harv., *Kalanchoe tubiflora* (Harv.) Raym.-Hamet, *K. delagoensis* Eckl. & Zeyh.)	1b	none	*Kalanchoe delagoensis* Eckl. & Zeyh.	1b	none	The risk analysis recommended using the name *Kalanchoe tubiflora* (Harv.) Raym.-Hamet but the nomenclature has changed since (https://powo.science.kew.org, accessed 30 Aug 2023)	29 September 2020	no	10.5281/zenodo.4058512
Canna indica L.	1b	none	*Canna indica* L.	1b	none	none	23 October 2025	no	10.5281/zenodo.17422935
Cardiospermum grandiflorum Sw.	1b	none	as listed	1b	none	none	31 March 2022	no	10.5281/zenodo.6401160
Cardiospermum halicacabum L.	3	none	as listed	1b	none	none	27 July 2023	no	10.5281/zenodo.8188551

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Casuarina cunninghamiana Miq.	various	none	as listed	2	plantings close to riparian areas or on untransformed land prohibited	none	22 October 2020	no	10.5281/zenodo.4118027
Centrochelys sulcata Gray, 1873	2	none	*Centrochelys sulcata* (Miller, 1779)	2	none	none	20 Mar 2025	no	10.5281/zenodo.15055430
Cervus elaphus Linnaeus, 1758	2	none	as listed	2	none	common name to include both red deer and elk	21 September 2021	no	10.5281/zenodo.5518568
Cervus nippon Temminick, 1838	2	none	as listed	1b	none	none	22 December 2023	yes	10.5281/zenodo.10423443
Chelydra serpentina (Linnaeus, 1758)	2	none	as listed	2	none	none	20 March 2024	yes, by 2029	10.5281/zenodo.10844372
Cherax cainii (Austin & Ryan, 2002)	2	catch and release prohibited	*Cherax cainii* Austin and Ryan, 2002	2	catch and release prohibited	none	28 March 2022	yes, by 2027	10.5281/zenodo.6390199
Cherax destructor Clark 1936	1a	catch and release prohibited	as listed	1a	none	none	22 March 2024	yes, by 2029	10.5281/zenodo.10853369
Cherax quadricarinatus (von Martens,1868)	1b	catch and release prohibited	as listed	1b	none	none	22 March 2024	no	10.5281/zenodo.10853501
Cherax tenuimanus (Smith, 1912)	2	catch and release prohibited	*Cherax tenuimanus* Smith, 1912	2	catch and release prohibited	none	28 March 2022	yes, by 2027	10.5281/zenodo.6390204
Chondrilla juncea L.	1a	none	as listed	1a	none	none	2 July 2019	yes, by 2024	10.5281/zenodo.4889844
Chromolaena odorata (L.) R.M.King & H.Rob. (= Eupatorium odoratum L.)	1b	none	Chromolaena odorata (L.) R.M.King & H.Rob.	1b	none	none	29 April 2024	no	10.5281/zenodo.11082398
Cinara cupressi (Buckton, 1881)	1b	none	*Cinara cupressi* sensu lato	1b	none	none	30 September 2020	no	10.5281/zenodo.4059942
Columba livia (Gmelin, 1789)	various	various	*Columba livia* J.F.Gmelin, 1789	2	non-commercial food use exempt	none	16 March 2023	no	10.5281/zenodo.7739937
Coreopsis lanceolata L.	various	none	as listed	1b	none	whether sterile cultivars or hybrids should be listed was not analysed	18 November 2019	no	10.5281/zenodo.3582672

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Cortaderia jubata (Lemoine ex Carrière) Stapf	1b	none	*Cortaderia jubata* (Lemoine) Stapf	1b	none	all cultivars to be included in regulation as these are genetically related	3 Dec 2024	no	10.5281/zenodo.14264679
Cortaderia selloana (Schult.) Asch. & Graebn.	1b	none	as listed	1b	none	none	3 Dec 2024	no	10.5281/zenodo.14265013
Crassostrea gigas (Thunberg, 1793)	2	various	*Magallana gigas* (Thunberg, 1793)	2	exemptions outlined in an appendix	The risk analysis recommended retaining the listing name as *Crassostrea gigas* but the nomenclature has changed since.	18 May 2018	no	10.5281/zenodo.4890068
Cylindropuntia pallida (Rose) F.M.Knuth	1a	none	as listed	1b	none	none	27 August 2021	no	10.5281/zenodo.5282733
Cylindropuntia spinosior (Engelm.) F.M. Knuth	1a	none	*Cylindropuntia imbricata* subsp. *spinosior* (Engelm.) M.A.Barker, Cloud-H. & Majure	1a	none	The risk analysis recommended retaining the listing name as *Cylindropuntia spinosior* but the nomenclature has changed since.	23 March 2022	yes, by 2027	10.5281/zenodo.6378994
Cytisus scoparius (L.) Link (= *Genista scoparia* (L.) Lam.)	1a	none	*Cytisus scoparius* (L.) Link	1a	none	none	31 March 2022	yes, by 2027	10.5281/zenodo.6400753
Dama dama (Linnaeus, 1758)	2	none	as listed	2	none	none	26 November 2020	no	10.5281/zenodo.4292277
Duranta erecta L. (= *D. repens* L., *D. plumieri* Jacq.)	various	none	*Duranta erecta* L.	1b	listed cultivars exempted	none	28 Mar 2025	yes	10.5281/zenodo.15101618
Elaphurus davidianus Milne-Edwards, 1866	2	none	as listed	do not list	none	none	28 Mar 2025	no	10.5281/zenodo.15100312
Eucalyptus camaldulensis Dehnh. and hybrids, varieties and selections	various	Exempted for an existing plantation	*Eucalyptus camaldulensis* Dehnh.	2	exemptions outlined in an appendix	none	27 January 2021	no	10.5281/zenodo.4471376

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Eugenia uniflora L.	1b	none	as listed	1b	trees planted prior to 2014 in urban areas more than 100m from riparian areas or untransformed land are exempt	none	6 March 2020	no	10.5281/zenodo.3698952
Fenneropenaeus indicus (H. Milne Edwards, 1837)	various	none	*Penaeus indicus* (H. Milne Edwards, 1837)	do not list	NA	native to a part of South Africa	29 March 2019	no	10.5281/zenodo.4896560
Gambusia affinis (Baird and Girard, 1853)	various	various	*Gambusia affinis* (Baird & Girard, 1853)	1b	none	none	30 March 2022	no	10.5281/zenodo.6396921
Hippotragus equinus koba (Gray, 1872)	2	none	*Hippotragus equinus* (É. Geoffroy Saint-Hilaire, 1803)	2	none	none	28 March 2025	no	10.5281/zenodo.15102314
Hippotragus niger Harris, 1838 (all subspecies except of H. n. niger)	2	none	*Hippotragus niger* (Harris, 1838)	2	none	none	28 March 2025	no	10.5281/zenodo.15102393
Hydrochoerus hydrochaeris (Linnaeus, 1766)	2	none	as listed	1b	none	none	30 March 2021	yes, by 2026	10.5281/zenodo.4646949
Hydrocleys nymphoides (Humb. & Bonpl. ex Willd.) Buchenau	1a	none	as listed	1a	none	reassessment in five years after an eradication feasibility study	26 April 2024	yes, by 2029	10.5281/zenodo.11072404
Hylocereus undatus (Haw.) Britton & Rose	various	none	*Selenicereus undatus* Haw. & D.R.Hunt	2	permits may only be issued for commercial fruit production; the fruit of Dragon fruit is not listed if used for human consumption	none	2 August 2021	no	10.5281/zenodo.5153307
Hypericum perforatum L.	2	none	as listed	2	none	none	21 October 2020	no	10.5281/zenodo.4115921
Iguana iguana (Linnaeus, 1758)	various	none	as listed	2	No permits to be issued to import, possess, breed, convey, and trade *I. iguana* in the Eastern Cape and KwaZulu-Natal.	none	6 April 2023	no	10.5281/zenodo.7805429

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Iris pseudacorus L.	1a	none	as listed	1b	none	none	26 November 2019	no	10.5281/zenodo.3582192
Jatropha curcas L.	2	none	as listed	1b	none	none	18 December 2019	no	10.5281/zenodo.3582785
Kobus ellipsiprymnus crawshayi (P. L. Sclater, 1894)	2	none	*Kobus ellipsiprymnus* (Ogilby, 1833) subsp. *defassa* (Rüppell, 1835)	1a	none	It is recommended that *Kobus ellipsiprymnus* subsp. *crawshayi* (currently listed as a separate subspecies) be considered as an ecotype of *K. e. subsp. defassa* and listed under a single listing	31 March 2023	no	10.5281/zenodo.7788400
Kobus ellipsiprymnus defassa (Rüppell, 1835).	2	none	*Kobus ellipsiprymnus* (Ogilby, 1833) subsp. *defassa* (Rüppell, 1835)	1a	none	none	31 March 2023	yes, by 2028	10.5281/zenodo.7788332
Kobus leche kafuensis Haltenorth, 1963	2	none	*Kobus leche* Gray, 1850 subsp. *kafuensis* Haltenorth, 1963	2	none	none	31 March 2023	no	10.5281/zenodo.7788284
Kobus leche leche Gray, 1850	2	none	*Kobus leche* Gray, 1850 subsp. *leche* Gray, 1850	2	none	The risk analysis recommended using the name *Kobus leche* subsp. *leche* Gray, 1850. For consistency the suggestion is to include the authorities for both the species and subspecies	25 March 2022	no	10.5281/zenodo.6384051
Kobus vardonii (Livingstone, 1857)	2	none	as listed	2	none	none	31 March 2023	yes, by 2028	10.5281/zenodo.7788232
Kunzea ericoides (A.Rich.) Joy Thomps. (= *Leptospermum ericoides* A. Rich.)	1a	none	*Kunzea ericoides* (A.Rich.) Joy Thomps.	1a	none	none	30 March 2021	yes, by 2026	10.5281/zenodo.4647555

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Lilium formosanum Wallace (= *L. longiflorum* Thunb. var. *formosanum* Baker)	1b	none	*Lilium formosanum* A.Wallace	1b	none	none	29 March 2019	no	10.5281/zenodo.4756205
Lythrum salicaria L.	1a	none	as listed	1a	none	none	17 Mar 2022	no	10.5281/zenodo.6365645
Macrochelys temminckii Troost in Harlan, 1835)	2	none	*Macrochelys temminckii* Troost, 1835	2	none	PIT tagging of individuals recommended	19 Mar 2025	no	10.5281/zenodo.15049399
Melaleuca hypericifolia Sm.	1a	none	as listed	1b	none	none	12 Feb 2019	no	10.5281/zenodo.4756290
Micropterus dolomieu (Lacepède, 1802)	various	various	*Micropterus dolomieu* Lacepède, 1802	2	exemptions and prohibitions outlined in an appendix	none	30 Mar 2023	no	10.5281/zenodo.7785981
Micropterus floridanus (Lesueur, 1822)	various	various	as listed	2	exemptions and prohibitions outlined in an appendix	none	30 Mar 2023	no	10.5281/zenodo.7786385
Micropterus floridanus (Lesueur, 1822) x *Micropterus salmoides* (Lacepède, 1802)	various	various	as listed	do not list	NA	already listed as parental taxa are both listed	30 Mar 2023	no	10.5281/zenodo.7786460
Micropterus punctulatus (Rafinesque, 1819)	various	various	as listed	2	exemptions and prohibitions outlined in an appendix	none	30 Mar 2023	no	10.5281/zenodo.7786135
Micropterus salmoides (Lacepède, 1802)	various	various	as listed	2	exemptions and prohibitions outlined in an appendix	none	30 Mar 2023	no	10.5281/zenodo.7786419
Morelia spilota (Lacépède, 1804)	2	none	as listed	2	none	none	21 Mar 2021	no	10.5281/zenodo.4630458
Murraya paniculata (L.) Jack. (= *M. exotica* L.)	various	none	as listed	1b	a) breeding in nurseries in KZN, LP, MP is exempt; b) not listed in EC, FS, G, NC, NWP, WC; c) sterile cultivars or hybrids are not listed	none	16 April 2024	yes, by 2029	10.5281/zenodo.10977000
Mustela putorius subsp furo (Linnaeus, 1758)	not listed	NA	*Mustela putorius subsp furo (Linnaeus, 1758)*	2	none	none	29 October 2025	no	10.5281/zenodo.17473323

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Myocastor coypus (Molina, 1782)	2	Prohibited for Restricted Activity (c): "Growing, breeding or in any other way propagating any specimen of a listed invasive species, or causing it to multiply."	as listed	prohibited list	NA	none	30 April 2019	no	10.5281/zenodo.4756375
Myrtillocactus geometrizans (Mart.) Console	1a	none	*Myrtillocactus geometrizans* (Mart. ex Pfeiff.) Console	1a	none	none	3 December 2024	yes, by 2029	10.5281/zenodo.14265968
Mytilus galloprovincialis (Lamarck, 1819)	2	various	*Mytilus galloprovincialis* Lamarck, 1819	2	none	none	15 March 2019	no	10.5281/zenodo.4756489
NA	not listed	NA	*Acacia cultriformis* A.Cunn. ex G.Don	1b	none	none	10 January 2023	no	10.5281/zenodo.7520507
NA	not listed	none	*Adalia bipunctata* (Linnaeus, 1758)	1b	flightless morphs present in the country exempted	none	28 Mar 2025	no	10.5281/zenodo.15101833
NA	not listed	NA	*Agapornis personatus* Reichenow, 1887	2	In the Northern Cape, no permits to be issued for breeding, conveying, or trading, with permits for possession limited to birds that were already present in the Northern Cape prior to this prohibition coming into effect.	none	29 March 2022	no	10.5281/zenodo.6394393
NA	not listed	NA	*Agapornis roseicollis* (Vieillot 1818)	do not list	NA	consider for provincial listing	28 March 2022	no	10.5281/zenodo.6390407
NA	not listed	NA	*Alnus glutinosa* (L.) Gaertn.	1b	none	none	26 November 2020	no	10.5281/zenodo.4292204
NA	not listed	NA	*Asphodelus fistulosus* L.	1a	none	none	20 July 2023	yes	10.5281/zenodo.8167476

