Track-based monitoring for the deserts and rangelands of Australia

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Envisage Environmental Services
Ecological Horizons

June 2008

for the Threatened Species Network at WWF-Australia

The Threatened Species Network is a community-based program of the Australian Government and WWF-Australia.

Executive Summary

This document outlines a broad-scale nationally-coordinated program for monitoring threatened and invasive species in the inland deserts and rangelands of Australia. The program uses a track-based monitoring technique which has been developed after extensive work with Indigenous groups in arid Australia and is well suited to engage the skills of Indigenous people and provide meaningful employment.

There is a pressing need to understand the broad-scale population trends and status of remnant threatened species and the distribution and abundance of invasive species in arid Australia. Animal populations are often highly dispersed, elusive and challenging to monitor and some species are producing considerable impact on agriculture and biodiversity.

The proposed technique produces multi-species occupancy data and these data are foundational in studies of distribution and range and the study of animal invasions. The data are statistically robust and relatively inexpensive to produce. The technique is simple to apply and monitoring can be conducted on a broad-scale and is well-suited to the isolated, large, sandy areas of the interior. A draft monitoring protocol and data sheet is provided.

To improve the validity of data it is proposed that a training and accreditation scheme would ensure the validity of data and allow skilled traditional owners to train others in their community.

Track-based monitoring is not a new technique, indigenous groups have been using animal sign for millennia, and more recently scientists have also adopted this method particularly for monitoring introduced predators. Currently, many different techniques exist and there is little validation of data. The data are stored in numerous unmanaged databases, data are analysed and reported inappropriately and much data is lost.

The proposed program would ensure standardization, collation and verification of track data and allow national and local trends to be conveyed back to land managers and government agencies, allowing them to critically assess the success of land management actions. A national track-based monitoring program would appropriately value indigenous knowledge as well as provide income and training opportunities for traditional owners in their own communities.
Key recommendations for the scoping study include:

- Development of local guidance and training for people involved in applying the track-based monitoring program, both for Indigenous and non-Indigenous users at the regional and enterprise level
- Development of meaningful incentives to increase adoption and involvement in the monitoring program by Indigenous people
- Development of a central data management facility to facilitate collation, review, storage of data and the development and application of intellectual property, analysis and reporting protocols

- Access to resources that would increase awareness and interest in the monitoring program
- Establishment of an organization for governance and administration of the Tracking Australia program

A snap shot of the proposed tracking technique and its application

The proposed method involves one or more observers recording all tracks and sign of a range of threatened and invasive species within a 2 ha plot over the equivalent of 30 minutes of observer time (1 observer=30 minutes, 2=15 minutes etc.). Species greater that 35 g mass leave sufficiently distinct and uniquely distinguishable tracks to monitor.

A multi-species snapshot of selected species' occupancy is produced for each plot. The age of the most recent track sequence for these species is estimated so that the plot occupancy of larger animals with longer lasting track imprints can be compared with small animals that have imprints that degrade quickly.

The proposed technique is similar to one advocated for use by Bird Australia in their Bird Atlas where bird species are recorded in repeated 2 ha search areas. The methods used by Birds Australia to analyse and document national trends in birds species would be relevant and applicable to the data produced from the track plots.

Plots are spaced about 4-5 km apart to produce independent results for most small and medium-sized animals. Plot filtering may be required to produce independent data for large animals.

The data produced are statistically robust and can be used to compare the distribution between sampling periods thus determining if threatened species are in decline or recovering.

Plots would need to be random, repeated and stratified but additional plots purposefully placed in threatened species locations could also be used as opportunistic records.

The plots provide a framework to collect other biophysical data including vegetation composition, structure and phenology and provide opportunities for ground-truthing of fire history and substrate mapping. Changes in the distribution of introduced species such as camels, foxes and rabbits could also be determined.

