1 MAKING MONITORING UP-FRONT AND CENTRE IN AUSTRALIAN BIODIVERSITY CONSERVATION

David Lindenmayer

Lesson #1. Monitoring has highlighted some outstanding monitoring successes like the recovery of the Grey-crowned Babbler after management interventions in Victoria.

Lesson #2. It is now possible to identify some simple attributes characteristic of successful monitoring programs.

Lesson #3. There is an increased recognition among government and non-government agencies of the importance of monitoring.

Lesson #4. There are far too few well-designed and implemented long-term biodiversity monitoring studies in Australia.

Lesson #5. There has been a demonstrable failure to slow biodiversity decline in Australia.

Lesson #6. There has been a failure by a large proportion of the scientific fraternity to engage in monitoring.

Lesson #7. New forms of long-term funding arrangements must be developed to support high quality, biodiversity monitoring programs in Australia.

Lesson #8. New institutional arrangements are urgently required to underpin effective biodiversity monitoring programs in Australia.

Lesson #9. New approaches are needed to link question-driven with mandated biodiversity monitoring programs.

Introduction

Australia has an appalling record on biodiversity monitoring. While there have been some outstanding monitoring successes, it seems that these are more than countered by a long list of failed programs that remain uncompleted, or poor quality programs that are characterised by many problems. As an example, Allen (1993) and Norton (1996) described how nearly half of the more than 55 monitoring programs on tussock grasslands in New Zealand were unreported, indicating a failure rate that is extremely high. These problems also characterise many biodiversity monitoring programs in Australia. Yet, high quality monitoring is critical for many reasons including (among others):

1. Guiding effective management interventions.
2. Gauging progress in conservation programs and providing a basis for assessing return on conservation investment.
3. Highlighting examples of conservation success as an antidote to the otherwise overwhelming number of negative stories in biodiversity conservation (Garnett and Lindenmayer 2011) and, in turn, building ongoing (and hopefully increased) public and political support for conservation programs.

These (and many other) reasons mean that it is critical to significantly increase the number and quality of biodiversity monitoring programs in Australia. Based on my experience in long-term ecological work in south-eastern Australia over the past three decades, I outline my perspectives on monitoring successes and failures as well as what I strongly believe is needed to improve biodiversity monitoring in this country.

Successes

1. Monitoring has highlighted some outstanding monitoring successes like the recovery of the Grey-crowned Babbler after management interventions in Victoria

Conservation biology is widely regarded as a crisis discipline and, like many efforts in crisis management, failures are common. Much of conservation biology has therefore become a negative pursuit in which successes are rare. However, Garnett and Lindenmayer (2011) argue that more evidence of success is needed in conservation biology to provide motivation for redoubled efforts and tangible signals of positive results that arise from appropriate management interventions. Well-designed and implemented monitoring is fundamental to demonstrating conservation success and there are some good examples in an Australian biodiversity conservation context. For example, Robinson (2010) highlighted how management efforts on private agricultural land in Victoria designed to enhance the conservation of the threatened bird species, the Grey-crowned Babbler (*Pomatostomus temporalis*), entailed the strategic widening of roadside reserves. Monitoring of these management interventions, as well as monitoring of bird populations, highlighted the outstanding success of such efforts. Similarly, a carefully planned monitoring program within Booderee National Park on coastal New South Wales demonstrated the strong positive response of the highly endangered Eastern Bristlebird to a coordinated baiting program for the Red Fox (*Vulpes vulpes*) (Lindenmayer *et al.* 2009). These examples highlight the importance of monitoring in demonstrating management success.

2. It is now possible to identify some simple attributes characteristic of successful monitoring programs

Recently, Gene Likens and I (Lindenmayer and Likens 2010) completed a major review of monitoring and identified seven key characteristics of effective monitoring programs. These were: (1) Good questions and evolving questions. (2) The use of a conceptual model of an ecosystem or population. (3) Well-developed partnerships between scientists, policy makers and resource managers. (4) Strong and dedicated leadership. (5) Ongoing funding. (6) Frequent use of data. (7) Maintenance of data integrity and calibration of field techniques.

General recognition of these characteristics is important because it means that it is possible to identify ways to guide the design of new monitoring programs as well as examine and then improve the performance of existing monitoring programs. Moreover, the seven characteris-

tics listed above are generic and are therefore relevant to any biodiversity monitoring program, irrespective of species, ecosystem or location.

3. There is an increased recognition among government and non-government agencies of the importance of monitoring

The importance of monitoring has long been recognised by the scientific fraternity (despite many scientists not engaging in monitoring programs – see Lesson 6 below). Although biodiversity monitoring has been acknowledged as important by policy makers and resource managers, this has often not converted to on-ground, high-quality monitoring programs. However, this has changed in many organisations in more recent times. For example, the Terrestrial Ecosystem Research Network (TERN), funded through the Australian Government Department of Innovation, Science and Research, commenced major funding in 2011 to maintain and/or expand long-term plot networks and environmental gradient transects in many parts of Australia. Formal environmental monitoring will be a significant component of this initiative.