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NA	not listed	NA	*Cistus ladanifer* L.	1a	none	none	23 March 2021	no	10.5281/zenodo.4630696
NA	Not listed	NA	*Cygnus atratus* (Latham, 1790)	2	none	none	31 March 2023	no	10.5281/zenodo.7789281
NA	not listed	NA	*Desmodium uncinatum* (Jacq.) DC.	1b	none	none	5 February 2021	no	10.5281/zenodo.4506259
NA	not listed	none	*Duttaphrynus melanostictus* (Schneider 1799)	prohibited	none	none	19 Mar 2025	no	10.5281/zenodo.15052928
NA	not listed	NA	*Euwallacea fornicatus* (Eichhoff, 1868)	1b	none	none	10 July 2021	no	10.5281/zenodo.5089866
NA	not listed	NA	*Fusarium euwallaceae* S. Freeman, Z. Mendel, T. Aoki & O'Donnell	1b	none	none	10 July 2021	no	10.5281/zenodo.5089866
NA	Not listed	NA	*Lymantria dispar* Linnaeus, 1758	prohibited list	NA	none	17 Jan 2023	no	10.5281/zenodo.7544043
NA	not listed	NA	*Oncorhynchus mykiss* (Walbaum, 1792)	2	catch-and-release is exempt in areas specified in maps produced as part of a National Management Plan for *O. mykiss*	none	26 Mar 2022	no	10.5281/zenodo.6386318
NA	not listed	NA	*Phyllostachys aurea* Rivière & C.Rivière	1b	none	none	30 Sep 2020	no	10.5281/zenodo.4059290
NA	not listed	NA	*Rhinella marina* (Linnaeus, 1758)	1a	none	none	23 March 2022	no	10.5281/zenodo.6378801

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
NA	Not listed	NA	*Salmo trutta* Linnaeus, 1758	2	catch-and-release is exempt in areas specified in maps produced as part of a National Management Plan for *S. trutta* Permits will only be issued for particular species at designated sites as outlined in a national management plan for the group Exemptions: a. The stocking of dams (farm or public) in catchments where the species already occurs providing such dams are not either in or upstream of Important Fish Areas (FEPA "fish sanctuaries"). b. Catch and release providing such release is at the same site as where the fish was caught. Catch and kill is strongly encouraged at any sites where stocking is not permitted or exempt.	none	31 March 2023	no	10.5281/zenodo.7789150
NA	not listed	NA	*Sphaeropteris cooperi* (F. Muell.) R.M. Tryon	1b	none	none	30 Nov 2018	no	10.5281/zenodo.5027595
NA	not listed	none	*Syzygium australe* (J.C.Wendl. ex Link) B.Hyland	1b	exemptions for existing plants in private gardens more than 100 m from riparian areas	none	3 June 2024	yes	10.5281/zenodo.11442551

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Nasturtium officinale R.Br. (= *Rorippa nasturtium-aquaticum* (L.) Hayek)	2	none	*Nasturtium officinale* W.T.Aiton	2	the harvesting of naturalised populations for human consumption or medicinal purposes is exempt providing it does not involve the spread of seeds or rhizomatous material	none	22 Aug 2023	no	10.5281/zenodo.8271840
Nephrolepis cordifolia (L.) C.Presl (= *Polypodium cordifolium* L.)	various	none	*Nephrolepis cordifolia* (L.) C.Presl	1b	none	none	28 Mar 2022	no	10.5281/zenodo.6390820
Nephrolepis exaltata (L.) Schott (= *Polypodium exaltatum* L.)	various	none	*Nephrolepis exaltata* L. (Schott)	1b	none	none	28 Mar 2022	yes, by 2027	10.5281/zenodo.6390824
Nerium oleander L.	various	none	as listed	1b	none	none	27 May 2020	no	10.5281/zenodo.3859982
Nymphoides peltata (S.G.Gmel.) Kuntze (= *Limnanthemum peltatum* S.G.Gmel.)	1a	none	*Nymphoides peltata* (S.G.Gmel.) Kuntze	1a	none	none	12 Jan 2023	no	10.5281/zenodo.7529731
Opuntia stricta (Haw.) Haw. var. *stricta* and var. *dillenii* (Ker Gawl.) L.D.Benson (= *O. dillenii* (Ker Gawl.)Haw.)	1b	none	*Opuntia stricta* (Haw.) Haw.	1b	none	none	29 Mar 2023	no	10.5281/zenodo.7780505.
Oreochromis niloticus (Linnaeus, 1758)	various	various	as listed	2	none	none	11 Dec 2018	no	10.5281/zenodo.4896423
Oryx dammah (Cretzschmar, 1827)	2	none	as listed	1b	none	none	3 Feb 2022	no	10.5281/zenodo.5958264
Ovis aries musimon Pallas, 1762	2	none	*Ovis aries* Linnaeus, 1758 subsp. *musimon* (Pallas, 1811)	2	none	none	26 Jul 2023	no	10.5281/zenodo.8186434
Oxyura jamaicensis (Gmelin, 1789)	2	none	*Oxyura jamaicensis* (J. F. Gmelin, 1789)	1a with management for efforts implemented	none	none	8 Feb 2024	no	10.5281/zenodo.10634437
Pacifastacus leniusculus (Dana, 1852)	1a	none	as listed	1a	none	none	22 Mar 2024	yes, by 2029	10.5281/zenodo.10853191

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Parthenium hysterophorus L.	1b	none	as listed	1b	none	none	28 Sep 2021	no	10.5281/zenodo.5534201
Paspalum quadrifarium Lam.	1a	none	as listed	1b	none	none	11 Dec 2018	no	10.5281/zenodo.4896500
Pennisetum purpureum Schumach.	2	none	Cenchrus purpureus *(Schumach.) Morrone*	2	none	none	28 Mar 2025	yes	10.5281/zenodo.15101043
Pennisetum setaceum (Forssk.) Chiov.	various	none	*Cenchrus setaceus* (Forssk.) Morrone	1b	specified sterile cultivars / hybrids listed in the scope of exemption column exempted	none	5 September 2020	no	10.5281/zenodo.4019028
Phasmatodea species (Jacobson and Blanchi, 1902)	1b	none	*Carausius morosus* (Sinety, 1901)	1b	none	none	15 March 2019	no	10.5281/zenodo.5027716
Populus alba L.	2	none	as listed	2	none	none	31 Mar 2021	yes	10.5281/zenodo.4650396
Populus x *canescens* (Aiton) Sm.	2	none	as listed	2	none	none	31 Mar 2021	yes	10.5281/zenodo.4650400
Procambarus clarkii (Girard, 1852)	not listed	none	as listed	1b	none	none	9 Feb 2024	no	10.5281/zenodo.10638441
Psidium cattleianum Sabine (= *P. littorale* Raddi var. *longipes* (O.Berg.) Fosberg	1b	none	*Psidium cattleyanum* Sabine	1b	none	none	30 Nov 2018	no	10.5281/zenodo.4756847
Psidium guajava L.	various	none	as listed	2	a) The fruit of guava is not listed if used for human consumption; and b) Guava is exempt in the Free State, Gauteng, Northern Cape, North-West Province, and the Western Cape.	none	27 March 2024	no	10.5281/zenodo.10888266
Psittacula krameri (Scopoli, 1769)	2	various	as listed	1b	none	none	18 May 2018	no	10.5281/zenodo.5026977
Pueraria montana (Lour.) Merr. var. *lobata* (Willd.) Maesen & S.M.Almeida (= *P. lobata* (Willd.) Ohwi)	1a	none	*Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & S.M.Almeida ex Sanjappa & Predeep	1a	none	none	9 Feb 2022	yes	10.5281/zenodo.6024210
Pycnonotus cafer (Linnaeus, 1766)	2	none	as listed	1a	none	none	30 Nov 2018	no	10.5281/zenodo.4756881

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Pyracantha angustifolia (Franch.) C.K.Schneid.	1b	none	as listed	1b	none	none	29 April 2024	no	10.5281/zenodo.11085948
Python bivittatus (Kuhl, 1820)	2	none	*Python bivittatus* Kuhl, 1820	2	prohibition on import and breeding	none	18 March 2025	no	10.5281/zenodo.15047732
Python natalensis x *Python molurus*	1a	none	NA	do not list	NA	taxon does not exist, if it did it would already be listed	23 March 2022	no	10.5281/zenodo.6378454
Rattus norvegicus (Berkenhout, 1769)	various	none	as listed	various	exempt for use in the pet / exhibit trade (including for use as feed) and for research or educational purposes	proposed to be listed as 1b on the mainland and 1a on offshore islands. the exemption was included in the recommended category but should have been elsewhere	10 January 2022	no	10.5281/zenodo.5834153
Rattus rattus (Linnaeus, 1758)	various	none	as listed	various	none	proposed to be listed as 1b on the mainland and 1a on offshore islands	27 January 2021	no	10.5281/zenodo.4472180
Rattus tanezumi Temminck, 1844	various	none	*Rattus tanezumi* (Temminck, 1845)	various	none	proposed to be listed as 1b on the mainland and 1a on offshore islands	10 January 2022	no	10.5281/zenodo.5834014
Ricinus communis L.	2	none	as listed	2	none	none	18 December 2019	yes, by 2024	10.5281/zenodo.3582889
Robinia pseudoacacia L.	1b	none	as listed	1b	none	none	18 May 2018	no	10.5281/zenodo.5027151
Rosa rubiginosa L. (= *R. eglanteria* L.)	1b	none	*Rosa rubiginosa* L.	1b	the harvesting of rosehips from invasive and naturalised populations along the Maloti-Drakensberg mountain region for the purpose of subsistence livelihoods is exempt providing it does not involve the spread of rhizomatous material	none	20 March 2024	no	10.5281/zenodo.10844045
Rusa unicolor (Kerr, 1792)	2	none	*Rusa unicolor* (Kerr, 1792)	1b	none	none	23 March 2021	yes, by 2026	10.5281/zenodo.4630790

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Sagittaria platyphylla (Engelm.) J.G.Sm.	1a	none	*Sagittaria platyphylla* (Engelm.) J.G.Sm.	1b	none	none	29 March 2019	no	10.5281/zenodo.5027351
Sasa ramosa (Makino) Makino & Shibata (= *Arundinaria vagans* Gamble)	3	none	*Sasaella ramosa* (Makino) Makino	do not list	NA	The risk analysis recommended using the name *Sasa ramosa* (Makino) Makino & Shibata but the nomenclature has changed since	12 Feb 2019	no	10.5281/zenodo.5027451
*Semimytilus patagonicus (*Hanley, 1843*)*	1b	none	*Semimytilus patagonicus* (Hanley, 1843)	1b	Harvesting is exempt	Given the difficulties in separating the two taxa in practice, the risk analysis of *S. patagonicus* should be aligned with the risk analysis for *Mytilus galloprovincialis*, and future revisions of the two risk analyses should be done in parallel	31 October 2025	yes	zenodo.17491510
Senna bicapsularis (L.) Roxb. (= *Cassia bicapsularis* L.)	1b	none	*Senna bicapsularis* (L.) Roxb.	1b	none	none	29 March 2019	no	10.5281/zenodo.5027534
Senna didymobotrya (Fresen.) H.S.Irwin & Barneby (= *Cassia didymobotrya* Fresen.)	various	none	*Senna didymobotrya* (Fresen.) H.S.Irwin & Barneby	1b	none	none	31 Oct 2025	no	10.5281/zenodo.17492240
Senna *hirsuta* (L.) H.S.Irwin & Barneby (= *Cassia hirsuta* L.)	1b	none	*Senna hirsuta* (L.) H.S.Irwin & Barneby	1b	none	none	31 Oct 2025	no	10.5281/zenodo.17492511
Senna occidentalis (L.) Link (= *Cassia occidentalis* L.)	1b	none	*Senna occidentalis* (L.) Link	1b	none	none	1 Nov 2025	no	10.5281/zenodo.17493085
Senna pendula (Willd.) H.S.Irwin & Barneby var. *glabrata* (Vogel) H.S.Irwin & Barneby (= *Cassia coluteoides* Collad.)	1b	none	*Senna pendula* (Willd.) H.S.Irwin & Barneby	1b	none	none	31 Oct 2025	no	10.5281/zenodo.17493858

regulatoryName	Regulatory Listing	Exemption or Prohibition	Recommended regulatoryName	Recommended Listing	Recommended Exemptions or Prohibitions	notes	Date approved	Flagged for re-evaluation	doi
Senna septemtrionalis (Viv.) H.S.Irwin & Barneby (= *Cassia floribunda* sensu Brenan, C. laevigata Willd.)	1b	none	*Senna septemtrionalis* (Viv.) H.S.Irwin & Barneby	1b	none	none	1 Nov 2025	no	10.5281/zenodo.17494007
Solanum mauritianum Scop.	1b	none	as listed	1b	none	The risk analysis recommended using the name *Solanum mauritianum* Scopoli but an abbreviated authority is used on POWO	1 Sep 2020	no	10.5281/zenodo.4018939
Sorghum halepense (L.) Pers.	2	none	as listed	1b	none	none	31 Mar 2022	no	10.5281/zenodo.6400942
Spartium junceum L.	various	none	as listed	1b	none	none	3 Feb 2022	no	10.5281/zenodo.5959982
Sus scrofa Linnaeus, 1758	various	none	as listed	1b	exemption for any animal in captivity or free-roaming for which there is clear evidence of ownership	none	27 March 2024	no	10.5281/zenodo.10887690
Syzygium cumini (L.) Skeels	various	The fruit of the jambolan is not listed if used for human consumption.	as listed	1b	none	none	3 June 2024	no	10.5281/zenodo.11444623
Syzygium jambos (L.) Alston	3	none	as listed	1b	individual trees planted by humans in cultivated areas outside of riparian zones prior to 2014 are exempt	The risk analysis recommended using the name *Syzygium jambos* L. Alston but the bracketing of the first authority is missing	24 March 2020	no	10.5281/zenodo.3726026
Tetrapygus niger (Molina, 1782)	1a	none	as listed	prohibited list	NA	none	19 June 2023	no	10.5281/zenodo.8054725
Tithonia diversifolia (Hemsl) A. Gray	1b	none	as listed	1b	none	none	21 October 2020	no	10.5281/zenodo.4115995
Ulex europaeus L.	1a	none	as listed	1a	none	none	17 May 2023	yes, by 2028	10.5281/zenodo.7944132
Vespula germanica (Fabricius, 1793)	1b	none	as listed	1b	none	none	30 April 2019	no	10.5281/zenodo.4756059

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S4.2 *Money spent*

Table S4.2. The amount of *money spent* by different organisations on aspects of biological invasions (2020–2025)

Figures are millions of ZAR, adjusted for inflation to 2025 values. Much of the money reported as spent by the DFFE WfW was allocated to other organisations (e.g., 100% of the amount recorded here as spent by SANBI, and most of SANParks funding). This means that the overall total cannot be calculated by summing up columns.

