Monitoring threatened species and ecological communities

This factsheet summarises key outputs from a Threatened Species Recovery Hub project that aimed to assess the current status of monitoring for Australia's threatened species and ecological communities; to develop a framework with practical standards that can be used to guide the development of national monitoring programs; and to outline general principles that characterise the most effective monitoring programs. More detail can be found in the further reading at the end of the factsheet.

Why is monitoring essential?

Monitoring is integral to achieving the recovery of threatened species. Monitoring reveals information about population status and trends, with such information often crucial for the recognition of a species as threatened. When well-designed, monitoring can identify causes of decline, reveal ecological information critical for management, measure management effectiveness, provide opportunities for public engagement and report on conservation investment to decision-makers and the public.

Northern Brown Bandicoot caught during a fauna monitoring study. Photo: Jaana Dielenberg

National threatened species monitoring assessment

The Threatened Species Recovery Hub has conducted the first national assessment of the monitoring of threatened species and ecological communities in Australia. The assessment considered whether, and how well, each Australian threatened mammal, bird, reptile, frog, freshwater fish and ecological community was currently monitored. Plants, invertebrates and marine fish were not assessed, but would make valuable additions in the future.

The monitoring assessments for species were based on a framework of metrics against which monitoring could be consistently judged. This framework establishes a set of standards that can be used to guide the development of effective national monitoring programs for threatened biodiversity. A brief summary of the metrics and results is presented here.

Monitoring metrics

Effective monitoring for threatened species usually entails more than simply counting individuals, although such tallies can be better than no data. The value of monitoring usually depends on the design of programs, the understanding they generate, and the integration of monitoring data into management decisions and reporting.

The review assessed monitoring programs against nine metrics which were originally developed in the Mammal Action Plan published in 2014.[1] These were extended so that they could consistently gauge the effectiveness of monitoring for any species. The metrics can also be used to evaluate whether monitoring improves over time. The metrics are all scaled from 0 (no monitoring) to 5 (best practice).

Metric 1: Fit-for-purpose

The detectability of many plant and animal species varies significantly according to survey techniques, and monitoring protocols should use techniques, and take place at times, that are most apt for the target species. Some threatened species are monitored as part of generic multi-species surveillance monitoring program. This can reveal some information for threatened species but is usually not detailed or tailored enough to adequately inform management of the species. A fit-for-purpose monitoring program for a particular threatened species is usually necessary.

Further reading

Legge, S., Lindenmayer, D. B., Robinson, N. M., Scheele, B. C., Southwell, D. M., & Wintle, B. A. (Eds). (2018). *Monitoring Threatened Species and Ecological Communities*. CSIRO Publishing: Melbourne.

Robinson, N., Scheele, B., Legge, S., Southwell, D., Carter, O., Lintermans, M., Radford, J., Skroblin, A., Dickman, C., Koleck, J., Wayne, A., Kanowski, J., Gillespie, G., Lindenmayer, D. (2018). How to ensure threatened species monitoring leads to threatened species conservation. *Ecological Management and Restoration* 19, 222–229.

Metric 2: Coverage

Monitoring should be representative, with monitoring sites located representatively or randomly across the species' distribution and habitats. The range of threats and management actions (and therefore population trends for a species) are likely to vary across its distribution. Representative monitoring should also include sampling across subspecies and major genetic lineages in the range.

Metric 3: Sampling periodicity

Monitoring should take place at appropriate intervals. Monitoring episodes should happen often enough to detect rapid changes and provide warning of any need for a response. Time intervals should also relate to the life history of a species (e.g., more frequent monitoring for shorter-lived species). They should also take into account seasonal variations, for example, migratory species should be monitored at an appropriate time of year, and at the same time each year.

Metric 4: Longevity

Monitoring should take place over sufficiently long periods so that short-term responses can be distinguished from longer-term trends. The monitoring longevity should be sufficient for detecting incremental changes that are still significant to conservation efforts. Longevity may be particularly important in Australia, as the abundance and distribution of many species changes markedly with drought, high rainfall or fire events, which introduce some statistical 'noise' into the detection of longer-term trends. The long-term security of resources for monitoring programs is also vital given that climate change may amplify threats to many species.

Metric 5: Design quality

Managers need early warning of declines and reliable evidence to justify remedial actions.

Monitoring programs should be of sufficient intensity, sample size and statistical power to readily and reliably detect trends of conservation significance.

Metric 6: Coordination

Monitoring must be coordinated across all relevant jurisdictions and stakeholder groups. Recovery teams, where they exist, may be best placed for coordinating and integrating monitoring activities. For example, recovery teams can advocate for the use of consistent methodologies across jurisdictions, and integrate databases, results and analyses from separate monitoring efforts. Those responsible for monitoring programs also need to consider a process for handing responsibility to successors, such that monitoring does not shrivel when one champion retires.

Metric 7: Data availability and reporting

Monitoring data should be readily accessible to all participants, and the public generally. Responsibility should be assigned for long-term database management, as well as for planning for any future data migration to new platforms. Monitoring should also feature an accessible and informative standard operating procedure that specifies protocols and goals.

