



Australian Government

National Land & Water Resources Audit

An initiative of the Australian Government

**ECOLOGICALLY
SIGNIFICANT INVASIVE
SPECIES**

INDICATOR HEADING

**Extent and impact of selected
ecologically significant**

INDICATOR PROTOCOL

**Distribution and abundance of
significant invasive vertebrate pests**

Endorsed

This protocol has been endorsed by the National Land and Water Resources Audit Advisory Council. Version 1 – March 2007. The indicators will need to be further developed as identified within the protocol.

www.nlwra.gov.au

Distribution and abundance of significant invasive
vertebrate pests

Status of indicator agreement

The National Land & Water Resources Audit (the Audit) coordinates the collation of data to support reporting on natural resource condition required under the National NRM Monitoring and Evaluation Framework (National M&E Framework).

The National M&E Framework identifies three requirements for monitoring natural resource condition:

- a set of resource condition indicators to measure progress toward the agreed national outcomes on a medium and long term basis
- a set of indicators for monitoring community and social processes relevant to or affected by NRM programs, as well as measures of the adoption of sustainable development and production techniques
- contextual data pertinent to the indicator being considered.

The Audit Advisory Council has agreed to a process for achieving a practical set of indicators under the National Monitoring and Evaluation Framework.

This process is to:

- obtain on-going **recommendations** from the relevant **National Coordination Committees** for each thematic area (including “Matters for Target”) on appropriate indicators, protocols and information needs
- seek **endorsement** from the **Audit Advisory Council** that the indicators and protocols can be implemented at the national, state / territory and regional levels
- seek **agreement** from the Natural Resource Policies and Programs Committee (**NRPPC**) (or the Marine and Coastal Committee –**MACC**- for Estuarine, Coastal and Marine) that the indicators will be used and promoted by jurisdictions to underpin evaluations of NRM initiatives.

The NRPPC and MACC report to the Natural Resource Management Ministerial Council (NRMMC).

Distribution and abundance of significant invasive vertebrate pests

Matter for target:

Ecologically significant invasive species

Indicator heading:

Extent and impact of selected ecologically significant vertebrate invasive species

Indicator name:

Distribution and abundance of significant invasive vertebrate pests

This document presents the recommended monitoring protocol for collecting, collating and reporting information on the distribution and abundance of significant invasive vertebrate pests, at the national, state and territory, and regional levels.

1 Definitions

Distribution (a measure of spatial pattern) and abundance (a measure of relative numbers) of animals in a defined area.

2 Rationale

Vertebrate pests have major effects on primary production, biodiversity, ecosystem services, health and tourism in Australia. Effective management of vertebrate pests across jurisdictions requires use of consistent monitoring techniques and reliable reporting of the distribution and abundance of the pests. Information on distribution and abundance is particularly useful where measures of impact are not obtainable, and gathering such information is relatively cost-effective (in contrast to broadscale monitoring of the impacts of particular pest species).

Monitoring of the distribution and abundance of invasive vertebrate pests is required to:

- identify priorities for immediate and future management (eg planning and resourcing)
- evaluate previous management activities (eg response to control)
- improve understanding and knowledge (eg relationship between animal numbers and their impacts)
- raise awareness and provide education on current and potential problems and opportunities.

2.1 Distribution

Information on species distribution provides an account of the area inhabited by a species, and of the species' spatial pattern and dispersion. Distribution information is particularly useful for:

- detecting expansion or contraction in the spatial and temporal range of species (including new incursions or emergent species)
- determining the feasibility of management options and the scale of management required.

2.2 Abundance

Information on species abundance provides an account of the numbers and relative abundance of a species in a given area. Abundance measures are particularly useful for:

- identifying priorities, problems and opportunities for management
- identifying the relationships between density and damage between species and resources
- evaluating the effectiveness of management in terms of change in the numbers of pest animals in a given area
- assessing species whose distribution changes very little in response to control, but whose relative numbers are a measurable and meaningful indicator of population size.

Changes in impact are the best means of assessing the effectiveness of control efforts, but where it is not feasible to assess impacts, information on abundance can be used instead. The relationship between density of a pest species and resource damage is often unknown. To improve our understanding of how changes in abundance affect resource damage, information on impacts should be collected wherever feasible (see the indicator protocol *Impacts of Significant Invasive Vertebrate Pests*).

3 Monitoring methodology

To be effective, monitoring programs need to be designed to:

- address key management questions and priorities
- minimise costs
- use consistent techniques to allow comparisons across jurisdiction and over time
- include established, emergent and new incursions of species
- focus on detecting trends in distribution and abundance of species, or their impacts.