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Abbreviations

ANU Australian National University
AQF Australian Qualifications Framework
BA Birds Australia
CAEPR Centre for Aboriginal Economic Policy Research -ANU
CDEP Community Development Employment Program
CLC Central Land Council
COAG Council of Australian Governments
CSIRO Commonwealth Scientific and Industrial Research Organisation
DK CRC Desert Knowledge Cooperative Research Centre
EPBC Environmental Protection and Biodiversity Conservation Act
GIS Geographic Information System
GPS Global Positioning System
IPA Indigenous Protected Area
KLC Kimberley Land Council
NGO Non Government Organisation
NHT Natural Heritage Trust
NLC Northern Land Council
NRM Natural Resource Management
NTRETA Northern Territory Department of Natural Resources, Environment and the Arts
OHS Occupational Health and Safety
RTO Registered training organisation
SRA Shared Responsibility Agreements
TBM Track-based monitoring
WoC Working on Country
WS Comments from Workshop Alice Springs

Acknowledgements

We wish to thank many people that contributed to this report by participating in the workshop and providing time to discuss the issues relevant to the development of a track-based monitoring program. In particular, we thank Theresa (Ada) Nano with Mike Misso who played a significant background role in the development and commissioning of the scoping study. Andy Vinter provided administrative expertise and organised the workshop in Alice Springs which was facilitated by Michelle Rodrigo. Michelle Watson contributed substantially to the development and field testing of the 2 ha plot. Dave Pearson, Chris Pavey, Reece Pedler and Jocelyn Davies provided valuable comments on the draft strategy.

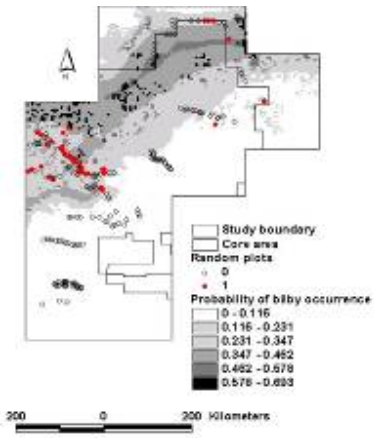
1 Introduction and background

The deserts and rangelands of Australia are vast and remote and the human population is the smallest and most sparsely populated in the world. In this part of Australia, profound changes in the composition and resilience of biological systems have occurred since European settlement. In some arid areas, more than 60% of native mammal species have become extinct. The loss of species can be attributed to habitat degradation caused by introduced herbivores and changed fire regimes, and the spread of introduced predators, some of which are still increasing in abundance and range.

To maintain and enhance biodiversity, land managers require accurate information on the extent and abundance of animal and plant populations and the effect of management and natural process variability. The immense size and temporal variability of the Australian landscape coupled with the low population base has made monitoring with precision and at an appropriate scale difficult to achieve. Despite an intimate and detailed understanding of regional biodiversity and ecosystem function, Indigenous people have had little opportunity to systematically contribute their knowledge and skills to biodiversity monitoring (Fisher *et al*. 2007). Instead, people living on Indigenous communities face chronic unemployment which has lead to poor health outcomes and social and or cultural disintegration (Garnett and Sithole 2007).

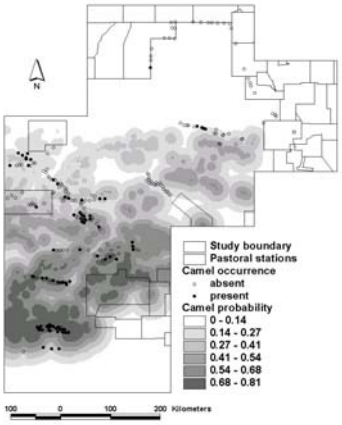
This report describes a track-based monitoring technique that can be used to collect systematic biodiversity data through the deserts and rangelands of Australia and considers the essential components and support required that would allow broad implementation of the program.

Our experience has been that a simple track-based monitoring approach combined with the skills of experienced trackers can deliver meaningful data on the distribution of threatened and invasive species in deserts and rangelands of Australia.



track plots + experienced trackers = meaningful data

Our experience has also been that the technique is highly suited for the involvement of Indigenous people because most have a familiarity with animal tracking and many have exceptional tracking skills. People also have strong ties with country and enjoy the mobile nature required from field work. Hence, there is great opportunity to engage people from Indigenous communities in track-based monitoring and develop meaningful training and employment.