In another example, in the Australian Federal Government's *Biodiversity Conservation Strategy*, it is stated that the nation will have a national long-term biodiversity monitoring and reporting system by 2015. Notably, the Federal Government has established formal monitoring programs as a fundamental component of several of its large-scale, long-term environmental initiatives. One of these is the Box-Gum Grassy Woodlands stewardship program which is paying private landholders to manage remnant areas of high quality woodland for conservation outcomes and in which a rigorously designed monitoring program will determine the effectiveness of management interventions (Zammit *et al.* 2010). Other organisations, like Catchment Management Authorities in NSW, are undertaking similar kinds of integrated management and monitoring initiatives. Of course, non-government organisations like Bush Heritage Australia and the Australian Wildlife Conservancy are similarly undertaking high quality management interventions accompanied by well-designed and implemented monitoring programs.

Monitoring failures

4. There are far too few well-designed and implemented long-term biodiversity monitoring studies in Australia

Despite the successes listed above, and the awakening recognition in some organisations of the need to undertake monitoring programs, the sad reality is that examples of effective biodiversity monitoring are far too rare in Australia. This problem is intimately linked with the fact that monitoring is almost invariably the last item funded in any environmental initiative; funding levels are never appropriate to do the monitoring well; funding is almost always too short term for work to be truly effective (e.g. a program exceeding 5–10 years; see Lindenmayer and Likens 2010), and funding for monitoring is invariably the first item cut from budgets. Our recent, questionnaire-based surveys of the people who are undertaking long-term ecological work in Australia clearly indicate that almost all projects are maintained and funded on an ad-hoc basis. These monitoring programs are highly susceptible to being terminated when the champion for the project leaves or dies, or when priorities change within the organisation with which the project champion is associated (Lindenmayer and Likens 2010).

The scarcity of good biodiversity monitoring programs means that it is impossible to report effectively on state and national environmental initiatives like the State of the Environment

reports or to gauge the effectiveness of major tax-payer funded programs like the Natural Heritage Trust (Hajkowicz 2009).

5. There has been a demonstrable failure to slow biodiversity decline in Australia

Related to the previous point, and notwithstanding the successes of some management interventions for some species, there has been a demonstrable failure to slow the loss of biodiversity in large parts of Australia (Kingsford *et al.* 2009). The decline of native mammals in northern Australia is one of many sobering examples (Fitzsimons *et al.* 2010). This means that, despite the fact that over 10 per cent of the Australian land mass is in reserves, and the extent of protected areas has been increasing in the past few decades, many threatened species are not well protected in those reserves (Watson *et al.* 2010).

6. There has been a failure by a large proportion of the scientific fraternity to engage in monitoring

Successful monitoring typically involves partnerships between scientists, policy makers and resource managers (Russell-Smith *et al.* 2003; Lindenmayer and Likens 2010). Despite almost every ecologist and/or environmental scientist at some stage writing about the need to undertake monitoring of some form or another, many scientists have refused to actively engage in monitoring programs to guide: (1) their design; (2) the development of appropriate protocols; (3) the collection of data; or (4) data analysis and data interpretation. This is unfortunate as it has led to important monitoring programs either not being instigated, failing after they have commenced, or being poorly implemented.

Scientists also have often failed to highlight the dangers of **not** doing monitoring, such as the failure to detect important environmental changes (Lindenmayer *et al.* 2010) and the enormous logistical and financial difficulties associated with reversing some environmental problems (such as those associated with populations of invasive plants and animals) (McNeely *et al.* 2003; Simberloff 2010).

Connected with the lack of engagement of scientists in biodiversity monitoring has been a loss of new generations of people with the requisite natural history skills for effective empirically based biodiversity monitoring (Noss 1996; Lindenmayer and Likens 2010).

Solutions

7. New forms of long-term funding arrangements must be developed to support high quality, biodiversity monitoring programs in Australia

As outlined above, 'last thing funded/first thing cut' has been the overarching characteristic of the vast majority of monitoring programs around Australia. Monitoring programs do not function without appropriate levels of funding over an appropriate time frame. Short-term political initiatives and short-term funding cycles are therefore the antithesis of the kinds of funding streams and time frames needed to support and maintain effective ecological biodiversity monitoring programs (Lindenmayer 2007).