This section looks at the scale and frequency of monitoring, and at methods for collecting, analysing, using and storing data.

3.1 Monitoring scale

Regional and local

At this level, the monitoring scale should be determined by relevant regional and local operational activities. Where possible, the scale used should be capable of being aggregated to a state level.

State and territory

Monitoring should be state-wide and should be undertaken using the methods defined by Appendix 1. Information can be collected at either property or grid level (eg 0.5 degree scales or finer where feasible).

National

The Australian Vertebrate Pest Committee has selected a minimum scale of 0.5 degree reporting units (equivalent to 1:100 000 map-sheet tiles, or approximately 50 km grid) for statewide and national information. To produce national data sets, state information should be aggregated, where necessary, to the recommended national reporting scale.

3.2 Monitoring frequency

Regional and local

The most suitable frequency for monitoring will depend on the species and region. Regional and local-scale monitoring should occur as frequently as deemed necessary to meet regional and local operational priorities.

State and territory

At state and territory level, monitoring should be coordinated (to allow trends in populations to be identified) at the following minimum frequencies:

- annually for new incursions of species (at a resolution of at least 1:25 000)
- 2–3 years for emergent species
- 4–5 years for established species.

National

Monitoring at national level is not required, because the information is obtained by combining information from states and territories.

3.3 Data measurement method

Monitoring should consider:

- occurrence (present, absent or unknown)
- distribution and dispersion (localised or widespread)
- abundance (occasional or low, common or medium, abundant or high).

At all levels, monitoring should include incursions of new species with pest potential, emerging pest species and well-established pest species.

Regional and local

For monitoring at the regional and local level, recommended techniques for vertebrate pests are outlined by Mitchell and Balogh (2006). Site-specific factors and the purpose of the monitoring will determine the methods to be used in particular situations. Priorities need to be identified through relevant planning processes.

State and territory

The recommended monitoring methods for state and territory monitoring and reporting are given in Appendix 1. The methods capture expert knowledge to classify pest animal populations according to the criteria outlined above for occurrence, distribution and abundance.

To maximise the quality of the information, the emphasis should be on obtaining and incorporating quantified data and information at fine resolution, especially as it relates to areas of intensive land use or significant value (see Appendix 1 and Section 3.7). The method can apply to 25 000, 50 000 or 100 000 scales, based on a nested system using Australian mapping tiles. Again, priorities need to be identified through relevant planning processes.

National

To obtain national information, state and territory-level information should be aggregated or scaled up, as explained in Section 3.4, below. Guidelines for reporting and managing core data and metadata obtained from these surveys are available from the Australian Government Department of the Environment and Water Resources.¹ A priority list of established, emergent and new incursion species will be maintained by the Vertebrate Pest Committee for monitoring activities under the National Monitoring and Evaluation Framework. Appendix 2 lists established species that are of priority for national monitoring.

3.4 Data collation and calculation method

Most jurisdictions currently collect and collate at least some information on the distribution and abundance of pest animals. In some cases, these data will need to be modified to meet the requirements for national reporting (a conversion procedure for this is given in Appendix 3). In other cases, data captured at varying spatial scales and formats (point, line and polygon format) will need to be reclassified and aggregated for reporting at state and territory, and at national level. A procedure is being developed for aggregating data at various spatial scales to state and national reporting formats.

3.5 Data storage and management

Responsibility for the storage and management of information and data collected by regional organisations should be negotiated with the relevant regional or state authorities. However, data should be maintained and be readily accessible for state and national reporting, and stored and managed in accordance with nationally agreed policies and guidelines established by the Australia and New Zealand Information Council (ANZLIC) — the Spatial Information Council. Relevant authorities at state and territory level should be custodians of their specific datasets.

3.6 Data analysis and interpretation

Depending on specific needs, data should be analysed and interpreted by regions, states and territories or the Australian Government. Spatial trends should be ascertained from datasets over time. Relevant state and territory authorities should be involved in the final interpretation of information. Caution is required when interpreting nonvalidated information obtained through descriptive processes.

Where areas are assigned a high abundance category, the probability of locating the species in that area is assumed to be greater than in areas classified as either medium or low abundance. However, wild animals can

¹ See *Guidelines for Biological Survey and Mapped Data*, available online at <http://www.environment.gov.au/erin.documentation/pubs/biodata.pdf>

sometimes move large distances or relocate, depending on localised conditions and resource availability. Movement behaviour should therefore be considered when interpreting data. Results of data analysis should be disseminated via existing government reporting mechanisms.