Organisation / sector	2020	2021	2022	2023	2024	2025	2023–2025
DFFE WfW	NA	NA	NA	482.6	351.1	162.7	996.4
Biological control of invasive plants	66.0	73.4	82.3	6.0	16.2	15.5	37.7
SANBI[1]	NA	NA	53.7	52.4	51.6	41.6	145.6
SANParks	NA	NA	NA	226.9	219.4	220.4	666.7
City of Cape Town[3]	NA	NA	NA	52.6	46.1	41.6	140.3
The Greater Cape Town Water Fund[4]	12.7	37.8	36.2	31.9	115.0	150.0	184.4
City of Ekurhuleni[5]	NA	NA	11.6	13.3	13.3	NA	26.6
Management of border posts	NA	NA	NA	NA	NA	NA	NA
Control of house crows[6]	NA	2.6	0.2	1.4	1.4	0.5	3.3

[1]For 2023–2025, 49% on detection and risk analysis, 25% on eradication planning and implementation, 19% on taxonomic research, and 6.7% on the preparation of the status report

[3]89.4% on plants, 6.6% on the polyphagous shot hole borer, and 4% on other animals

[4]Figure is a projection, 37.5M was spent up to 31 July 2025

[5]Budgeted amounts

[6]Figures for City of Cape Town only. Money was also spent in eThekweni (Durban) but amounts not yet supplied

S4.3 *Planning coverage*—pathways

In previous reports *planning coverage* for pathways was determined based on the number of pathways that are currently managed and those for which plans have been developed, but for which management is not yet in place. Therefore, it was assumed that plans are in place for all pathways that are managed. The global nature of pathways means that pathway management is often guided by international agreements and by the various guidelines and standards linked to these agreements. Therefore, this decision was taken as it is difficult to determine the true extent to which plans are in place for pathways that are managed. It was also not clear whether and how pathway management plans should differ from international guidelines and standards. Recently, however, guidance has been provided at an international level on the role and composition of what has been termed 'pathway action plans' (CBD and IUCN 2024), and this has necessitated a reinterpretation of the situation.

According to these guidelines pathway action plans should be developed for pathways that have been prioritised for management and for which management is feasible, and should set out strategic actions (e.g., at-border checks, methods to minimise contamination, codes of practice, awareness raising) that need to be taken for each pathway (whether or not groups of pathways are being targeted). While the actions outlined in these plans should be informed by international agreements, additional, national

actions that are required need to be identified and included. Below is a summary of the sections that pathway action plans should contain (taken from Scalera and Genovesi 2016):

- Description of the target pathway: including spatio-temporal analysis highlighting trends, evaluation of impacts and risks of associated species; identification of knowledge gaps and inconsistencies);
- Policy and legal background: including policy and legal background at the global, regional, national and local levels; process for development, approval, review and revision of the pathway action plan; responsibilities);
- Aims and strategies: including the overall objective(s) of the pathway action plan, and the specific objectives of each action; performance indicators;
- Identification of key stakeholders: including the name and role of each main stakeholders; opportunities and need to involve active participation of some stakeholders;
- Foreseen actions: including a clear explanation of the required actions; their priority; technical and financial means required; an exhaustive description for each action on what will be done, how, where and by whom;
- Time schedule: including a detailed time schedule for the plan and for each action; and
- Financial planning: including cost for the plan and for each action; analysis of funding sources

No pathway management plans that follow these guidelines have been developed for South Africa. In the previous report (2020–2022) it was reported that 40 pathways (91%) had plans in place, it was unclear whether one pathway had a plan in place, and three pathways had no plans in place. The changes are due to our reinterpretation of the situation. Importantly, there is no legal requirement for pathway management plans, as per the NEM:BA A&IS Regulations or any of the other relevant regulations. As there has been no national exercise to prioritise pathways for management or to determine the feasibility of such management, for this indicator we assumed that all pathways should be managed, and thus should have a plan in place. Ballast water management plans have reportedly been developed for eight ports, but a study found that only three such reports (Port of Saldanha Bay, Port of Ngqura, and the Port of Durban) could be produced (Calitz 2012). The requirements set out in these plans differ (Calitz 2012), and they do not meet the guidelines for national level pathway action plans. Notably, the ballast water management plan for one of these ports (Saldanha Bay) is still well-recognised and details several mechanisms to track and control ballast water release (Anchor Environmental Consultants 2024). As this assessment is largely based on the knowledge of experts, our confidence in the assessment is low. See Appendix 5 for the data used in this assessment and for our confidence in the assessment for each pathway.

S4.4 *Planning coverage*—sites

Table S4.3 The number of site-specific management plans ('Invasive Species Monitoring, Control and Eradication Plans' as per the A&IS Regulations) submitted to and approved by the DFFE since 2016

Province	State		Private	
	Submitted	Approved	Submitted	Approved
Eastern Cape	8	3	0	0
Free State	4	2	1	1
Gauteng	6	1	1	1
KwaZulu-Natal	11	0	2	0
Limpopo	6	2	0	0
Mpumalanga	0	0	1	1
Northern Cape	8	6	0	0
North-West	0	0	2	1
Western Cape	85	34	81	52
Total	128	48	88	56

S4.5 *Pathways treated*

Pathways treated is the number of pathways requiring management that are managed to some degree. As in the previous reports, all pathways should require management. Although organisms might not have been introduced through some pathways, changes to socioeconomic trends could lead to introductions through these pathways. In the previous report, it was reported that 39 pathways (89%) were managed to some extent, with 19 pathways (43%) having partial management, and 20 having complete management (45%). There has been a slight change to this assessment, with 20 pathways having partial management, and 20 having complete management. This change is due to the collection of new information (on ballast water management) that necessitated a revision to the baseline. As permits are required to import alien taxa, all pathways that involve the intentional introduction of alien taxa have complete management (45% of pathways). As interventions for pathways that involve the accidental introduction of alien taxa are not in place at all ports of entry and focus on threats to human health and agriculture, and neglect other threats, these pathways have partial management (45% of pathways). As this assessment is largely based on the knowledge of experts, the confidence is low.

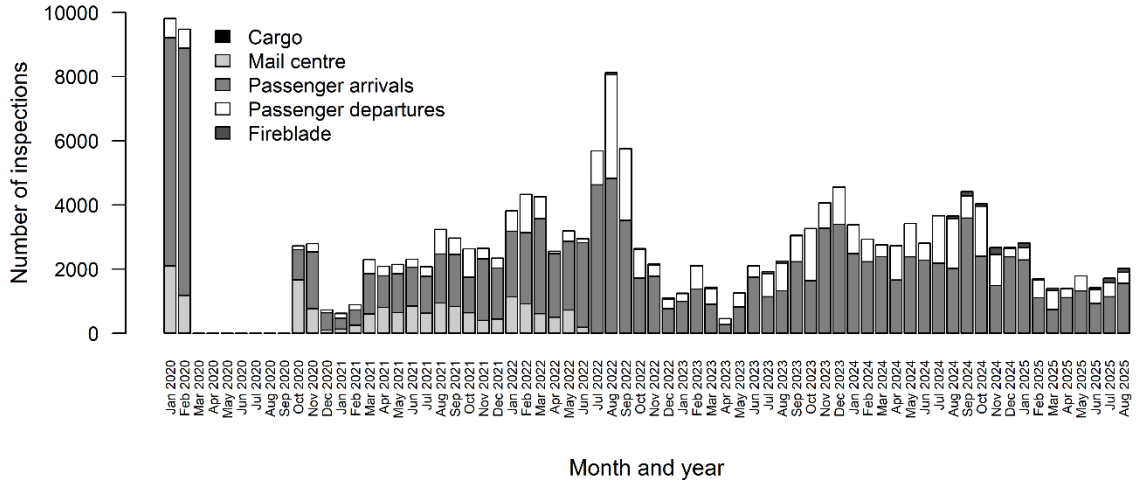

Figure S4.1 The number of inspections performed at OR Tambo International Airport for environmental threats between January 2020 and August 2025.

S4.6 *Effectiveness of treatments*

For research into the effectiveness of other interventions see Table S4.4.

The *effectiveness of pathway treatments* was determined based on recently published data and data obtained from management agencies. In the previous report, it was reported that one pathway (aesthetic release) had permanent management (2%) as this pathway is no longer present, six pathways (14%) were effectively managed as there have been no recent introductions or as the pathway is well regulated and there have been no illegal introductions, 21 pathways (48%) had either no management or management was ineffective as there is evidence of illegal introductions or non-compliance, and the management effectiveness of 15 pathways (34%) was not known as the data are inadequate. There has been little change to these estimates. One pathway (aesthetic release) had permanent management (2%) as this pathway is no longer present, five pathways (11%) were effectively managed as there have been no recent introductions or as the pathway is well regulated and there have been no illegal introductions, one pathway had partially effective management (2%), 24 pathways (55%) had either no management or management was ineffective as there is evidence of illegal introductions or non-compliance, and the management effectiveness of 13 pathways (30%) was not known as the data are inadequate. The *effectiveness of pathway treatments* could be estimated for the first time for two pathways (ornamental, and live food and live bait), and for these pathways management appears to be ineffective. For one pathway, aquaculture/mariculture the assessment changed from effective to ineffective management, this was due to the interception of several illegal consignments of aquatic species (e.g., *Cherax quadricarinathus* (red claw crayfish)) for use as food and commercialisation. As this assessment is based on incomplete data or data that are

often not pathway-specific our confidence is low. See Appendix 5 for the data used in this assessment and for our confidence in the assessment for each pathway.

Table S4.4 Research published 2023–2025 evaluating interventions aimed at addressing biological invasions in South Africa.

No studies were found for the following indicators: Input: Planning coverage; Output: Pathways treated; Output: Sites treated; Outcome: Pathways treated

Indicator	Research topic addressed	Finding	Source
4.1. *Quality of the regulatory framework*	Development of improvements to the risk analysis framework	Partial as recommendations have been adopted	Kumschick et al. (2025)
	A review of how lists of regulated alien species were developed, changed over time, and how they have been implemented.	Partial: The study concluded that process of listing, and regulating alien taxa would become more transparent, consistent, and acceptable, thus facilitating efforts to reduce the harmful impacts of alien species.	Wilson and Kumschick (2014)
	Development of a watch list of alien species with the potential to invade kelp forests.	Potential: The watch list can be used to facilitate targeted monitoring. The initial proposed monitoring programme could be a test case to streamline administration and implementation for use elsewhere.	Steyn et al. (2025)
4.2. *Money spent*	Quantification of the known monetary costs of biological invasions to South Africa	ZAR9.6 billion (adjusted to 2022 values) was spent between 1960 and 2023 managing invasions, which is 4% of the money necessary for management, which amounted to ZAR231.8 billion in 2022 values.	McCulloch-Jones et al. (2025)
4.5. *Species treated*	Potential for herbicides to contribute to the control of *Cylindropuntia pallida*	Ineffective: Herbicides were useful at small scales but expensive. Biological control recommended.	Mokotjomela et al. (2024a)
	Evaluation of the effectiveness of foliar spray to control the cactus *Tephrocactus articulatus*	Partial: Foliar spray significantly suppressed populations	Mokotjomela et al. (2024b)
	Evaluation of the effectiveness of herbicides to control the cactus *Cylindropuntia pallida*	Partial: Treatment reduced the height of treated plants	Makaota et al. (2025)
	Use of fire to control *Metrosideros excelsa* trees	Partial: Fire showed some promise, but additional herbicide interventions would be needed.	Kraaij et al. (2024)
	The susceptibility of the invasive wasp species *Vespula germanica* and *Polistes dominula* larvae to native entomopathogenic nematodes and an entomopathogenic fungus	Partial: Over 30% of larvae were successfully infected.	Van Zyl et al. (024)
	Investigation of herbicide treatment to control the alien succulent *Furcraea foetida*	Partial: The treatment could potentially slow the spread	Chetty et al. (2025)
	Effectiveness of biological control agent where congeneric target species are present	Partial: The biological control agent predominantly attacks the target species (*Solanum mauritianum*) Ineffective: The biological control agent was consequently not effective on *Solanum viaum*	Olkers and Egli (2025); Olkers (2025)
	Effectiveness of biological control agent	Partial: Biological control contributed to the reduced vigour of *Salix babylonica* trees	Martin et al. (2025)