Metric 8: Management linkage

Monitoring should be embedded in management planning, be meaningful to managers, and provide feedback to enhance management. It should assess the relative impacts of different threats and measure the effectiveness of management actions addressing those threats. Management agencies should recognise and respect clearly established trigger points, which typically involve a threshold rate of decline or population size, at which point timely and effective responses can be carried out.

Metric 9: Demographic parameters

Monitoring programs should also assess critical factors influencing demographics. Information on important life history parameters (e.g., reproductive success, population age and sex composition, mortality) can provide much more ecological insight than simple measures of abundance. This insight may allow management to target critical leverage points in a species' biology, or identify demographic stages that might benefit most from intervention.

How are we faring?

The review found that 21% to 46% of threatened vertebrates receive no monitoring, and that the situation was worst for freshwater fish and reptiles. In the case of threatened ecological communities, 70%, or 56 of the 80 listed, are not monitored at all.

This is a troubling result, for without monitoring information, managers may not know how to focus conservation efforts. Without monitoring, we may even fail to notice that a species is declining, and lose the chance to recover it.
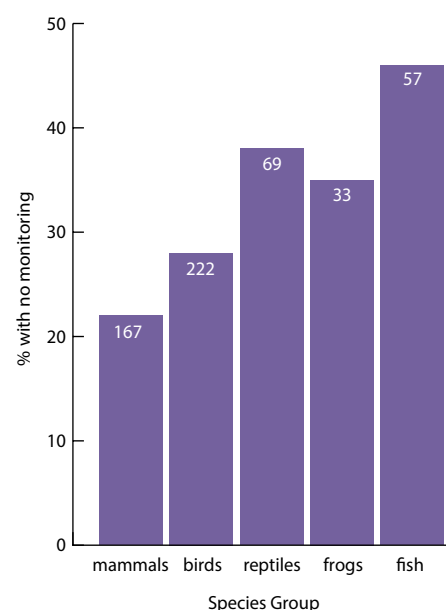

Figure 1. The percentage of threatened species that lack any monitoring, by vertebrate group. Numbers within the bars show the numbers of listed species included in the analysis.

Scheele, B., Legge, S., Armstrong, D., Copley, P., Robinson, N., Southwell, D., Westgate, M., Lindenmayer, D. (2018). How to improve threatened species management: An Australian perspective. *Journal of Environmental Management* 223, 668–675.

Scheele, B. C., Legge, S., Blanchard, W., Garnett, S., Geyle, H., Gillespie, G., Harrison, P., Lindenmayer, D., Lintermans, M., Robinson, N., Woinarski, J. (2019.) Continental-scale assessment reveals inadequate monitoring for threatened vertebrates in a megadiverse country. *Biological Conservation* 235, 273–278.

The review found further that where monitoring does occur, quality is often poor. Of the 24 threatened ecological communities that do have some monitoring activity, eight had no on-ground assessments, relying solely on remote sensing data. For threatened vertebrate species that were monitored, the average score across the nine metrics was higher than or equal to three (out of five) in just four cases out of 45.

Some types of vertebrates scored consistently higher on the monitoring metrics than others.

The highest quality scores overall were for frogs and birds, then mammals, fish, with reptiles last. Large and enthusiastic volunteer networks may explain the more favourable bird scores. Frogs may enjoy relatively high scores because many species have small distributions that make national monitoring easier.

The metrics that scored worst overall were those relating to links to management, data availability and reporting, and demographic information.

The review found that species listed as threatened under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* are generally better monitored than species included only in non-statutory lists (e.g., IUCN). For most vertebrate groups, more highly threatened species, and species with recovery plans, tend to have better monitoring. This finding suggests that listing and recovery planning lead to better information on the trends for threatened species.

Species where monitoring is the responsibility of a single individual or organisation generally scored higher. These cases frequently occur when a species has a very small range, such as some frogs, so their good performance is due largely to monitoring tractability.

Species with a high public profile (e.g., Tasmanian devils, marine turtles, migratory shorebirds, parrots) also tended to have better monitoring programs.