3.7 Reliability, validity and quality assurance

Information about the quality of distribution and abundance data for invasive vertebrate pests should be recorded. Consistent with the survey methodology outlined in Appendix 1, data quality and reliability should be reported using the following grading system or classification (note: a given area may attract a combination of, or all, categories, depending on the information incorporated into the estimate):

- Class 1 (low) — Anecdotal information from ad-hoc sources and incidental reports; no reliable expert knowledge or survey data.
- Class 2 (medium) — Expert opinion from local specialists providing general knowledge based on observations and other sources, such as control activities.
- Class 3 (high) — Scientific data from recognised field sampling protocols, field surveys, systematic sampling or formal assessment.

Additional quality assurance statements may be prepared for state and territory and national datasets. Additional information on data quality standards is available from the National Land and Water Resources Audit (NLWRA) website.²

3.8 Metadata statement

Metadata documentation needs to be completed for all datasets. Such metadata statements should be consistent with ANZLIC standards.^{3,4}

4 Reporting and information products

4.1 Audiences

Information on the distribution and abundance of invasive vertebrate pests is useful to a wide range of natural resource managers:

- regional and local levels — local control authorities and councils, natural resource management (NRM) regional managers and planners, and those developing regional investment strategies
- state and territory, and national levels — animal health and biosecurity authorities, policy-makers, industry, research, regulatory authorities and quarantine services, funding authorities, disease surveillance and contingency planning specialists
- broader community — education, training, tourism and environment groups.

² http://www.nlwra.gov.au/archive/full/35_data/41_data_protocols/data_protocols.html

³ <http://www.anzlic.org.au/policies.html> (go to *Metadata protocol and standard metadata profile*)

⁴ ANZLIC is working towards the international ISO 19115 standard
http://www.osdm.gov.au/osdm/docs/resources/mwg_au_gov_profile.pdf

4.2 Products

Geographic

Products from mapping at regional, state and territory, and national level can be periodically produced, to report the distribution and abundance of vertebrate pests, gauge the effectiveness of management over time and establish trends in populations (assuming there are few gaps in the data). Additional products may be developed, focused on NRM regions, river basins, and the Interim Biogeographic Regionalisation for Australia (IBRA).

Summary statistics

Summary reports and statistics can be produced to gauge the effectiveness of management over time (eg showing the area inhabited). Distribution and abundance information should be reported (in appropriate area units) according to area inhabited by each species (see Appendix 1). Data should be reported for management areas as necessary.

4.3 Confidentiality

Maintaining confidentiality of data will be the responsibility of the custodian of the original data (for example, the management authority responsible for monitoring and reporting invasive animal information at the state level).

4.4 Data collation and calculation method

The development of national datasets and information products will require transformation of state and territory datasets (see Appendix 3), and reclassification or aggregation of data from various scales to national reporting grid or format (see Section 3.4).

4.5 Data analysis, integration and interpretation

Analytical functions are unlikely to be required for processing or production of information products from distribution and abundance information for invasive vertebrate pests. Development and interpretation of information products will require consultation with relevant state and territory authorities (particularly for products that are relevant across borders). Modelling of potential distribution and abundance may be developed from national data.

4.6 Data access and storage

It is important that national level information has the potential to be updated via links to relevant database and information systems at regional and state and territory levels. It is proposed that national information be reported through the NLWRA Atlas and Data Library, and in the future through the *Australian Resources Online* [website due out 2007]. The Australian Government will be responsible for hosting these services. Data access arrangements will be developed with relevant data suppliers or custodians, and will address data confidentiality (see Section 4.3).

4.7 Product definition statement

Each product should have a product definition statement following the same format as the metadata statement (see Appendix 4 and Section 3.8).

5 Implications

Appropriate data infrastructure and a reporting framework at all levels (local and regional, state and territory, and national) will be required for reporting distribution and abundance data.

6 Future development

Procedures for reclassifying or aggregating state and territory-level data (at a range of scales) to the national data format will be required. The national priority species list will be refined and more species may need to be added, based on state and territory and national priorities (see Section 3.3).

7 Links to other indicators

Other indicators relevant to distribution and abundance of significant vertebrate pests are:

- selected ecologically significant invasive vertebrate species extent and impact <http://www.nrm.gov.au/monitoring/indicators/vertebrate.html>
- selected ecologically significant invasive vegetation species extent and impact <http://www.nrm.gov.au/monitoring/indicators/weed-extent-impact.html>
- selected significant native species and ecological communities extent and conservation status <http://www.nrm.gov.au/monitoring/indicators/signif-species.html>
- estuarine, coastal and marine habitat extent and distribution: pest species (number, density, distribution) <http://www.nrm.gov.au/monitoring/indicators/estuarine/pest-species.html> .