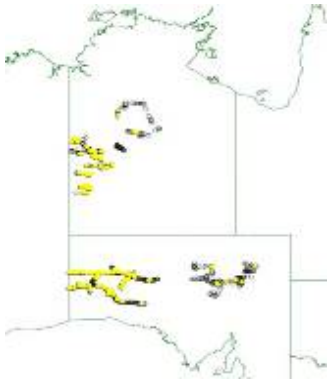


track plots + indigenous communities = meaningful work

This motivated us to examine what is needed to develop a structured program to deliver meaningful broad-scale monitoring and community benefit at national scale.

Methodology Verification Application Collation Training Accreditation Brokering

Federal agencies DEEWR DAFF DEWHA NRM IPA State agencies Indigenous NGOs Consultants



structured program + national coordination = broad-scale monitoring & community benefits

The Threatened Species Network (Alice Springs) with funding from WWF Australia provided an opportunity to develop a scoping study for the development of a national track-based monitoring program suitable for surveying a range of threatened and invasive species. The monitoring program would aid assessment of recovery efforts across the sandy desert regions of arid Australia. The objectives and Terms of Reference for the project are contained in **Appendix 1**.

The focus of this report is to identify the issues that relate to the development of:

- a robust track-based monitoring technique suitable for monitoring threatened and invasive species in arid and semi Australia
- a structured program that would support deployment and broad-scale adoption of a standardised monitoring technique
- a nationally coordinated approach that would result in meaningful broad-scale monitoring and community benefit particularly regarding work opportunities on Indigenous communities.

To set the task fully in context the first part of the report (**Part A**) outlines the broad range of issues needed to be considered in development of a track-based monitoring technique. Key advice provided at the workshop and from other informants has been used to identify the strengths, weaknesses, threats and opportunities provided by the technique in relation to existing programs. This has been used to develop a vein of logic linking the issues identified in the sections of the report listed below and to guide technique design and priorities for program development:

- Current status of threatened and invasive species & monitoring activity
- Current condition of Indigenous employment and well-being
- Requirements of biodiversity monitoring programs and the options for fauna monitoring in the Australian deserts and rangelands
- Requirements for the development of community participative monitoring programs and particularly those that provide opportunities for participation by Indigenous people
- Issues relating to track-based monitoring methodology, training and accreditation of trackers
- Issues related to data management
- Knowledge gaps and program development needs

The second part of the report (**Part B**) provides the outline of a work program and material that could be used to develop a track-based monitoring project within Indigenous communities and examples of track identification material under development.

2 Development of the scoping study

This scoping study represents the culmination of extensive field testing of different techniques, and interviews and discussion with people from a mix of disciplinary backgrounds including Traditional Owners, biophysical scientists (ecologists), social scientists (anthropologists, political scientists), administrators of government and non-government organisations and the examination of numerous reports.

Track-based monitoring has been used by the authors since the mid 1980s to monitor a range of invasive and threatened species. A number of publications and reports have resulted (Southgate 1987; Southgate 1990; Masters *et al*. 1998, Southgate *et al*. 2005; Southgate 2006; Southgate *et al*. 2007abc).

The need for a single technique for use in threatened and invasive species monitoring has been discussed during arid zone species recovery meetings held in various locations (Alice Springs, Dryandra, Adelaide, Broome) for over a decade.

A workshop was held in Alice Springs in April 2, 2008 to discuss the development of a national track-based monitoring program and interviews have been conducted with key people unable to attend the workshop (**Appendix 2**). The transcribed notes from the workshop are presented in **Appendix 4**.

People within NGOs and Federal Government Departments were contacted during a visit to Melbourne and Canberra in May 2008 and while attending the Vertebrate Pest Conference in Darwin, June 2008.

Part A Overview

3 Current situation

3.1 Threatened and invasive species monitoring

The composition of the biota in arid Australia has changed profoundly in the past 200 years. Over 33% of native mammal species are now extinct and 90% of medium-sized mammals have become extinct, endangered or vulnerable in the deserts and rangelands of Australia (Endangered Species Advisory Committee 1992). The most severely affected species are ground-dwelling, medium-sized and arid-adapted.