Indicator	Research topic addressed	Finding	Source
	Evaluation of phosphite effectiveness against *Phytophthora cinnamomi* infection in *Leucadendron argenteum*.	Ineffective: *L. argenteum* trees treated with phosphite showed no significant difference in survival rates compared to untreated controls.	Msweli et al. (2025)
	Comparison of effectiveness of biological, chemical and physical methods to control the invasive tall grass *Arundo donax*	Partial: (biological combined with physical control) Ineffective: (herbicidal control)	Bownes et al. (2025)
	Assessment of the effectiveness of control interventions for 126 alien plant species in protected areas in the Cape Floristic Region.	Management effectiveness was assessed as either permanent, effective or partially effective for 29 species (20 due to biological control), and ineffective for 25; for the remainder effectiveness could not be evaluated.	Van Wilgen et al. (2025)
	Population dynamics of aquatic alien plants *Salvinia minima* and *Pontaderia crassipes* in the presence of the biological control agent *Megamelus scutellaris*.	Ineffective: The competitive vigour of *S. minima* more than doubled in the presence of herbivory on *P. crassipes*.	Chikodza et al. (2024)
	Report of an unintended impact of a biological control agent on the tree *Acacia cyclops*	Counter-productive: Galls formed by the biological control agent *Dasinura dielsi* harbour mites which are also known to cause dermatitis in humans.	Veldman et al. (2023)
4.6. *Sites treated*	Recovery of native vegetation after clearing of *Acacia saligna* trees	Partial: Recover was incomplete below burnt stacks, and re-seeding was recommended	Nsikania et al. (2025)
	Recovery of grassland vegetation after 25 years of alien plant control	Partial: Species richness did not recover fully, and active restoration will be needed.	Chikowore et al. (2025)
	Recovery of native vegetation after removal of pine plantations	Partial: Restoration potential of the montane grassy fynbos was superior to that previously documented in montane proteoid fynbos.	Baard et al. (2023)
	Assessment of the effectiveness of control interventions in 18 protected areas in protected areas in the Cape Floristic Region.	Partial: Some progress has been made, but insufficient and declining funding remains a significant barrier to effective management.	Van Wilgen et al. (2025)
	Assessment of vegetation and soil recovery 6 years after clearing *Eucalyptus grandis*	Partial: The study concluded that recovery is moving towards a positive vegetation and soil recovery trajectory.	Ruwanza (2024)
	Assessment of the efficacy of delaying a prescribed burn to promote recruitment of native species in an ecosystem invaded by alien *Acacia saligna* trees	Partial: The density of *A. saligna* seeds and post-fire acacia recruitment was reduced by >50%, which would assist the restoration process.	Ngwenya et al. (2023)
	Assessment of six combinations of restoration treatments applied to an area covered by invasive grasses.	Partial: The application of fire and topsoil translocation from near-pristine sites can help to reduce competition from alien species,	Retief et al. (2024)
	Assessment of the effects of the control of alien *Acacia dealbata* trees on soil seed banks in grasslands targeted for ecological restoration.	Partial: Control of *A. dealbata* can potentially facilitate passive restoration of native species, but post-clearing rapid growth of secondary can hamper restoration.	Ruwanza (2024)

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S4.7 Trends in indicators for interventions

Table S4.5 Current status, confidence, trends, and outlook for interventions

Indicator	Trend[2]	Confidence	Desired trend	Current status and trend	Outlook
4. *Level of success in managing invasions*	Not assessed	NA	↑	The level of success in managing invasions cannot be scored with any confidence given the lack of monitoring of interventions. However, while interventions are in place to address many facets of biological invasions, funding is insufficient and declining. Despite local successes, invasions are increasing in extent and impact when assessed at a national scale	Extensive regulations are in place to prevent the entry of new species and to manage those that are here, but the capacity to enforce these regulations falls well below what is needed. Research studies have typically reported failures to contain invasions when assessed at wider scales. For half of the known pathways of introduction there is either no management, or management is ineffective or could not be estimated. Control efforts have not managed to stem the spread of invasive plants at a national scale, other than for some of those under biological control (Kotzé et al. 2025). Limited progress has been made in in containing invasions in some protected areas in the Cape Floristic Region, but insufficient and declining funding is reversing the situation (van Wilgen et al. 2025). Concerted efforts to eradicate house crows were initially successful but have fallen behind as funding was not sustained. Attempts to control invasive freshwater fish species have either been unsuccessful or limited to highly localised sites.
4.1. *Quality of regulatory framework*	→	Medium	↑		
4.2. *Money spent*	↓	High	↑	Funding has declined sharply over the past three years	Government funding is likely to remain low or even decline further. Alternative sources of funding will be needed and focussed on priority areas if interventions are to become effective

[2] → no change; ↗ an increase; ↘ a decrease

Indicator	Trend[2]	Confidence	Desired trend	Current status and trend	Outlook
4.3. *Planning coverage*	Pathway and Species: → Sites: ↑	Pathway and Species: High Sites: Low	↑	Pathways: No plans have been developed Species: No plans have been accepted Sites: 48 site management plans approved. Area covered not recorded	Pathways: Plans are not legally required but should ideally be developed. Species: For progress to be made, plans will need to be developed and approved, and an entity will need to be established in terms of Section 75 of NEM:BA to coordinate and implement plans. Sites: Recent progress has been made within the DFFE to assess and curate site management plans, but coverage remains low and approval rates are slow. All organs of state are required to submit plans in terms of Section 76 of NEM:BA. For progress to be made, a list of relevant organs of state needs to be compiled plans should be solicited from and relevant entities.
4.4. *Pathways treated*					
4.5. *Species treated*	Not assessed		↑	Information on species treated over the past three years is not available.	Species treatments are carried out by a wide range of government, non-government, private landowners and volunteer groups, and records are not kept consistently if at all. It is therefore not possible to report on this indicator with any degree of confidence.
4.6. *Sites treated*	Not assessed		↑	Information on sites treated over the past three years is not available.	As above, site treatments are carried out by a wide range of government, non-government, private landowners and volunteer groups, and records are not kept consistently if at all. It is therefore not possible to report on this indicator with any degree of confidence.
4.7. *Effectiveness of pathways treated*					

Indicator	Trend[2]	Confidence	Desired trend	Current status and trend	Outlook
4.8. *Effectiveness of species treated*	→	Low	↑	For most species there is either no evidence of interventions, or the effectiveness cannot be assessed. Biological control has frequently been effective for plant species, and for a few other species control has been partially effective, but invasions of important species continue to grow when assessed at a national scale despite ongoing control.	Monitoring of the effectiveness of control interventions that targeted invasive species remains largely absent, except in the case of plants under biological control. A few research projects have documented outcomes for a small number of other species. It will remain challenging to evaluate this aspect in future.
4.9. *Effectiveness of sites treated*	Not assessed		↑	The extent of invasions has increased over the past 15 years when assessed at a biome or primary catchment scale despite ongoing control. Some treatments are partially effective in that natural vegetation recovers, but not fully.	Monitoring of the effectiveness of control interventions across managed sites remains largely absent. A few research projects have documented outcomes for a small number of sites. It will remain challenging to evaluate this aspect in future.

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Supplementary Material to 'Chapter 5: Monitoring Framework'

S5.1 Summary of progress to meet GBF Target 6

[Note: section under development]

This section provides guidance as to how this status report can contribute to South Africa's national-level reporting to the CBD on progress towards Target 6 of the GBF. The discussion is broken down into different aspects of the target 6 (as different heading in italics), and then the indicator, recognising that that national target title and proposed policy measures and action as per the 7th national report is slightly different to this (cf. Section 5.7).

Eliminate, minimize, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by…

[add info on Impact assessments evaluated; and interventions]

…identifying and managing pathways of the introduction of alien species,…

[add info from Chapter 1 and 6]

…preventing the introduction and establishment of priority invasive alien species,…

[add info from Chapter 1 and 6]

… reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 per cent, by 2030,…

[see discussion on head-line indicator and indicator 1.]

…eradicating or controlling invasive alien species…

[add info from Chapter 4; over 50 taxa are listed as nation-wide eradication targets (i.e., category 1a), and more than 500 over taxa are listed as required national management programmes to be in place (Wilson & Kumschick, 2025)]

…especially in priority sites,…

[add info from Chapter 3; the focus is on sites that are sensitive to the impacts of invasions, noting this can differ from sites that are exposed (i.e., likely to receive propagules) and those that are susceptible (i.e., high invasibilty—invasions are likely to result if taxa are introduced)]

…such as islands.

[add link to Chapter on the Prince Edward Islands in the last report]

Headline Indicator: Rate of invasive alien species establishment

At present South Africa is not able to report against the headline indicators but can against a similar national indicator (1. *Rate of unregulated introduction of new species*). Data gaps exist and although methods have been developed to calculate the headline indicator, there is still a lot of work to do (in particular to incorporate proxies of survey effort which at present have not been routinely captured). Improved institutional co-ordination would assist (e.g., with Dept Agriculture for new agricultural pest introductions). Work and capacity are required to bridge the gap, noting the stated concerns about the appropriateness of the indicator. South Africa is aware of these gaps and have processes that, capacity allowing, could address them.

Parties are encouraged to contribute to the computation of this indicator through submission of data to GRIIS (Global Register of Introduced and Invasive Species). GBIF has a GRIIS page for South Africa (https://cloud.gbif.org/griis/resource?r=south-africa-griis-gbif) though this last updated 2020. A workflow is needed to convert the list produced as part of this report into the GRIIS format and to stream-line the process for information to be fed through to update information on the GRIIS website. To update the GRIIS list and keep it up to date, assessments of invasion status and impact are also needed; first record/date of introduction data need to be collected; and monitoring for and collection of new records is required. In the South Africa national list, information based solely on expert opinion (as many notes on impact in GRIIS lists are) are deprecated; the stricter criteria used by South Africa will affect updates to GRIIS and comparison between countries. An estimate of uncertainty is required, and for this, survey effort data need to be collected and shared, or useful proxies need to be identified. Data are validated as part of South Africa's national list of alien taxa, with information required to have sources and confidence levels ascribed to them. Resources are still urgently needed to ensure all historical information on alien taxa in South Africa are incorporated into databases such that a reliable baseline can be created and to avoid repeatedly revising baselines as existing information is incorporated.

Currently South Africa's national list of alien taxa is stored as a discrete database updated and uploaded to a repository (Zenodo) every few years. The intention is, resource permitting, to move to a dashboard that can be more readily updated. A system to house and share new records is needed, as are resources to ensure the lists are updated regularly (e.g., based on data from molecular databases, atlas projects, and scientific publications). There is no system in place to collect, curate, and share survey effort.

This indicator requires collaboration between multiple institutions beyond the biodiversity sector (e.g., including health, trade, and agriculture), and capacity to keep lists up to date.

Supplementary Material to 'Chapter 6: Gaps'

S6.1 Progress towards filling previously identified data and information gaps

Table S6.1 Progress towards filling the data and information gaps identified in previous reports (SANBI and CIB, 2018, 2020, 2023), with the consequences of not filling these gaps as updated here

Details from previous reports are verbatim with a grey background; references have not been copied across, the reader is advised to consult the previous reports for details. Progress as measured for this report (2023–2025) and qualitative assessments across all reports are shown in Table 6.1 in the main report.

Indicator	Level of knowledge and information gaps (SANBI and CIB, 2018)	Proposed solution (SANBI and CIB, 2018)	Progress (SANBI and CIB, 2020)	Progress (SANBI and CIB, 2023)	Consequence if the gap is not filled (updated for this report)
1. *Rate of unregulated introduction of new species*	Knowledge of rates of introduction is largely based on observations of alien species post-border, rather than interceptions at border. It is not always possible to determine dates of introduction based on dates of first record. Only data on inputs and not on outputs are recorded. Currently, the Department of Agriculture, Forestry and Fisheries (DAFF) is responsible for most surveillance with a focus on agricultural pests and diseases, and surveillance with respect to environmental concerns is only done consistently at one of the 72 entry points, and then only during certain working hours.	An integrated approach with other authorities that report and monitor the introduction of species at ports of entry is needed. Alignment by the Department of Environmental Affairs (DEA) with the DAFF processes is needed to ensure adequate monitoring and reporting on the rates of introduction on new species, and that relevant interception data with both positive and negative results are curated and included in future reports.	The various authorities involved in monitoring and reporting interceptions at the border still have their own processes and approaches. It is not clear if efforts to align the various processes and ensure adequate monitoring and reporting have been implemented to a degree that allows for co-ordinated data management. A cross-cutting panel to make biosecurity decisions is being formed and this might assist with this.	The development of a National Border Management Authority offers the opportunity for substantially increased co-ordination. Several databases on historical interceptions/ introductions have been published.	These data as well as survey effort data, or a useful proxy, are required to measure progress towards Target 6 of the GBF. Without good estimates of rates of introduction the effectiveness of interventions to prevent introductions cannot be determined.
1.1. *Introduction pathway prominence*	Socio-economic information is required to assess introduction pathway prominence. Some of the required data are available from global and local databases. However, for some of the pathways of introduction these data could not be obtained. Unfortunately, these data are often owned by companies or are regarded as sensitive and, therefore, it is often difficult or impossible to obtain the required information. In some instances, large sums of money need to be paid to the companies that own the information to gain access to these data (for an example see Faulkner, Robertson, Rouget, & Wilson, 2017b). Finally, for some pathways it is difficult to obtain or collate relevant socio-economic data, simply because the description of the pathway is imprecise (e.g. 'other intentional release').	To lessen the gaps in our knowledge on the pathways of introduction and dispersal, research into specific pathways is required, particularly for inconspicuous pathways such as e-commerce (Humair, Humair, Kuhn, & Kueffer, 2015). It is important to note that research is currently being undertaken on a number of pathways of introduction, including the pet trade, the traditional medicine trade and the aquarium plant trade. This information needs to be incorporated into subsequent reports.	There has been significant research on some pathways of introduction (e.g. the pet trade (Nelufule, 2018; Shivambu, 2018) and the medicinal plant trade (Burness, 2019; Byrne, Williams, & Wojtasik, 2017), and on the pathways of introduction for certain taxa (e.g. bamboo (Canavan, Richardson, Le Roux, & Wilson, 2019). The information generated by this research has been incorporated in this report, however, many pathways of introduction remain poorly studied.	Recent research on some pathways of introduction means that our understanding of certain pathways, such as the pet trade and medicinal plant trade, aquarium trade has improved significantly. But, many pathways of introduction remain poorly studied.	Without information on the size or socio-economic importance of the pathways and how their size has changed over time, the relative potential of the pathways to introduce alien taxa cannot be determined. Consequently, the pathways cannot be prioritised for management and the effectiveness of the interventions that are currently in place to manage pathways cannot be assessed.