8 Further information

Specific references

DEH Guidelines for Biological Survey and Mapped Data
<http://www.environment.gov.au/erin/documentation/pubs/biodata.pdf>

Mitchell B and Balogh S (2006). *Monitoring Techniques for Vertebrate Pests: Series*. NSW Department of Primary Industries, Orange. NSW.

Woolnough AP, West PB and Saunders GR (2004). Institutional knowledge as a tool for pest animal management. *Ecological Management and Restoration* 5:226–228.

Links

Australian Government Department of Agriculture, Fisheries and Forestry
<http://www.daff.gov.au>

Australian Government Department of the Environment and Water Resources
<http://www.environment.gov.au>

Australian Capital Territory – Environment ACT

<http://www.environment.act.gov.au>

New South Wales – Department of Primary Industries

<http://www.dpi.nsw.gov.au>

Northern Territory – Department of Natural Resources, Environment and the Arts

<http://www.nt.gov.au/nreta>

Queensland – Department of Natural Resources and Water

<http://www.nrw.qld.gov.au>

South Australia – Department of Water, Land and Biodiversity Conservation

<http://www.dwlbc.sa.gov.au>

Tasmania – Department of Primary Industries and Water

<http://www.dpiw.tas.gov.au>

Victoria – Department of Sustainability and Environment

<http://www.dse.vic.gov.au>

Western Australia – Department of Agriculture and Food

<http://www.agric.wa.gov.au>

9 Glossary

Abundance	A measure of numbers or relative density in a defined area (eg occasional, common or abundant).
Distribution	Measure of spatial pattern or dispersion throughout an area (eg localised or widespread).
Emerging species	Any newly established vertebrate species whose distribution and abundance is expanding and whose impacts are likely to be significant.
Established species	Any vertebrate species whose populations are self-sustaining through reproduction or immigration and that has occurred in an area for a significant time since introduction.
National data format	Agreed minimum scale of state and territory, and national reporting (eg 0.5 degree units, equivalent to 1:100 000 map sheet series or approximately 50 km grid).
New incursions	Any vertebrate species that has not been recorded previously at a location and whose impacts are likely to be significant
Occurrence	Presence status of a species within an area (eg present or absent).
Significant	Defined by state and territory or national declarations and recommendations from relevant national authorities.

Appendix I Recommended state/territory-wide pest distribution and abundance survey methodology

Source: modified from the Queensland Government Department of Natural Resources and Water Annual Pest Distribution Survey.²

Step 1 Species occurrence

The occurrence of a pest can be recorded as:

- *present* — species exists in the defined area
- *present: control* — pest species is present and under formal control
- *absent* — species does not exist in the defined area
- *absent: eradicated* — pest incursion that has been previously eradicated
- *unknown* — it is not known (or participants are unsure) whether the species exists.

This criterion has the highest level of accuracy.

Step 2 Distribution — spatial pattern

When presence is confirmed, the distribution of the species (incursion or spread of a species) within the defined area can be recorded as:

- *localised* — species occurs in a clumped pattern and occupies less than 50% of a cell
- *widespread* — species occurs in most areas and occupies greater than 50% of a cell.

Distribution provides a useful indication of the size of infestations; however, its accuracy is influenced by survey participants' varying perceptions of populations; and the difficulty of assessing large areas of land. This criterion has a lower level of accuracy than 'occurrence'.

Step 3 Abundance — relative numbers

Abundance refers to the relative density of a species within an area and can be described as:

- *occasional or low* — single animals spaced at wide intervals, or few or no sightings and/or little active evidence (eg very infrequent observations or evidence of animals and tracks, scats and other traces)
- *common or medium* — a middle measure between occasional and abundant, or some animals seen at almost any time and/or much sign of activity (eg frequent observations or evidence of animals and tracks, scats and other traces)
- *abundant or high* — infestations that have reached their full potential and provide little opportunity for additional animals to survive in that area, or many animals seen at any time and much sign of activity (eg very frequent observations or evidence of animals and tracks, scats and other traces).

² http://www.nrw.qld.gov.au/pests/maps/pest_distribution/distribution_maps.html

Abundance is particularly difficult to estimate because participants' perception of abundance levels vary with species and impact levels; species detection varies between habitat types; and some habitats support higher concentrations of species, which depends on environmental conditions or carrying capacity.