About 80 introduced animal species have established significant wild populations on mainland Australia and 49 occur in the rangelands (Norris and Low 2007). A number of species have become significant pests of agriculture and the environment (Bomford and Hart 2002). Eleven of these pest species (wild populations of foxes, cats, dogs, rabbits, camels, goats, horses, mice, cane toads, pigs and carp) are conservatively estimated to have impacts valued at over $720 million annually (McLeod 2004). Introduced herbivores particularly the rabbit, feral cat and fox have been linked to the decline of native species (Maxwell *et al*. 1996).

Currently, very little monitoring of biodiversity values takes place in the deserts and rangelands (Fisher *et al*. 2007). What does occur has the following characteristics:

- The purpose for the programs are driven by policy, legislative or development objectives and initiated by Federal and State Government agencies
- Surrogates are measured instead of direct biodiversity attributes
- Most of the programs cease once the short term objectives have been satisfied
- Native flora and fauna monitoring are usually designed to provide specific information about a single species. Exceptions include kangaroo and wildfowl monitoring to determine harvest quotas
- Large feral herbivore monitoring may occurs as an add-on to kangaroo population monitoring
- Carnivore monitoring most often occur to assess a control program and infrequently to assess non-manipulated characteristics of populations
- Weed monitoring is neglected at a regional scale

Efforts to produce a national assessment of threatened and invasive species status have been problematic because of the broad range of monitoring approaches, data standards and inconsistent reporting standards (West 2008). Improvements are required to consolidate the:

- current monitoring protocols
- procedures for information collation and reporting,
- products for stakeholders, and
- information management

Stakeholders

There are many stakeholders in threatened and invasive species monitoring and management. At a Federal Government level, the Department of Environment, Water, Heritage and the Arts (DEWHA) and the Department of Agriculture, Forests and Fisheries (DAFF) are primarily responsible for the administration of Natural Heritage Trust (NHT), Natural Resource Management (NRM), National Action Plan for Salinity (NAP) and the new overarching natural resource management program: Caring for our Country. Threatened species monitoring and management under the Environment Protection and Biodiversity Conservation (EPBC) Act and the establishment of Indigenous Protected Areas (IPA) program is the responsibility of DEWHA.

The Department of Agriculture, Forests and Fisheries (DAFF) is responsible for the coordination, facilitation and promotion of pest (invasive) animal management policies and programs. Land & Water Australia is a statutory research and development corporation within the DAFF portfolio. As such, it supports Australian NRM policies and programs through investing in research which improves the way natural resources are managed for sustainability. The Board for each NRM region identifies the priority areas for management and associated evaluation and monitoring programs seen as most appropriate for each region. While there is variation in emphasis, the need to monitor threatened and invasive species has been identified as priority in the regions covering the deserts and rangeland of Australia (**Appendix 3**).

Monitoring at a regional scale occurs through regional planning processes under the NHT or NAP. Through this process, the community, State Governments, Natural Resource Management Boards and Land Councils obtain most of the funding to develop monitoring and management programs.

Each State and Territory Government has a range of policies relating to threatened species and invasive species management supported by a mix of Departments and programs funded by State or Territory and Federal Government allocations.

Within State and Territory jurisdictions there are Indigenous organisations including the Central, Kimberley, APY and Northern Land Councils that have responsibilities for land management over vast areas.

A number of NGOs now have significant land ownership and caretaker responsibilities and the capacity to manage and monitor threatened and invasive species. Australian Wildlife Conservancy (AWC) and Bush Heritage Australia (BHA) now have a combined estate of many thousands of square kilometers, much of which is located in the Australian deserts and rangelands. Other NGOs such as The Nature Conservancy, Wilderness Society and WWF Australia provide strong advocacy for conservation programs and Indigenous engagement programs. Birds Australia is an NGO that provides strong advocacy and expertise in community participative monitoring but its charter is limited to birds. Some of the NGOs receive support from Federal Government to maintain their administrative and on-ground functions.