Poorer results were seen for species with large or multi-jurisdictional distributions, mostly because of poor coordination and poor coverage. Results were also often poor for species that are difficult to monitor, such as some bats, or birds at inaccessible sites like continental islands.
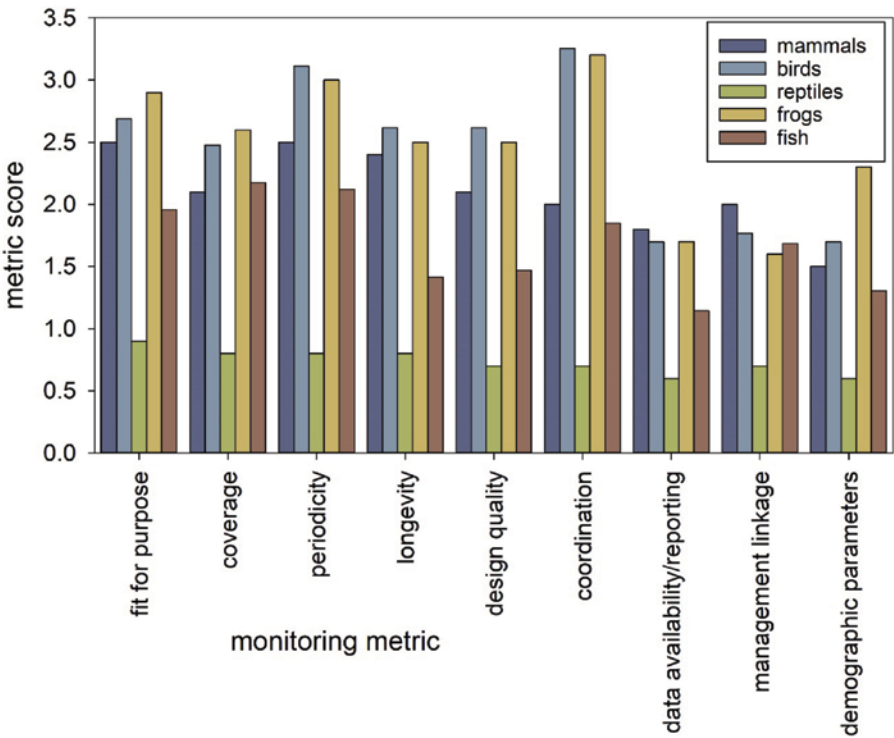

Figure 2. The average scores out of five for each of nine metrics for the quality of a national monitoring program, evaluated for threatened taxa in each of five vertebrate groups.

Who is monitoring?

Monitoring practitioners are drawn from state governments, the Australian Government and CSIRO, university researchers, non-government organisations, Indigenous groups, natural resource management groups, independent consultants and zoos, in roughly that order. This diversity presents a challenge to national monitoring, as the objectives of these practitioners vary, activities may be uncoordinated, results are rarely publicly available or reported, and some practitioners may be unlikely to maintain monitoring programs for longer periods. However, this diversity could be transformed into a strength with adequate coordination and resourcing.

Monitoring assessments were led by:

Mammals – John Woinarski, Andrew Burbidge, Peter Harrison
Birds – Stephen Garnett, Hayley Geyle
Reptiles – John Woinarski
Frogs – Ben Scheele, Graeme Gillespie
Freshwater fish – Mark Lintermans, Wayne Robinson
Ecological communities – David Keith, Belinda Pellow, Matt Appleby

Principles of effective monitoring

As well as carrying out the review of current monitoring for threatened biodiversity, this project hosted a discussion between 26 monitoring practitioners from government, non-government organisations, consultancies and academic institutions around Australia to distil the key principles for effective monitoring.

Principle 1: Engage people

Engaging with community groups, citizen scientists, Indigenous groups, landowners and natural resource managers is vital for encouraging support for monitoring, and for getting monitoring data integrated into decision-making, including resourcing.

Principle 2: Integrate monitoring with management

Monitoring must be strongly linked to, even embedded in, conservation management to influence conservation outcomes. Many management agencies adopt the MER framework for integrating monitoring – monitoring, evaluation and reporting.

Principle 3: Plan, design and implement a fit-for-purpose program

The aim of monitoring threatened species is to avert extinction by identifying and reversing the causes of population declines. To achieve this, the monitoring needs to be tailored to suit the species.

[1] Woinarski, J. C. Z., Burbidge, A. A., and Harrison, P. L. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing: Melbourne.

Principle 4: Ensure good data management and coordination

Data management is key to the success of monitoring programs, yet often neglected. Failures in its execution can cause loss of data or compromised data, and budget blow-outs. Data management plans should cover how data will be stored, accessed and made available, the analysis methodology, and responsibilities for these tasks.

Principle 5: Communicate the value

Communication is the responsibility of all monitoring practitioners, from first discussions with land managers, landowners and decision-makers, to evaluating and sharing results, to reporting on conservation outcomes. Good communication will help to ensure continuing support from all stakeholders and to justify future resource allocation.

Lessons learned

The review highlighted the need for better information on the trends of Australia's threatened species and ecological communities. We need to know how we are faring, and how effective management actions are. This information is rarely available from current national monitoring and reporting programs. However, the assessment framework can be used to guide the development of new monitoring programs, as well as the improvement of existing monitoring.

A national program for monitoring threatened biodiversity could be supported with a well-resourced monitoring facility, to build on and co-ordinate existing monitoring activities, produce monitoring guidelines for diverse threatened species, fill identified gaps and strengthen weaknesses in the current effort, engage, train and support Indigenous groups, citizen naturalists and recovery teams, and be responsible for reporting, and hence prioritising management responses.

Monitoring, as an essential ingredient of conservation management, needs to be regarded as indispensable and supported across land-managers, policy-makers, researchers and funding bodies.

Threatened Species Recovery Hub

National Environmental Science Programme