Step 4 Trend

Change in animal abundance over time using anecdotal information where trends cannot be obtained – recorded as:

- *increasing* — populations have increased in abundance over previous 5 years
- *stable* — populations have remained stable in abundance over previous 5 years
- *decreasing* — populations have decreased in abundance over previous 5 years
- *unknown* — no information available.

Trend is particularly useful to measure change in populations over time, but this criterion only has a moderate level of accuracy.

Step 5 Data quality

Data quality and reliability should be reported using the following classification:

- *no data* — no information about data quality
- *low* — anecdotal information from ad-hoc sources and incidental reports; no reliable expert knowledge or survey data
- *medium* — expert opinion from local specialists providing general knowledge based on observations and other sources, such as control activities
- *high* — scientific data from recognised field sampling protocols, field surveys, systematic sampling or formal assessment.

Data quality is particularly useful to verify the accuracy of information for interpretation and analysis.

Appendix 2 Species of national significance for monitoring under the National Monitoring and Evaluation Framework

Common name	Latin name
Rabbits	<i>Oryctolagus cuniculus</i>
Foxes	<i>Vulpes vulpes</i>
Feral pigs	<i>Sus scrofa</i>
Feral goats	<i>Capra hircus</i>
Common carp	<i>Cyprinus carpio</i>
Cane toads	<i>Bufo marinus</i>
Starlings	<i>Sturnus vulgaris</i>
Feral cats	<i>Felis catus</i>
Wild dogs; dingoes	<i>Canis lupus familiaris</i> ; <i>Canis lupus dingo</i>
Deer	
Fallow	<i>Dama dama</i>
Red	<i>Cervus elaphus</i>
Sambar	<i>Cervus unicolour</i>
Rusa	<i>Cervus timorensis</i>
Chital	<i>Axis axis</i>
Hog	<i>Axis porcinus</i>

Appendix 3 Pest animal abundance conversions

Classification ¹	Classification ²
Occasional	Low
Common	Medium
Abundant	High

1. Queensland Annual Pest Distribution Survey classification

2. Pest animal abundance classification system from Woolnough et al (2004)

Appendix 4 Information product template

Information product name		
Product ID or reference number	Jurisdiction, agency or custodian's reference number if applicable.	
URL for product metadata	A webpage reference to where more comprehensive details of the product are recorded.	
Jurisdiction		
Custodian		
Contact details	Relevant person, position, branch/unit/section, location and phone, email contacts.	

Relevant matter for target	Which National Monitoring and Evaluation Framework matter for target does this product relate to?	
Relevant national indicator	Which National Monitoring and Evaluation Framework indicator(s), if any, does this product relate to?	
Relevant state/territory indicator	Which state/territory indicator(s), if any, does this product relate to?	

Description	Provide a brief description of the product including the purpose and the output file format.	
Source data name and ASDD link	Name all the source data set(s) used to produce the product. Provide references to metadata for source datasets used. This should be either the ASDD metadata reference or other URL. If any source dataset is not already described to ASDD Page 0 standard, please complete the accompanying template.	
Source data attributes used	Please list the attributes used from each of the source datasets to produce the information product.	
Processing of source data	Please describe the steps taken in processing and combining the source data to produce the information product.	

Status	What is the current status of the product? If the product is 'In progress' or 'Is planned', please complete as many of the remaining descriptors as are known.	Currently exists In progress Is planned
Coverage	How much of the state/territory distribution of the resource (or applicable part of the state/territory) is covered by the product?	80–100% 50–80% 20–50% 0–20%
Recency	When was the dominant contributing data established?	2005–2000 2000–1995 1995–1985 1985–1970 1970–1950 <1950
Trend	Does the dataset support trend interpretation?	Sequence (eg river flow, rainfall) Multiple (few) (eg land use 1990 and 2000) Single (eg soil type)
Usability scale	What is the finest resolution that maintains confidence in the product? That is, not to be used at 1:100,000 or less.	Local Regional State National
Availability	What is the public availability of the product? Is a licence required for outside users?	Open Restricted/licence Closed
Delivery	How is the product best delivered?	Web services Digital data Electronic document Paper document

Content type	What type of information does the product represent?	Real data Mixture of real and modelled data Modelled data
Update	What will be the frequency of update for the product?	Frequently At least once/planned Not planned/unknown
Other relevant information	Please add any other important information relevant to this information product that should be known.	