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1.2. *Introduction rates*	To assess introduction rates for the pathways, pathway of introduction and date of introduction data for the species introduced to South Africa are required. These data are not available or have not been collated for many alien species, particularly for introduced plants and insects (Faulkner, Spear, Robertson, Rouget, & Wilson, 2015). Additionally, the dataset used in this assessment was collated a few years ago, and so data for very recently introduced species (e.g., the marine amphipod Caprella mutica (Japanese skeleton shrimp) is not included (Peters & Robinson, 2017). The pathway of introduction data that are available were also in some instances not of sufficient quality or detail to designate pathways of introduction with certainty. Furthermore, the increased level of detail provided by the pathway categorisation scheme adopted by the CBD (CBD, 2014) has led to an increase in uncertainty when designating pathways of introduction (Tsiamis, Cardoso, & Gervasini, 2017). This is because the differences between some of the pathway subcategories are unclear (Tsiamis et al., 2017). Although an effort was made to rate the confidence in the pathway categorisations and in the assessment as a whole, information on the quality and source of the original data (e.g. direct evidence vs assumptions based on species traits or knowledge from other regions) are required to better rate confidence, and these data were often not available. Few introduction pathways have been researched in detail, but the work that has been done includes research into the aquatic plant trade (Martin & Coetzee, 2011), trade in traditional medicine (Byrne et al., 2017; Wojtasik, 2013), and the unintentional introduction of contaminants on imported plant cuttings (Saccaggi & Pieterse, 2013).	The rates of species introduction into, and spread within, South Africa need to be quantified. One possible extension is to weight pathways according to the consequences of the species introduced, i.e., whether species introduced along a particular pathway led to particularly severe impacts. For example, in the Czech Republic species that were introduced intentionally seem to be more likely to have naturalised and become invasive, but invasive taxa that were accidentally introduced tend to be more widespread and have greater impacts, perhaps because they have been preselected for dispersal and competitive traits (Pyšek, Jarošík, & Pergl, 2011).	The dataset used in the first report has been updated and integrated where possible with the species list, however, information on the date and pathway of introduction for many introduced species has still not been collated. Recommendations on improvements to the pathway categorisation scheme adopted by the CBD have been published and information has been provided on the interpretation of the categories (Harrower, Scalera, Pagad, Schönrogge, & Roy, 2018). However, the data that are available are often still not of sufficient quality to designate pathways of introduction with certainty. There has been recent research on some pathways of introduction (e.g. on hull fouling (Peters & Robinson, 2017), and on the pathways for certain types of organisms (e.g. parasites of freshwater fish (Weyl et al., 2020), but many pathways of introduction remain poorly studied. Weighting pathways according to the consequences of the introductions is still not possible due to a lack of data on impacts.	While progress has been made, there are still significant gaps, e.g., in terms of dates of introduction to South Africa. With new indicators being developed, there is a greater recognition of the need to separate search effort from observations. This promises to be an area where substantial progress can be made.	Data on the pathways and dates of introduction of alien taxa are vital to determine the relative importance of the pathways for the introduction of alien taxa. Without these data, pathways of introduction cannot be prioritised for management and the effectiveness of the interventions that are in place to manage the pathways cannot be assessed.

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1.3. *Within-country pathway prominence*	Limited knowledge on the dispersal of alien species throughout the country from ports of entry.	An assessment of the relative prominence of dispersal pathways within South Africa is needed.	Limited information on the pathways of dispersal still precludes an assessment of the relative prominence of the within-country dispersal pathways. Plans are in place to start data collection.	Insights into certain pathways due to research on the pet trade, medicinal plant trade, and game farms, but these are only a few of the pathways active within South Africa.	Information on the size or socio-economic importance of the within-country pathways of dispersal is required to determine the potential of the pathways to facilitate the movement of species within the country. Consequently, without these data the pathways that require management cannot be identified, and the effectiveness of the interventions that are currently in place to manage these pathways cannot be assessed.
1.4. *Within-country dispersal rates*	Data on within-country dispersal have not been collated for alien species in South Africa. Such information is only available for a few groups of extralimital species [e.g., amphibians (Measey et al., 2017) and fish (Picker & Griffiths, 2011)].	Within-country dispersal rates for the pathways of dispersal should be assessed using data on the pathways and dates of dispersal for introduced species and species that are native to the country but that have been introduced to parts of the country where they are not native (extralimital introductions).	Data on within-country dispersal have not been collated. Plans are in place to start data collection for extralimital species.	A database of native-alien populations has been constructed addressing this significant data gap. Information is also available for alien plants in South African National Parks. The pathways for other taxa dispersing within the country, however, remain unknown.	Data on how alien and extralimital taxa are dispersing within the country and their rates of dispersal are required to determine the relative importance of the pathways for the within-country dispersal of alien taxa. Without these data the pathways of dispersal that require management cannot be identified, and the effectiveness of the interventions that are in place to manage the pathways cannot be assessed.

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2. *Number of invasive species that have 'Major' impacts*	There are few data on the impacts caused by even the most widespread species, and so this indicator cannot be estimated reliably. There is generally a dearth of accessible studies documenting impacts of alien species across all taxa. Studies of the impacts on socio-economic issues (e.g. human and animal health, agriculture, livelihoods, values, and food security) are often entirely missing.	There is a need for a system of collating information on impact through formal EICAT and SEICAT assessments. The impacts associated with the most widespread and invasive species need to be confirmed and documented. The list might change over time, so procedures to obtain the first list are needed. Studies that document impacts of individual invasive species and/or taxa need to be promoted and funded and in particular to explore taxa other than invasive alien plants. An integrated and coordinated approach in documenting and undertaking research and management of invasive species with impacts on socio-economic issues is needed. Efforts with other relevant departments where the impacts of invasive species are relevant at national, provincial and local levels [e.g. DAFF, Department of Health, Department of Water and Sanitation (DWS)] need to be aligned and co-ordinated.	155 species have been assessed using the EICAT and SEICAT assessment protocols.	Improved impact assessment methodologies have aided in identifying highly impactful species this should facilitate the prioritisation of interventions. There is ongoing development of frameworks and models assessing potential impacts and risk posed, enabling the prioritisation of management actions based on threat levels. There is additional progress developing standards and assessing alien taxa at a global level.	See Chapter 6 in SANBI and CIB (2020) "*The gravity of the problem with biological invasions must be highlighted if an appropriate policy response is to be elicited. The rationale for government to continue to invest substantial resources in tackling biological invasions rests on the need to reduce the impacts that invasions cause to all sectors of South African society and to the country's unique biodiversity. Data on impacts are essential if control measures are to be prioritised and to track the effectiveness of interventions (e.g., in terms of increasing the resilience of South African cities, towns, and rural communities to droughts and fires; ensuring agricultural sustainability; and protecting our natural capital for future generations).*"

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2.1. *Number and status of alien species*	The numbers of alien terrestrial plant species and vertebrate species are well documented. The number of alien invertebrates, marine species and, especially, microbial species are much less well known. The same applies to introduction status, i.e., alien plant and vertebrate species are relatively well documented compared to other taxa. However, introduction status is not formally recorded anywhere, so this aspect cannot accurately be summarised and updated.	Databases should record introduction status, and the records should be updated regularly.	The species list has been updated and redesigned to align with Darwin Core (Groom et al. 2019). The source for data is now clearly specified as is the level of confidence in each entry. A workflow has been developed to add new species as they are recorded.	The species list has seen major improvements over the report, with, in this report, clearer metadata, the development of explicit links to taxonomic backbones, and the improvement of workflows. The focus for the next phase should be to increase the number of data-sources incorporated into the species list, and to formalise processes (e.g., for declaring a taxon as alien and present).	A national registry of alien species would help clarify which species are legally in the country, consolidate information on the status of invasive species, and provide an important reference resource for those working on biodiversity and the broader community. Without this the regulations will be more likely subject to challenges.
2.2. *Extent of alien species*	Reliable distribution data are available for terrestrial and freshwater plants and birds, but not for other taxa. This status report was only able to estimate the extent of 835 out of the 2033 species (section 5.2.1).	Databases for terrestrial and freshwater plants and birds should continue to be updated, and more effort will be needed to assemble reliable data on taxa other than terrestrial and freshwater plants and birds.	There is support for various atlassing projects, ensuring the long-term sustainability of these is a priority. Much more still needs to be done to integrate these datasets and citizen science platforms.	While information from citizen science platforms can be useful, the lack of activity around the Southern African Plant Invaders Atlas means that arguably our knowledge of (at least invasive plant) distributions has declined.	For indicators 2.2–2.4 see indicators 2. and 3.
2.3. *Abundance of alien species*	The Abundance of alien species is very poorly known. For almost all species, there are no assessments of cover or density (for sessile organisms) or of population sizes or biomass (for mobile organisms). There is a mapping exercise under way to estimate the cover of invasive alien plants (Kotzé et al., 2010), but it is limited to about half of the country and to selected taxa, and there are concerns that the methodology is not documented.	The use of remote sensing techniques should be explored. For mobile organisms, distribution and population size data could be used to model abundance, but this would require research.	Some exploratory work has been initiated on remote sensing, and some general guidelines are available on the types of data that need to be collected (e.g. Cheney et al. 2018), but there are still very few tangible data (cf. sites chapter)	No additional progress has been made when compared to the previous report	

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2.4. *Impact of alien species*	For most species, there is almost no documented evidence of impact, and available evidence is mainly anecdotal (e.g., not available as peer reviewed research papers). There are some notable exceptions, for example for Prosopis species (see Box 4.2). Several taxa are listed at levels other than species (e.g., genus or family), but fundamentally biological invasions result from introduction events resulting in a population-level phenomenon. Impacts at the gene level can be particularly concerning (e.g., the loss of indigenous species through hybridisation), but have rarely been assessed.	An understanding of impacts of invasive species can be strengthened by new approaches, including assessments of the effects of the species concerned on ecosystem services, ecosystem resilience, human livelihoods, agriculture, and animal and human health. There is a need for a system of collating information on impact through formal EICAT and SEICAT assessments. There is a need to promote and fund studies that document impacts of individual invasive species, and in particular to explore species other than invasive alien plants. There needs to be an integrated and coordinated approach to documenting and undertaking research and management of invasive species with impacts on socio-economic issues, in addition to the biophysical or ecological effects. Efforts are needed to align the activities of relevant government departments (e.g. the Department of Environmental Affairs, Department of Health, Department of Water and Sanitation, Department of Agriculture, Forestry and Fisheries), as invasive species have a variety of impacts across national, provincial and local levels. There will need to be a substantial on-going investment in impact studies for EICAT and SEICAT to be sufficiently reactive to allow the monitoring of trends on the scale of years rather than decades.	Data presented in this report represent a shift from expert assessments of impact towards assessments based on published data (e.g. through EICAT and SEICAT). This process still needs to be completed and aligned with the developing international frameworks in the area. A few studies have indicated impact, but this remains a major gap where detailed research is needed.	Improved impact assessment methodologies have aided in identifying highly impactful species this should facilitate the prioritisation of interventions. There is ongoing development of frameworks and models assessing potential impacts and risk posed, enabling the prioritisation of management actions based on threat levels. There is additional progress developing standards and assessing alien taxa at a global level. However, these methodologies have not, as yet, been systematically applied to most of the alien taxa found in South Africa.	