Issues

- **Little monitoring is occurring in a vast area by many stakeholders using different methods.**
- **Many monitoring programs are short-term projects producing incompatible data that often ends up lost.**
- **It is difficult to find a champion at a Federal level because monitoring responsibilities fall across a range of departments**
- **Alignment with a CRC, University or NGO and development of a solid business plan is required before Government would consider substantial investment (Charlie Zammit, DEWHA)**

Solutions

- ✓ **Track-based monitoring offers a tool to monitor components of the fauna that are of national significance to conservation and agriculture and hence of concern for federal, state and local government (WS)**
- ✓ **The proposed monitoring would promote and improve cross-border data sharing and pooling for analysis (WS)**
- ✓ **There has been strong interest from State and Territory Government employees responsible for development of biodiversity monitoring programs (Peter Copley, SA DEH; Neil Burrows, WA DEC; Glen Edwards, NT NRETA)**
- ✓ **There has been strong interest from NGOs (AWC and BHA) in applying the technique but it is not part of their core business to host a program monitoring program with national focus**
- ✓ **Birds Australia provides an example of an NGO with a national monitoring focus with a wealth of experience in governance, administration, data management applicable to the development of a track-based monitoring program (James O'Connor, BA).**

3.2 Indigenous employment and well-being

For over 200 years Australia has failed to engage with Indigenous communities and to recognize their skills and talent. Government funding over time has built and supported a high reliance by indigenous communities on government supported social security and funded initiatives. This failure has lead to high levels of welfare dependency, a lack of meaningful employment, incentives for education and training, and worst of all, a lack of hope for future generations (Conlon 2007). Key issues include;

- Indigenous communities have entrenched levels of poverty and intergenerational unemployment, in some communities at a rate of 100% of potential workers.
- Indigenous people are three times more likely to be unemployed than other Australians (ABS 2004). Approximately 70 per cent of young indigenous adults (aged 20-24 years) are not fully engaged with work or education.
- Approximately 50 per cent of indigenous adults are reliant on some form of welfare payment and for young people (aged 15 to 24 years) the proportion is only slightly lower.

- Indigenous women are the least likely of all groups to be in the labour force, with a participation rate of 43%.
- Indigenous people suffer ill-health and disability at greater rates than non-Indigenous people.
- The life expectancy rates for Indigenous people are around 20 years lower than non-Indigenous rates. Ill-health impacts significantly on work opportunities and places a burden of care on individuals and communities.

In June 2004, the Council of Australian Governments (COAG) agreed to a National Framework of Principles for Government Service Delivery to Indigenous Australians. The principles identified effective environmental health systems and economic participation and development as priority areas along with issues of social disadvantage.

A recent study by Garnet and Sithole (2007) has demonstrated the link between continued Indigenous cultural and natural resource management (ICNRM) and biodiversity conservation. Aboriginal people actively involved in ICNRM were demonstrably healthier than those who were not. In particular they had low levels of the precursors of cardiovascular disease and diabetes. They also felt good about themselves because they were fulfilling cultural responsibilities, eating good traditional food and avoiding the social tensions of town life.

Stakeholders

Since the 2004 COAG agreement, the Australian Government has moved Indigenous specific programs into mainstream departments, established an appointed National Indigenous Council, refocused coordination and planning of programs through regionally based Indigenous Coordination Councils (ICC), refocused government engagement with communities on Shared Responsibility Agreements (SRA) and introduced contestability into community based service delivery (Roughley and Williams 2007).

The Department of Education, Employment and Workplace Relations (DEEWR) is responsible for the nature and form of work contracts that can be used in the employment and education of Indigenous people including CDEP.

The Department of Environment, Water, Heritage and the Arts (DEWHA) is the key Australian Government agency in supporting Indigenous people in NRM. It considers Indigenous Australians as a key partner in managing Australia's environment and cultural heritage (http://www.environment.gov.au/indigenous/index.html). The range of programs and services to support Indigenous people in natural resource management (NRM) are delivered largely under the *Indigenous Australians Caring for Country* banner.

The State and Territory Governments, NRM and Indigenous organisations and most of the NGOs concerned with land management have programs targeting Indigenous engagement, training and employment.