New kinds of long-term funding arrangements must be developed to support high-quality, biodiversity monitoring programs. The scale of action and level of these funding investments must match the seriousness of Australia's environmental and biodiversity conservation problems. Arguably, the plot and gradient-transect component of the national TERN initiative has made some tentative progress in this regard – but unfortunately it is only a 3-year funded

program. As an example, I have recommended the establishment of a true environmental trust (that would support monitoring programs using the interest but not the capital of major investments) (Lindenmayer 2007). There are examples of environmental trusts and levies from around the world and there would be considerable value in 'cherry-picking' the best qualities of those that can be shown to have worked (Lindenmayer 2007). In addition, there also needs to be far more rigorous attention paid to ensuring that high-quality monitoring (by reputable individuals and organisations) is a mandatory part of any significant development proposal. Moreover, the level of investment in monitoring must be congruent with the scale of a development proposal. For example, a $50 000 biodiversity monitoring program in a multi-billion dollar natural resource extraction venture is an obscene mismatch.

Whatever the most appropriate and politically digestible funding formula ends up being, it is critical that the funding issues associated with establishing and then maintaining high-quality biodiversity monitoring should be resolved. Indeed, there will be few robust solutions to Australia's biodiversity problems (and indeed the nation's broader environmental problems) without tackling funding issues underpinning the maintenance of robust monitoring.

8. New institutional arrangements are urgently required to underpin effective biodiversity monitoring programs in Australia

The establishment and maintenance of effective biodiversity monitoring programs around Australia will require effective institutions and organisational structures. A new biodiversity monitoring-based institution is urgently required to fulfil a number of critically important roles. These include: (1) Mapping where and when past and existing monitoring efforts have taken place in Australia. (2) Coordinating and widely disseminating new ideas, protocols and methods about biodiversity monitoring, including providing opportunities for regular information exchange (e.g. conferences and workshops). (3) Providing advanced training in many of the key tasks associated with effective biodiversity monitoring, such as experimental design, application of field protocols, databasing, statistical analysis and interpretation, and scientific writing and reporting. This might include undergraduate training to provide high-quality professional staff to government and non-government agencies and corporate entities that will be undertaking biodiversity monitoring programs. (4) Lobbying for cultural changes within government bodies and other organisations so that they take biodiversity monitoring far more seriously and invest in it accordingly. And, (5) Assessing existing biodiversity monitoring programs to ensure they are improved to meet at least minimum quality standards (including proper and regular analysis and reporting of results).

9. New approaches are needed to link question-driven with mandated biodiversity monitoring programs

Recently, Gene Likens and I classified different kinds of monitoring (Lindenmayer and Likens 2010) and suggested that mandated monitoring occurs when environmental data are gathered as a stipulated requirement of government legislation or a political directive. Mandated monitoring is usually large scale (encompassing state or national level information) but does not attempt to identify or understand the mechanism influencing a change in an ecosystem or an entity. Rather, the focus is usually to identify trends (e.g. whether environmental conditions are getting 'better' or 'worse'). In contrast, question-driven monitoring programs often operate at the level of sites, landscapes or regions. These kinds of monitoring programs are guided by a conceptual model and by a rigorous experimental design. The use of a conceptual model will typically result in *a priori* predictions that then can be tested as part of the monitoring program. Often such learning is informed by strongly contrasting management interventions.

Different kinds of monitoring programs are conducted in different ways and at different spatial scales. A fundamentally important challenge remains about how to: (1) better integrate data, approaches and insights from different kinds of monitoring programs into useful environmental management, and, (2) use knowledge about the advantages and disadvantages of different kinds of monitoring programs to improve monitoring efforts.

I believe that many of the arguments in the scientific and resource management literatures about the suitability or otherwise of particular monitoring frameworks, as well as criticisms about particular monitoring programs being ineffective, stem from a failure to recognise the inherent values of, and differences between, large-scale mandated monitoring programs and smaller-scaled question-driven monitoring programs. I also suggest the next major challenge for long-term monitoring is to work out how to combine the data sets, results and outcomes that are conducted at different scales, in different ways and by different groups to produce integrated assessments useful to decision makers.

Concluding comments

High-quality biodiversity monitoring is fundamental to truly tackling Australia's biodiversity and environmental management problems. The appalling record on biodiversity monitoring in this nation needs to be urgently addressed. It is critical that governments in Australia are held accountable to pledges to implement a national long-term biodiversity monitoring and reporting system by 2015. Major changes in institutional arrangements and funding streams will be essential for achieving this stated goal and convincing a wide range of stakeholders that real gains are being made and that there are real biodiversity returns resulting from conservation investments.

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Biography

David Lindenmayer is Professor of Ecology and Conservation Science in the Fenner School of Environment and Society at The Australian National University. He has worked on an array of long-term ecological projects in south-eastern Australia over the past three decades, including several that classify as monitoring. He has written extensively on forest ecology and management, woodland biology, conservation biology, landscape ecology, wildlife conservation and management.

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