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3. *Extent of area that suffers 'Major' impacts from invasions*	There are some data available on the distribution (occurrence) of invasive alien plants and birds at the scale of quarter degree grid cells, but there is limited or no knowledge about the impacts caused by non-plant taxa. Even less is known about the abundance of invasions at sites where the relevant alien species occur. The lack of knowledge about (1) the impacts of individual species, and (2) their abundance precludes any sensible estimate of the area that experiences major impacts.	A systematic approach to documenting the level of non-plant invasions at sites is needed. Monitoring techniques to estimate the extent of invasions and models to go from this to projected impacts need to be developed. The extent of invasions at the scale of both biophysical (biomes, catchments or ecosystems), and administrative (provincial or municipal) areas need to be documented. Remote sensing tools should be used to provide a broad-scale analysis of areas that are heavily invaded.	There are several initiatives in place to collect data, but little tangible progress to date (cf. sites chapter)	Despite several remote sensing initiatives under development there has still been little tangible progress (cf. sites chapter).	See Chapter 6 in SANBI and CIB (2020) "*Without detailed maps at national and local scales estimates of the impact of invasions remain crude, it is not possible to appropriately prioritise interventions across sites, and the ability to ensure interventions can adapt and respond to invasions before they are widespread and damaging is limited*."
3.1. *Alien species richness*	There are data on the extent of species that can be used to assess Alien species richness in areas using Geographic Information System (GIS) overlays. These data are much more comprehensive for terrestrial and freshwater plants and for birds than for other taxa.	South African National Parks, most provincial conservation departments, and some Metros should have information about invasions in their protected areas. These data were not available or accessible at the time of this assessment and will need to be sourced for future reports.	There has been good progress for South African National Parks (van Wilgen and Herbst 2017), but not for other conservation agencies.	No additional progress has been made when compared to the previous report	It will be difficult to predict what the likely future threats are at a given site until the alien species that are not currently invasive are known.
3.2. *Relative invasive abundance*	There are no reliable data to assess abundance. There are insufficient data to assign values of cover, biomass or population size to indigenous species, which would be needed if relative abundance is to be estimated.	More research is needed in priority areas to assess relative abundance At a finer scale it can be important to consider abundance in ecologically relevant sub-divisions, e.g. habitats or vegetation types.	The methodology to underpin a national assessment of relative tree cover has been published (Kotzé et al. 2019), but no results are yet available. This should be seen as a priority, as relative abundance will be closely correlated with impact.	2017–2019 minimal 2020–2022 none No additional progress has been made when compared to the previous report	For 10–11, see indicators 2. *Number of invasive species that have Major impacts* and 3. *Extent of area that suffers Major impacts from invasions*

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3.3. *Impact of invasions*	There are very few data on the impacts of co-occurring alien species in particular areas. There are a few studies on impacts on water resources at a catchment scale, and on rangeland productivity and biodiversity at a biome scale. These are coarse estimates, as many assumptions had to be made due to a lack of impact studies at a species scale. The choice of what to measure in terms of the Impact of invasions will be influential and the importance of different impacts will be context-dependent. A "minor" reduction in biodiversity in a biodiversity hotspot might be much more important than a "massive" reduction elsewhere; similarly providing the cost of an invasion in absolute terms might hide major and profound societal inequities.	More research is required to translate the species-level impact into ecosystem-level impacts, and protocols need to be developed that will allow for joint consideration of environmental and socio-economic impacts when making decisions. There are insufficient data to express the effects of reductions in ecosystem services in economic or social terms (De Lange & Van Wilgen, 2010). There is a need for a conceptual link with the EICAT and SEICAT scheme for species. Reductions in ecosystem services should be placed in the context of how critical those services are in particular areas.	A small number of studies have been conducted since the first report (see Chapter 4). There is a particular need to develop protocols to scale up the implications of studies at local scales to the scale of catchments, protected areas or biomes (e.g. Görgens and van Wilgen 2004).	2017–2019 minimal 2020–2022 moderate Economic estimates of impact have been collated as part of this report (cf. Box 3.1), with an accompanying workflow. There are some conceptual work looking at risk of extinction, however, there is still a need to look at broader measures of impact and to ensure these are repeatable (e.g., water loss, impact on extinction risk, and impact on grazing potential).	???
4. *Level of success in managing invasions*	The capacity and understanding exists to measure the degree of control achieved by plant biological control, but currently very little can be said about the effectiveness of other forms of management due to a lack of monitoring. The effectiveness of the Regulations (NEM:BA: Alien and Invasive Species Regulations, 2014) has not been assessed as it is too early to do so.	Adequate procedures, including goal-setting and monitoring, need to be in place for future assessments. An integrated and coordinated approach and alignment with other programmes by other government departments and institutions is needed. Explore options to ensure adequate monitoring data are collected (e.g. clearing contracts are not paid out until there is a documented assessment of performance) The indicator needs to be assessed at different scales and areas and through simulations to explore how responsive it is to different behaviours. A system of setting up national or local goals and the strategies to achieve these is needed.	The absence of clear goals and monitoring of progress has not been addressed to date. There has been no research on indicator performance yet, and proposals to apply the indicators to particular sites are still in the initiation phase. Similarly there are several research projects designed to assess the impact of particular policies, but these are mostly still in the early stages.	2017–2019 minimal 2020–2022 none A recent analysis of the effectiveness of control (van Wilgen et al. 2022a) provided some useful estimates of the effort taken, but served to highlight the lack of monitoring of control effectiveness.	Monitoring of interventions in terms of their outputs and outcomes is essential if their effectiveness is to be assessed, and for management to become adaptive. The effectiveness of interventions cannot be assessed (and improved) unless monitoring and reporting data workflows (that result in clearly documented information) are in place and made available for scrutiny.

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4.1. *Quality of regulatory framework*	The Alien and Invasive Species regulations are amongst the most comprehensive in the world, but are not explicit on pathway measures. The reason for listing or not listing particular species has not been adequately documented.	An independent assessment of the regulations would provide valuable insights. The evidence for including or excluding, adding or removing species from lists should be clearly documented, with both retrospective assessments of the evidence base and a requirement for future changes to be clearly documented.	The DFFtE have published for public comment a list of species that they intend to add to the list of regulated species. This is being held up due to a legal challenge. A recent publication (Lukey and Hall 2020) noted that the current regulations operate in a policy vacuum, and that a comprehensive evidence-based policy-making process should be instituted as a matter of urgency. Moreover a legal expert assisted with the compilation of this report. In terms of the evidence for listing species, a risk analysis framework has been developed, ASRARP has been established, there is already some progress in producing retrospective risk analyses, and the DFFtE are in the process of establishing an inter-departmental decision making panel on biosecurity.	2017–2019 moderate 2020–2022 moderate A process is now in place to systematically evaluate all listed taxa and to underpin future changes to the A&IS Lists. However, a national strategy is still notably absent.	The absence of a policy, and therefore an absence of a clear policy position on biological invasions in South Africa, means that the organs of state and other stakeholders are not guided in administrative decision-making relating to biological invasions. Parliament also has no guidance when asked to review legislation pertaining to biological invasions. The lack of clarity on policy objectives makes it difficult for relevant organs of state to devise short- and medium-term implementation plans, and to estimate the annual budget required for the implementation of those plans. This, in turn, makes monitoring and reporting difficult. The absence of a policy is also inimical to setting clear indicators against which the quality of the regulations could be measured.
4.2. *Money spent*	Data presented in the report are largely only available in terms of the spending by the Department of Environmental Affairs.	An assessment of the contributions from different departments at all spheres of government (national, provincial and local), and from the private sector, is needed.	The amount spent by DFFtE has been updated and is now estimated to be around ZAR 1.2 billion annually. This is lower than what was reported in the first status report, and the difference arises because there is no clear record of how much is spent on biological invasions opposed to other functions funded by NRM. Data on spending by other spheres of government, and by the private sector, are not available.	2017–2019 none 2020–2022 moderate A workflow to evaluate the amount of money spent has been developed, and existing data collated. However, from this exercise it is clear that there are significant gaps.	Without a clear understanding of the costs of interventions, it is impossible to assess their cost effectiveness and thereby whether a particular intervention should be implemented or stopped.

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4.3. *Planning coverage*	Only 29 site-specific control plans were submitted (Appendix 4) covering ~4.5%) of the country. Most of these control plans did not have explicit goals. Other site-specific plans exist, but these have shortcomings. For example, van Wilgen et al. (2017) reported that high-level goals in protected area management plans are not effectively carried forward to 5-year implementation plans or annual plans of operation. As a result, there is a focus on only monitoring inputs and outputs rather than outcomes.	A greater emphasis of stating the goal of management at all levels of planning is required for management effectiveness to be assessed. Goals would need to be quantifiable and time-bound.	An additional 45 management site-specific plans, covering a total of 648 000 hectares have been submitted. Most of the plans were found to be partially adequate but there is still a need to improve the quality of submitted plans. Species-specific control plans are only available for some of the species targeted for eradication; the quality of these plans has not yet been evaluated.	The quality of plans increased, but the coverage decreased as some plans assessed during previous status reports have lapsed and updates have not been provided for re-assessment.	Without plans in place, control measures will be haphazard, and it will be very difficult for control to improve. It will also be difficult (impossible) to track and motivate for resources. The scarcity of plans with clear goals also means that there is no logical basis for monitoring progress towards goals and using this information to practice adaptive management that would improve effectiveness.
4.4. *Pathways treated*	Detailed data on the total number of imports or vessels per pathway and the number that have been subjected to a management intervention. Information on the exact procedure followed (e.g. random or targeted inspections, number of ports of entry covered). Assessment of quality of the interventions.	Detailed information from the various Governmental Departments involved on the pathways with control in place, and details on the procedure followed and coverage. Assessments of the quality of the intervention in place for each pathway or groups of similar pathways.	Information was obtained from the DALRRD on inspections performed on agricultural products.	Information available on plant health inspections.	Without detailed information on the interventions in place for each pathway and the procedures followed, the effectiveness of the interventions cannot be assessed.

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4.5. *Species treated*	Currently, most control operations report on the area treated (in the case of plants) or individuals removed (in the case of animals). The data are often not reliable, however, and the quality of treatment is typically not recorded at all (see, for example, Kraaij et al. 2017).	Monitoring records should include an assessment of the quality and outcome of treatment interventions, accompanied by quality control to assure accuracy.	This report provides a list of 237 species that have been the subject of control interventions, with estimated costs for some. The quality and outcomes of control operations are still not assessed (except for some species subjected to biological control). Seven new biological control agents have been released against alien plants. Some additional information on the control of invasive fishes and birds has become available, and there have been some localised successes and some failures. Additional information on the control of invasive plant species is limited to two studies, which support earlier conclusions that (1) biological control can be effective, and (2) that improvements in control efficiency will be needed if the goals of reducing alien plant invasions to maintenance levels are to be achieved.	There has been no improvement in the design of databases that record control efforts against individual species, except in the case of biological control. There are also indications that field staff responsible for the recording of interventions in the field do not have the necessary skills to identify species accurately, leading to lower confidence in the records.	Without detailed information on the interventions in place for each species and the procedures followed, the effectiveness of the interventions cannot be assessed.

Indicator	Level of knowledge and information gaps (SANBI and CIB, 2018)	Proposed solution (SANBI and CIB, 2018)	Progress (SANBI and CIB, 2020)	Progress (SANBI and CIB, 2023)	Consequence if the gap is not filled (updated for this report)
4.6. *Sites treated*	There is almost complete lack of monitoring programmes that assess progress towards goals. What monitoring there is has a focus on inputs (money spent, jobs created), and arguably on area treated, although this is uncritical as the quality of treatment is largely ignored.	Without the collection of primary monitoring data, future reports will be similarly limited. Changing this will require both training and a change in working practices. The need for such data must be clearly communicated to stakeholders. There are some specific areas where data can be collated and analysed. For example, it is important that there is an assessment of the scale and impact of herbicides used (Wagner et al., 2017) as well as the effectiveness of herbicide application in terms of quantity and timing.	It remains challenging to assess the area treated. Monitoring data from DFFtE's NRM programmes suggest a decrease in area treated since 2014, but this may not be real due to a relaxation of the requirement to record areas treated (van Wilgen et al. 2020c).	There has been an increase in the number of entities that have reported on treatments to sites. The entry of NGOs in the Cape Town Water Fund has contributed to this.	Without detailed information on the interventions in place for each site and the procedures followed, the effectiveness of the interventions cannot be assessed.
4.7. *Effectiveness of pathway treatments*	Pathway interventions (regulation, inspection and interception) are intended to slow or halt the rate of new introductions. However, it is challenging to accurately quantify the rates of introductions, and even more so to attribute any changes in rates to a particular intervention.	A historical review of the effectiveness of pathway, species and area-based management in South Africa is needed. For pathways it would be desirable to assess the outcomes of interventions in terms of their cost-effectiveness, and perhaps to explicitly separate efforts pre-border, at-border, and post-border, as different management goals are appropriate at different invasion stages (see Section 2.1). For example, for pathways it is important to get estimates of how much effort, where, and when should be placed in monitoring a given pathways (Bacon et al., 2012, Faulkner et al., 2016).	Recent research on pathways of introduction (e.g. Canavan, Richardson, Le Roux, & Wilson, 2019; Cronin, Kaplan, Gaertner, Irlich, & Hoffman, 2017) meant that the effectiveness of the interventions for some pathways could be assessed for the first time. Information was obtained from the DALRRD on the results of inspections performed on agricultural products.	Information was obtained from both DALRRD and DFFE on at-border inspections, and the results of those inspections. The information recorded is the number of inspections performed, and whether there was a positive result (an interception). But whether these interventions reduce introduction rates is not estimated, and clear information on procedures followed is not available.	See Chapter 6 in SANBI and CIB (2020) "*Without information on the procedures followed to manage the pathways, the degree to which these procedures have reduced introduction rates, and their cost-effectiveness, pathway interventions cannot be properly assessed and improved, and the benefits of this approach as opposed to others (e.g., eradication or control of species post-introduction) cannot be determined.*" See also indicator 4. *Level of success in managing invasions*.

Indicator	Level of knowledge and information gaps (SANBI and CIB, 2018)	Proposed solution (SANBI and CIB, 2018)	Progress (SANBI and CIB, 2020)	Progress (SANBI and CIB, 2023)	Consequence if the gap is not filled (updated for this report)
4.8. *Effectiveness of species treatments*	The effectiveness of biological control of invasive alien plants is well understood. The effectiveness of other control efforts is not understood due to an almost complete lack of monitoring. At a national scale, for terrestrial plants, the Southern African Plant Invaders Atlas (SAPIA) has provided some indications that control efforts are not succeeding at a national scale (Henderson & Wilson 2017).	Accurate national-scale monitoring of species populations needs to be improved, especially for taxa other than terrestrial plants and birds. For plants, a review is needed of existing monitoring efforts (SAPIA and the National Invasive Alien Plant Survey, Kotzé et al. 2010), and the use of other approaches (for example remote sensing), with a view to increasing the effectiveness of monitoring. It would be useful to conduct comparative studies in which invaded areas with and without the implementation of control measures are compared to assess control effectiveness.	The challenges reported in the first report remain. The level of national-scale monitoring has not improved, although information on biocontrol effectiveness continues to be collected. [to be updated to reflect progress with the level of knowledge, not activities]	A few taxon-specific management plans have been developed but none have been formally approved. The situation with regard to alien plant species that are potential targets for eradication, or for biological control, has improved as populations are regularly monitored, but this accounts for a small number of species.	See indicator 4. *Level of success in managing invasions*.
4.9. *Effectiveness of site treatments*	There is almost a complete lack of assessment of conservation and/or biodiversity outcomes in particular areas.	An assessment of the value and role of ecological restoration in managing biological invasions and contributing to conservation goals is needed.	A few studies have explored the recovery of sites after treatment, but data on the recovery of treated sites are not routinely collected.	What monitoring there is continues to focus on inputs and outputs rather than outcomes. The scarcity of adequate plans with clear goals in terms of outcomes exacerbates this situation.	See indicator 4. *Level of success in managing invasions*.