Issues

- **To determine social welfare advantages from implementation of a track-based monitoring technique would require broad-scale, long term rollout (WS, John Altman, CAEPR)**
- **There is current uncertainty about the status of employment and contract programs eg. CDEP and funding sources are fragmented and unfocused (WS)**

Solutions

- ✓ **Track-based monitoring involves a physical activity familiar and relevant to people living in Indigenous communities (WS)**
- ✓ **Social welfare outcomes and employment advantages are readily recognizable (WS)**
- ✓ **The technique could provide an important ingredient, component and support for Indigenous ranger programs (WS)**
- ✓ **There has been strong interest from the Federal Government agency responsible for IPAs to meet monitoring requirements and deliver employment opportunities (Bruce Rose, IPA and WoC)**
- ✓ **Many indigenous groups are already involved in track-based monitoring on a small scale**

4 Requirements for biodiversity monitoring programs

4.1 Reasons and principles

It is vital that the reasons for undertaking a monitoring program are clear and unambiguous from the start (Hunt *et al*. 2006). It is also important to have a clear idea about how the information is to be used. There are two main reasons for monitoring:

- to support decision-making around management and resource use. For example, to assess whether a management action has worked.
- to provide a measure of environmental performance and condition. For example, to determine whether a management action is warranted.

Effective monitoring requires an appropriate set of indicators. Hunt *et al*. (2006) identified a number of desirable principles for indicators:

- Informative, in terms of the biodiversity values of concern
- Sensitive, in terms of the detection, abundance or condition of a variable
- Easy to assess
- Meaningful, in terms of peoples' understanding of biodiversity
- Linked to management actions with a clear vein of logic

Indicators can be grouped into two main classes according to the sorts of attributes they assess. *Pressure* indicators assess the threats to biodiversity like the abundance and distribution of invasive predator or herbivores. *Response* indicators assess abundance and extent of threatened biodiversity that are posed by threatening processes and pressures.

4.2 Key requirements of biodiversity programs

The requirements for a biodiversity monitoring program for deserts and rangelands of Australia have been identified by Fisher *et al*. (2007) and Norris and Low (2007). These include:

- robust, systematic monitoring programs which are standardized and coordinated and allow the cost-effectiveness of control or management to be assessed
- appropriate training for people involved in biodiversity monitoring at enterprise and regional levels
- support officers equipped with strong skills in ecology and monitoring and strong networks with other biodiversity scientists
- processes that facilitate the collection and sharing of baseline data at property, regional and national levels
- meaningful incentives for those who undertake monitoring programs
- a clear understanding of who is responsible for monitoring, who has ownership of data and is responsible for collation, analysis and storing data
- resources that support the development of biodiversity monitoring, feedback of results and local ownership and relevance but also promotes standards
- monitoring needs to have the capacity to continue over a long time frame and to ensure the effect of climatic variability can be separated from management

4.3 Options for fauna monitoring in the Australian deserts and rangelands

There are a number of factors that limit the range of techniques suited to monitor fauna in the deserts and rangelands of Australia.

- The indicators and techniques chosen to monitor biodiversity depend on the spatial and temporal scale over which the monitoring and reporting will occur (Smyth 2003) and the technical feasibility and the availability of skills and resources necessary to satisfactorily apply the monitoring are also important considerations (Fisher *et al*. 2007).
- A technique suited to monitor a group of species will be affected by the size, mobility, density and dispersion of the populations and this will also affect the spatial scale at which it can effectively operate. For example, the monitoring of small mammals (10-100 g) may be achieved adequately by a trapping program but the intensity of the trapping generally requires the program to be limited to the scale resolution of < 1 km^2. Monitoring of large mammals (20-1000 kg) by trapping is generally ineffective compared to other forms of monitoring such as aerial surveys, ground transects or plot counts but these techniques are inappropriate unless they are applied at a scale resolution of >100 km^2.
- The skewed nature of the Australian climate to long periods of below average rainfall fluctuations and the low productivity of the Australian landscape (Stafford Smith and Morton 1990) make monitoring sparse populations a more common occurrence than measuring those in great abundance.

Table 4.1 identifies the suggested indicators and techniques to monitor terrestrial vertebrate fauna in the deserts and rangelands of Australia (adapted from Fisher *et al*. 2007) and the applicability and technical feasibility required to monitor different groups. It is evident that no single technique is suitable for all groups of fauna but that the track-based techniques offer high feasibility to monitor a range of taxa.

Table 4.1 Some of the indicators and techniques used to monitor terrestrial vertebrate fauna in the deserts and rangelands of Australia. The symbol ☺ indicates a good technical feasibility to monitor the specified fauna group, ~ indicates a feasibility for some species and ≠ indicates a poor feasibility.