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S6.2 Questionnaire

[Note: some slight editorial changes were made to the version that is on-line, these changes will be made to the version included in the final report, the questionnaire is available at: https://tinyurl.com/ycymbd3v]

Survey to assess stakeholder uptake of the report on the status of biological invasions and their management in South Africa

Background

The South African National Biodiversity Institute (SANBI) has produced reports on the status of biological invasions and their management in South Africa in 2017, 2020, and 2023 as mandated under national legislation (see http://iasreport.sanbi.org.za), and a fourth report is in preparation.

The status report provides a mechanism to link research, policy, and implementation. To evaluate how the report is used and can be improved, we are conducting a survey of stakeholders.

We are approaching you as a potential respondent because you have either provided us with information used in the report, are likely to use the report, or have assisted with writing and reviewing previous reports.

The survey should take about 10–15 minutes to complete.

Details on the survey

The information gathered will be used in the next status report, and potentially, in a published scientific article. Personal information is not collected in this survey, but there are some broad demographic questions. All responses will be anonymised.

By completing this survey, you confirm that you understand that:

- The information you provide will be held securely and treated confidentially.
- You have the opportunity to ask questions.
- Your participation in this survey is voluntary and that you are free to withdraw your participation at any time.

Please can you return the completed form to us at ias.report.sanbi@gmail.com by no later than [insert date] If you have any questions, please feel free to contact us at the same email address.

1229 **Table S6.2.** Survey questions

Question no.	Question	Question type	*Response options*	How responses will be interpreted
Consent				
Q1	I consent to taking part in this questionnaire	Multiple choice	*Yes, No*	
Demographic information				
Q2	Who is your employer?	Multiple choice	*Local, provincial or national government; University; Research organization; Bursary holder; NGO; Private sector; Self-employed; Currently unemployed*	To provide insights into the role of the stakeholder in broader community of practice in biological invasions
Q3	What best describes your current role?	Multiple choice	*Land manager; Researcher; Regulator; Consultant; Funder; Educator; Student; Other (specify)*	
Q4	How long have you been in your current role?	Multiple choice	*0–5 years; 6–10 years; 11–20 years; > 20 years*	
Structure and scope of the status report				
Q5	What parts of the report did you read or engage with?	Select all that apply	*Aspect* / *Read* / *Used* *Executive summary* *Introduction Chapter* *Pathways Chapter* *Species Chapter* *Sites Chapter* *Interventions Chapter* *Gaps Chapter* *Prince Edward Islands Chapter* *Indicator factsheets* *Species List*	To provide a measure of engagement with the report and to assess which section(s) of the report are widely used
Q6	Did you face any challenges in engaging with the content of the report (e.g., technical jargon, flows in logic or unjustified interpretations)	Free text	*Yes/ No; if yes, list them briefly*	To check if stakeholders faced any barriers to engagement with contents of the report

Question no.	Question	Question type	*Response options*	How responses will be interpreted
Q7	Do you have any comments to improve future reports? e.g., structure, missing topics, sources that were not used, or aspects that could be removed?	Free text	*Yes/ No; if yes, list them briefly*	A horizon scan to check for any additional comments about the structure and scope of the report and suggestions for potential improvements
Stakeholder engagement				
Q8	I have had the opportunity to contribute to the report	Multiple choice	*Provided text as a chapter lead author; Provided data or text as a contributing author; Provided comments on a draft; Had the opportunity to contribute but did not; Had the opportunity to comment but did not; Did not get an opportunity to contribute or comment*	To check if stakeholders perceive that they have an equal opportunity to contribute to the process to compile the report
Q9	The process used to obtain information from stakeholders is appropriate and based on best practice	Likert	*Strongly disagree; Disagree; Neither agree nor disagree; Agree; Strongly agree; Don't know/ not able to answer*	To check if the report processes follow credible and appropriate standards of practices If the report processes are deemed to be not clear, transparent and or credible we have to change the processes to align with international best practices
Q10	Would you recommend improving stakeholder engagement on the report?	Free text	*Yes/ No; if yes, list proposed improvements briefly*	To provide an opportunity for any additional comments on the stakeholder engagement processes used by the report and suggestions for potential improvements
Policy alignment and impact				
Q11		Multiple choice	*Aspect* / *Level of insights gained*: *None*, *Some*, *A lot*	To gauge the usefulness of the report to stakeholders

Question no.	Question	Question type	*Response options*				How responses will be interpreted
	Did you gain new insights into different aspects of biological invasions from the report (tick one for each aspect)?		*Pathways of introduction and spread*				
			The number, type, status and impact of species				
			The status and impacts of invasions on sites				
			The status and effectiveness of control interventions in terms of inputs, outputs and outcomes				
Q12	Have you used information acquired from the report to change management practices?	Multiple choice	*No changes to management were made; Made small changes to management; Made large changes to management; I am not a manager*				To gauge if the report has been used for adaptive management of biological invasions
Q13a	Have you used information acquired from the report to make changes to policy?	Multiple choice	*The information in the report did not suggest or indicate that policy changes were needed; The information in the report indicated that policy changes would be beneficial, but none have been proposed; Some changes have been proposed for policy but not yet implemented; Policy changes have been made and implemented; I am not in a position to make policy changes*				To gauge if the report has been used to make informed decisions on policies, strategies and other implementing instruments (e.g., applications for funding)
***Q*13b**		Free text	*If yes, please indicate which policies have been changed*				Provides examples and evidence that the report has been used to inform policy decisions
Q14	Do you think that the policy alignment and impact of the report can be improved?	Free text	*Yes/ No; if yes, provide examples of how*				To provide an opportunity for any additional comments about

Question no.	Question	Question type	*Response options*	How responses will be interpreted
				the policy alignment and impact of the report and suggestions for potential improvements
Communication and outreach				
Q15	The report effectively communicates key findings to stakeholders, allowing them to assess the consequences of policy or management decisions while not being prescriptive	Likert	*Strongly disagree; Disagree; Neither agree nor disagree; Agree; Strongly agree; Don't know/ not able to answer*	To gauge if the report effectively communicates issues around the management of biological invasions to the broader community
Q16	How do you access the report?	Multiple choice	*SANBI website; Printed copies; Online repository – Zenodo*	To check how people access the report
Q17	Is the SANBI website (http://iasreport.sanbi.org.za) where the report can be accessed user-friendly and easy to navigate?	Likert	*Strongly disagree; Disagree; Neither agree nor disagree; Agree; Strongly agree; Don't know/ not able to answer*	To check the extent to which the report is accessible on information platforms. If people are dissatisfied with the website, it must be redesigned
Q18	Do you think that the way in which the report is communicated and disseminated can be improved?	Free text	*Yes/ No; if yes, list improvements briefly*	To provide an opportunity for any additional comments on the communication and outreach processes used by the report and suggestions for potential improvements

Thank you for completing this survey.

S6.3 Pathways

For a large proportion of introduced taxa data on introduction pathways (4%), introduction dates (20%), or both (45%) are missing. This is particularly an issue for plants, for which ~90% are missing one or both types of data, and fungi, for which ~86% are missing one or both types of data (Figure S6.1).

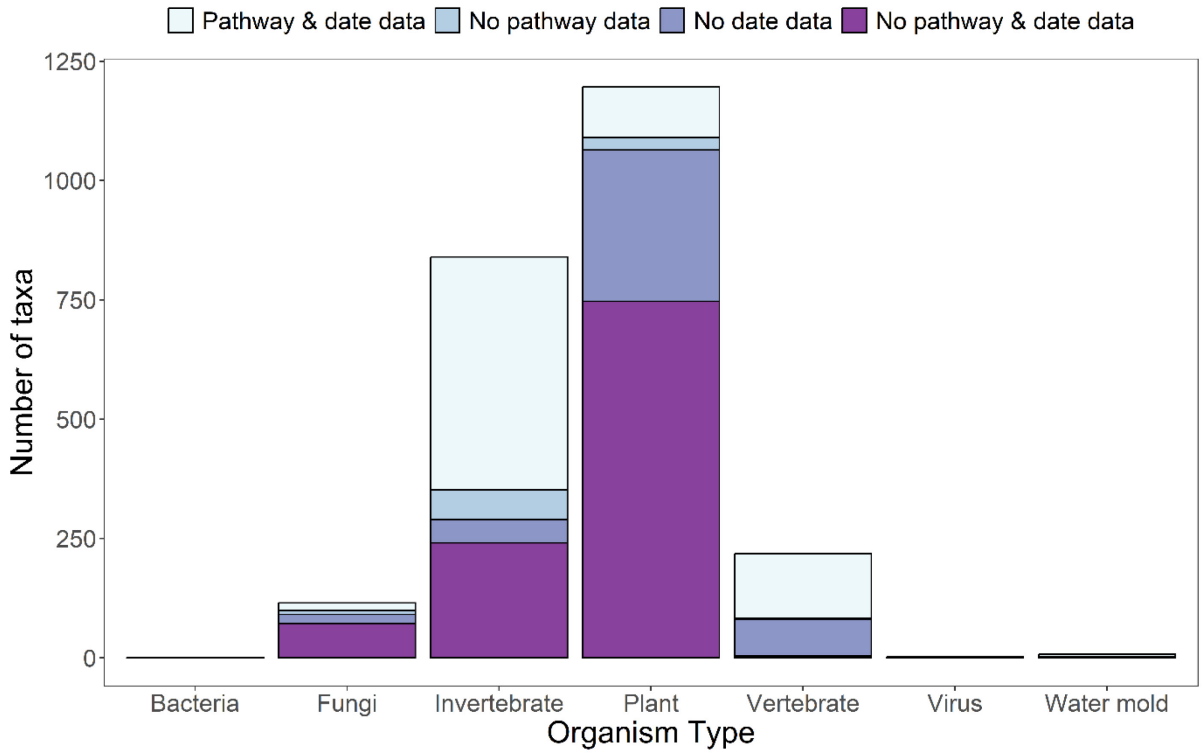

Figure S6.1 The number of taxa introduced to South Africa for which pathway and date of introduction data are available ('Pathway and date data'), as well as the number for which introduction pathway data ('No pathway data'), introduction date data ('No date data'), or both ('No pathway & date data) are not available.

S6.4 Review of gaps identified as part of IPBES IAS Assessment

Table S6.2 Knowledge and data gaps identified in the IPBES IAS Assessment (IPBES, 2023) in the context of South Africa

This table is largely a direct extract from Table S4 in Wilson et al. (2025), with a few minor edits to ensure the focus is on South Africa. In the original table, the value of addressing the gaps for management and understanding was qualitatively scored.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Incomplete or lack of inventories of invasive alien species in marine, tropical … ecosystems	Marine surveys have taken place, but these are primarily in harbours, with less known about natural habitats. Tropical areas (a relatively small area of the country) are not specifically under-sampled in South Africa, in fact the alien taxa in the Kruger National Park are regularly inventoried.	- Integrate data from citizen science into inventories for marine protected areas and other relevant databases. -Coordinated long-term monitoring and data curation needed concurrently with detection activities.
Incomplete or lack of inventories of invasive alien microorganisms and invertebrates	No systematic inventory of micro-organisms in part due to issues with biogeographic knowledge, but also as existing information has not been collated within the framework on biological invasions. Various invertebrate lists, but there is significant under-sampling. The completeness of particular lists depends on the availability of relevant taxonomists and sampling. Biocontrol introductions are well documented and inventoried. Better knowledge would provide opportunities for eradication or control.	-Integration of current data sources and database into current species lists (e.g., the Foundational Biodiversity Information Programme). -Ensure molecular data and eDNA surveys are linked to ground truthing surveys and alongside conventional methods (in particular for studies on microorganisms). -Link foundational biodiversity data to lists of aliens. -Support taxonomists foundational work. -Support for general surveys targeting invertebrates and microorganisms.
Lack of understanding of the drivers of change that facilitate biological invasion for some animal groups (notably invertebrates), fungi and microbes	Drivers of ecosystem change in terrestrial, freshwater and marine ecosystems are fairly well studied for some taxa (plants and vertebrates) but less so for fungi, microbes, and invertebrates. There are gaps in our understanding of pathways for invertebrates, fungi, and microbes; particularly accidental introductions. Deliberate introductions are much better understood. Better knowledge would enable risks to be estimated, mapped and interventions to be targeted and predictive.	-A study of drivers (driver mapping) facilitating invasions and looking at scenarios for how they are affected in future, particularly around accidental introductions. -Study to look at the movement of organisms around the country (deliberately and accidentally).