Technique	Indicators Reptiles & amphibians	Birds	Mammals small	medium	large	Comments
Ground searches	☺	≠	≠	≠	≠	Expertise required
Pit-fall trapping	☺	≠	☺	≠	≠	Expertise required
Hair tube	≠	≠	☺	☺	≠	Low return on effort
Elliott trapping	~	≠	☺	~	≠	Expertise required
Cage trapping	≠	≠	≠	~	≠	Low return on effort
Spotlight transect	~	≠	≠	~	~	Low return on effort exc rabbits
Track transect	≠	~	~	☺	☺	**Feasible but expertise required**
Track plots	~	~	~	☺	☺	**Feasible but expertise required**
Scat counts	~	≠	≠	≠	☺	Low return on effort
Counts plot	~	☺	≠	≠	☺	Low return on effort exc birds
Counts ground transect	~	☺	≠	≠	☺	Low return on effort exc birds
Counts aerial transect	≠	~	≠	≠	☺	Feasible but low return on effort
Culling returns	≠	≠	≠	≠	~	Only some regions

Issues

- **There is already a shortage of appropriate skills to deliver desert and rangeland biodiversity monitoring techniques. A new technique will create more pressure (WS).**
- **An array of monitoring techniques is being used by consultants and people working within government and non-government organizations.**
- **Limited time and resources are available within State and Territory governments to keep tabs on the validity of existing monitoring techniques used and hence skepticism about new ones (Dave Pearson, WA DEC).**
- **Uncertainty regarding the advantages and limitations of the array of monitoring techniques exists among environment constants and agency staff.**
- **The technique would require independent assessment of efficacy before broad endorsement by Federal government agencies dealing with national spatial data libraries and State of the Environment reporting (John Tranter, ERIN).**

Solutions

- ✓ **Track-based monitoring already generally accepted by ecologists and traditional owners and used in monitoring programs in the arid zone.**
- ✓ **The track-based monitoring program would focus new attention on desert and rangeland biodiversity monitoring and inject training and capacity data capture.**
- ✓ **The track-based monitoring technique monitors both pressure and response indicators simultaneously.**
- ✓ **Suitable to monitor a range of taxa groups.**
- ✓ **Sensitive to monitor species at low density.**
- ✓ **Easy to assess and meaningful in terms of people's understanding of biodiversity.**
- ✓ **Consolidation of a technique, independent assessment and multi-jurisdictional endorsement would streamline management and evaluation of environmental programs and consultancies by Federal, State and Territory agencies (Dave Pearson, WA DEC).**

5 Community participative monitoring

5.1 Background

Track-based monitoring is a tool that could be used in community participative monitoring programs and by government agency scientists and consultants. Use of the technique by Indigenous communities, friends of national parks, amateur naturalists, four-wheel drive enthusiasts and by 'grey nomad' traveller groups would raise the relevance of the program and increase the spatial and temporal dimensions for data capture. There are over one hundred Indigenous communities in the desert and rangelands of Australia (**Fig 5.1**).

Both in Australia and internationally there has been a trend toward increased collaboration between scientific and local communities to monitor biodiversity and landscape condition at a regional, catchment or community level. A suite of locally based approaches to environmental assessment are emerging (Carr 2004; Danielsen *et al*. 2007).

The trend for decentralisation of monitoring effort has been a response to:

- a recognition that locally based methods can be effective in conducting evidence-based assessments and producing accurate cost-effective data.
- local stakeholders have considerable potential to influence on-the-ground management activities and hence are important to engage in determining whether management is warranted or has worked.