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Lack of understanding and synthesis of the impacts of invasive alien microbes & Incomplete data on the impacts of invasive alien species across Africa …	There are few limited studies on the impacts of alien microbes. For example, recent studies have highlighted the impact of the polyphagous shot hole borer and its fungal symbiont, *Fusarium euwallaceae.* In general calls for greater interaction between microbiologists and invasion scientists have not been met. Improved impact assessment methodologies have aided in identifying highly impactful species in South Africa. There is ongoing development of frameworks and models assessing potential impacts and risks posed. Better knowledge would assist management but only if effective interventions are feasible.	-Promote and fund studies that formally assess the impacts of alien species, especially underrepresented taxa such as microbes. -Test existing risk analysis and impact frameworks for their applicability to microbes (and develop new tools as needed). -Create working groups or points of interaction between pathologists, fungal biologists, and those working on biological invasions. -Collate existing information in terms of biological invasions. - Develop pathway management strategies relating to high-risk microbes or implementation of contingency plans. - Institutionalise alerts through surveillance mechanisms.
Poor understanding of drivers of change that facilitate biological invasions in aquatic and marine systems & Comparative lack of understanding of the drivers of change that facilitate biological invasions in developing economies & Lack of data and knowledge of the drivers of biological invasions in sub-Saharan Africa…	Drivers of ecosystem change in terrestrial, freshwater, and marine ecosystems are fairly well studied but there are some gaps. Eutrophication and variation in water flow are well known to have impacts on aquatic weeds. The impacts of plastic pollution on the marine environment (South Africa is a collector of plastics) is not known. Elevated dissolved CO_2 levels is likely affect aquatic plant growth. FBIS (https://freshwaterbiodiversity.org/) provides a baseline of species distribution, richness, and abundance to enable an understanding of drivers in freshwater ecosystems. Better knowledge would enable risks to be estimated, mapped and interventions to be targeted and predictive.	-Research on impacts of biological invasions with other drivers of global change.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Lack of data on successful restoration attempts in terrestrial and marine systems	South Africa has been a leading country in the science of restoration of invaded habitats in riparian and terrestrial ecosystems. Such studies need long term monitoring of restoration success post invader removal. Some specific active restoration projects have been well documented. The Working for Water Programme has substantial clearing activities, but it is not designed specifically for restoration (largely relying on passive restoration). Nothing has been done in marine systems as uncertainties are too high. As eradication is not feasible, removal and ensuing restoration would need to be ongoing, making it costly. Better knowledge would allow for adaptive management.	-Support is needed for the development of tools such as the 'Management Unit Clear Plan' (MUCP) to track clearing activities and expand these to explicitly include restoration. -Current and future work needs to specify costs, spatial coverage of work, volunteer and paid work hours, so methods are transferable. -Upscale the restoration component of management projects. -Adapt indicators used to track invasions so that ecosystem recovery is integral to evaluating outcomes of interventions.
Comparatively incomplete inventories of IAS in Africa…	South Africa has reliable estimates of invasive mammals, plants, birds, and freshwater fishes but not of other taxa. Knowledge in neighbouring countries tends to be a lot less than in South Africa. Better knowledge is foundational for regulations and the prioritisation of interventions.	-Curate and regularly update inventories. -Formalised processes and workflows for adding or removing species from national inventories. -Collaborate with neighbouring countries to improve data flow.
Lack of standardization of terminology for invasive alien species monitoring	South Africa has terminology set out in regulations and national syntheses. The understanding of mandates can be affected by views on terminology belonging to a particular discipline (e.g., pests are agriculture, invasive are biodiversity, emerging infectious diseases are health), potentially leading to a disconnect.	-Align regulatory terms with terms used in the glossary in the South African status report and to those used in practice. -Where possible and desirable align terms to international standards. -Curate terms used in a single place. -Ensure terms are defined wherever used
Lack of information on the role of indirect drivers, especially governance and sociocultural drivers, in affecting biological invasions	Various conflicts have arisen when all stakeholders are not considered. Perverse incentives are arising (e.g., a focus on the need for tree planting). Better knowledge would allow for more integrated governance and likely facilitate management.	-Incentivise interdisciplinary research (e.g., looking at causal loops and feedbacks). -A stakeholder mapping exercise. -An evaluation of information on social media culture and 'fashions' as an indirect driver to assist with evaluating the degree to which alien species have been incorporated into tradition and culture.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Lack of understanding of the net effects of multiple interacting drivers in shaping and promoting biological invasions & Lack of knowledge on interactions and feedback across drivers in promoting invasions	There is a realisation that interactions between drivers can be important, but few studies explicitly look at them (given how difficult such studies often are). Different governmental departments with different mandates and performance measures are not conducive to looking at interacting drivers.	-Set up mechanisms to allow for cross-departmental and cross-provincial alignment of strategies and monitoring efforts (integrated governance). -Utilise symposia to exchange ideas and promote cross-sectoral collaboration.
Incomplete data on impacts on nature's contributions to people and good quality of life	While arguably South Africa is a leader in research on the topic, much more is needed. All impacts have been understudied. A handful of preliminary studies have evaluated impacts using the SEICAT framework. There are historical studies on the impact of invasions on ecosystems services, economics, and livelihoods. Relatively few collaborations between invasion scientists, social scientists, and economists in South Africa. Where this has happened, the papers have been highly cited and the research very impactful. Better knowledge would help demonstrate the impacts on nature's contributions to people and good quality of life and likely be highly effective for prompting action.	-Synthesise studies on the impact of biological invasions on South Africa and update the estimates where possible. -Set up methods to collect targeted data & systematic evaluation to monitor impacts on nature's contribution to people and good quality of life.
Lack of control options for marine invasive alien species and invasive alien microbial fungal pathogens of plants and animals	There are very few control options in marine systems in South Africa (as globally), almost all are mechanical, very difficult, and often very dangerous. Some control techniques have been developed for fungal pathogens of plants, but only in a few cases. It seems unlikely that game-changing technologies will come along soon.	-Piggyback on the development of novel technologies as they become available. -Interact with plant pathologists to explore control options.
Lack of agreed-upon methods of supporting management decision making for invasive alien species with both positive and negative impacts	The current regulatory system is well established, and it includes mechanisms for consultation. The risk analysis framework used in South Africa considers positive and negative impacts. There has been some historical disagreements around the introduction of biocontrol agents (e.g., to control invasive trees used in forestry) that have been resolved, some are on-going (e.g., on pines). Economic studies have been used to justify the introduction of biocontrol agents on species with both positive and negative impacts Some species prioritisation exercises have been undertaken, for example for plants suitable for biocontrol.	-Continue consultation on regulatory listings. -Ensure listing decisions are transparent and can be contested, e.g., by publishing risk analyses. -Align regulatory instruments across sectors.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Lack of methods of managing pathways for invasive alien species arriving as contaminants, or through shipping containers, e-commerce (legal/illegal), biofouling or ports, and across land borders and along trade supply chains	Current methods for contaminants and along trade supply chains focus on agricultural and health pests, a greater focus on environmental threats is needed. The DFFE has established a trial at Durban Harbour on shipping containers. Mail arriving at OR Tambo is inspected, but e-commerce is largely unmanaged In terms of shipping, there have been studies on hull encapsulation for yachts, but most activities are focussed on keeping hulls clean for other reasons, and in-water hull cleaning could lead to more invasions Post-border monitoring is in place for specific species (e.g., agricultural pests) that are likely to spread from neighbouring countries into South Africa. Preventing accidental introductions will likely be harder than deliberate introduction though the only way to currently address marine invasions.	-Increase understanding of relative risks posed by the pathways and routes. -Co-ordinate actions at ports of entry. -Piggyback on methods developed for other sectors. -Align pathway-management actions and goals between different agencies. -Establish pathway management programmes for specific pathways or vectors.
Lack of methods for adaptive management of invasive alien invertebrates and plants using alternative approaches given the declining number of chemical control options	There is a lack of flexibility in governance systems (e.g., to redirect funds as needed) so management is not adaptive. Biological control is highly cost effective against some targets, but in other cases there are no current replacements for herbicides	-Establish mechanisms to allow decisions to be made at the appropriate level (so can respond to monitoring and flexibility to change). -Invest in biological control.
Lack of eradication guidelines and strategies for generalist invasive alien invertebrates, diseases and hard-to-detect freshwater and marine invasive alien species	There have been few eradication attempts in South Africa. Eradication of fruit flies has not been achieved. However, some areas are kept free of *Bactrocera dorsalis* and in other areas *Ceratitis capitata* is kept at low prevalence. Guidelines are available for fish (extirpating from discrete stretches of river or waterbodies).	-Extirpate invasive fishes were feasible and desirable. -Transparent process formalised for identifying and evaluating eradication targets, and declaring eradication.
Lack of scenarios and models of invasive alien species that consider interactions with other drivers of global change	Not addressed at a management / policy level in South Africa Scenarios and models are important to justify and guide interventions, though need to be critical of the value of model outputs if models are not appropriately informed by experiments and field observations, and particularly in cases where extrapolations have been made.	-Set up mechanisms to allow for cross-departmental and cross-provincial alignment of strategies and monitoring efforts (integrated governance). -Utilise symposia to exchange ideas and promote cross-sectoral collaboration. -Fund specific research on scenario and model development focussing on the potential futures of biological invasions in South (and southern) Africa.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Missing information on the implementation of adaptive-collaborative governance for biological invasions and factors important to the success of that governance strategy	Implementation is often not coordinated between government departments responsible for managing invasions, so information on such implementation is missing, affecting integrated control.	-Set up mechanisms to allow for cross-departmental and cross-provincial alignment of strategies and monitoring efforts (integrated governance). -Promote interdisciplinary work and invasion science from a social perspective (particularly political ecology).
Incomplete data on the effectiveness of policies, management strategies and actions related to biological invasions	The effectiveness of most interventions has not been assessed nor is current monitoring sufficient to do this. This is well established as a significant problem.	-Consolidate information on an accessible platform. -Establish systems to track the effectiveness of all interventions.
Lack of tools and frameworks to predict biological invasions	Many tools and frameworks are available, but they are often not integrated into policy and management. A risk analysis framework has been developed and provides some predictions. Species distribution models have been created for many taxa to allow for environmental scanning, and in a few instances explicit risk maps have been produced. There have been some efforts at horizon scanning and scenario planning, but it is often unclear whether they have been accepted and adopted. Maps of invasions are often outdated and relatively coarse, although some detailed maps exist for local areas.	-Explore uptake of existing tools and frameworks and integration into decision making. -Ensure mapping of species spread is up to date. -Collate clearing information centrally to assist with research activities. -Develop tools to address taxa that have no invasion history elsewhere. -Adapt tools for the South African situation where needed. -Initiate a broad future thinking exercise to facilitate pro-active management, and set up a process to ensure the exercise is regularly updated.
Lack of tools to reduce the barriers to information-sharing within and across countries	*Within South Africa* There are various forums in place and data shared; barriers to information sharing are relatively low (includes list server and information campaigns). *Internationally* Several platforms are available (GBIF and GRISS and iNaturalist) but often not populated.	*Within South Africa* - Consolidate information on an accessible platform that allows for integration with mobile phone applications. *Internationally* -Support shared working groups.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Lack of research and data on how best to implement integrated governance systems to manage biological invasions	The social network of people managing and studying biological invasions in South Africa has been explored and some sectors, such as social sciences, are largely missing.	-Promote interdisciplinary work and invasion science from a social perspective (particularly political ecology). -Facilitate implementation of environmental, social, and governance of conveyancers (air, land, and sea).
Design principles for an integrated governance system to manage biological invasions	This is largely lacking in South Africa. Governance is mainly top-down (e.g., through WfW).	-Promote co-development of management plans and collaborative implementation among stakeholders. -Assist companies (especially those linked to transport supply chains/ logistics) to comply with regulations.
Lack of mechanisms that allow effective collaboration among different elements of the socioecological systems	Several alien clearing prioritisation activities have taken place to account for different aspects of the social-ecological system. Often social, ecological, and economic information is used to define priorities. However, it is unclear if these priorities have affected action.	-Promote interdisciplinary work and invasion science drawing on social-ecological systems thinking. -Reduce the reliance of national data that does not consider issues relevant to management at local scales.
Lack of information on invasive alien species status and trends on land and water managed by Indigenous Peoples and local communities	There is fairly good broad-scale information on the presence of alien species in terrestrial systems (e.g., through the Southern African Plant Invaders Atlas); though information on trends and perceptions is lacking. No marine areas are specifically managed by Indigenous Peoples and local communities though there are examples of co-management of some marine resources (e.g., within Isimangaliso Marine Protected Area). An important issue is the concept/meaning of 'land and water managed by indigenous peoples and local communities' in South Africa. Does the land and water refer to that covered by Natives Land Act, 1913? Land ownership is often contested, and terminology should be adjusted to make it appropriate to the South African context.	-Encourage collaboration with communities to understand perceptions, usages, and distribution of invasive species and how they are incorporated into traditional knowledge systems
Lack of information on Indigenous and local knowledge, values and culture regarding the drivers and impacts of invasive alien species on land and water managed by Indigenous Peoples and local communities	South Africa has had a strong research focus in this area. There are many studies on the environment, livelihood, ecosystem service, and human well-being implications of invasive species in communal land settings.	-More research is needed on how local communities interact with invasive species in the context of freshwater and marine invasions.

Gap	Gap, situation in South Africa, and notes on value of improved knowledge	Proposed actions for South Africa's national strategy
Lack of understanding of and mechanisms for sharing knowledge on invasive alien species and their drivers, impacts, management and governance among Indigenous Peoples and local communities and researchers and other outsiders	There are several programmes and projects in South Africa that aimed at local communities (e.g., the Tsitsa in the Eastern Cape). These have adopted a holistic approach to land management, conservation, and water conservation.	-Support local communities to reduce alien biomass and fire risk.
Lack of consideration of the knowledge and perceptions of Indigenous Peoples and local communities in scenarios and models	The ASSET project aimed to be inclusive in their approach to clearing and beneficiation exercises to support restoration activities (https://assetresearch.org.za/interactive-restoration-models/).	-Combine participatory mapping exercises to improve the inclusion of local communities in scenario planning and modelling exercises.

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