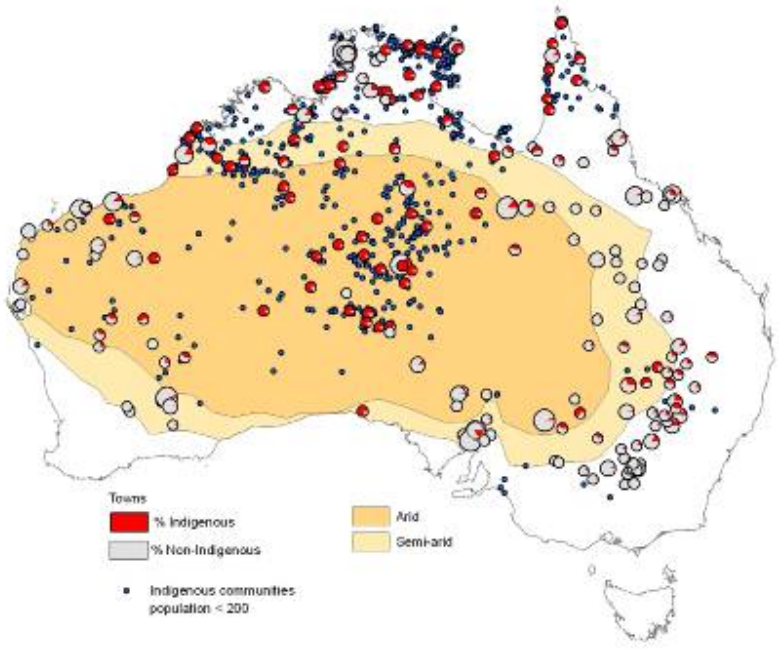


Fig. 5.1 The distribution of indigenous communities in the deserts and rangelands of Australia (sources DKCRC website)

- locally based methods can deliver immediacy in monitoring because of the proximity of communities to natural ecosystems and that this type of monitoring is extremely hard to achieve using a top-down approach.
- a recognition that the limited budgets of organisations responsible for biodiversity monitoring and management can not adequately extend and survey remote localities

However, it is widely recognised that locally based approaches are vulnerable to various sources of bias. Problems include a risk of methods drifting over time or of results reflecting long-term perceptions more than current trends.

5.2 Examples of community participative programs

Birds Australia is an example of a non-government organization delivering a national community participative monitoring program. Its broad aims are to involve the community in the conservation and monitoring of birds and to collect information on the distribution and relative abundance of Australia's bird species. It collates information collected by thousands of volunteer experienced bird watchers and provides analysis of distribution and relative abundance and resulting in an Atlas of Australian Birds.

http://www.birdsaustralia.com.au/

The Australian Collaborative Rangelands Information System (ACRIS) is an example of a government organised participative monitoring program. It provides a coordinating mechanism that collates rangeland information from various state and federal agencies and other sources. The aim is to combine equivalent data from various jurisdictions to produce a more robust and meaningful analysis and interpretation on landscape scale aspects of management that would otherwise be difficult to achieve.

http://www.environment.gov.au/land/management/rangelands/acris/

Many other models exist including:
The Canadian Community Monitoring Network has been developed after extensive investigation and analysis of program needs and the essential ingredients for success (see **Appendix 5**). The initiative was lead by the Canadian National Federation in partnership with the Ecological Monitoring and Assessment Network Coordinating Office.

http://www.ccmm.ca/English/library/Whitelaw/introduction.html
http://dev.stewardshipcanada/communities/citizenscience/

The *naturemapping* program (a combined venture of the Washington Department of Fish and Wildlife and the University of Washington) has built a volunteer monitoring program with a strong education focus.

http://www.depts.washington.edu/natmap/publications/JEE_2001.html

The South African Environmental Observation Network (RSA Government funded) functions to some degree like ACRIS in coordinating and facilitating data retrieval from existing research and monitoring establishments.

http://www.saeon.ac.za/

For additional examples see *Biodiversity and Conservation* 14 (2005) and the websites:

http://www.monitoringmatters.org/

http://www.coastal.crc.org/bibliography/

5.3 Indigenous engagement

More specifically a number of key principles for effective engagement of Indigenous Australians have been developed in natural resource management activities and for the collection of information and knowledge management (Roughley and Williams 2007). They stress that the understanding of core Indigenous values should underpin research, monitoring and management in Indigenous Australia. Aboriginal knowledge is not only about content but is also concerned with ways of knowing (J. Davies, pers. com.).
A number of the key principles echo the essential components of a community participative monitoring program outlined in **Appendix 5**.

Key principles for engagement with Indigenous people

- Research should be highly integrated recognising that the social, spiritual, cultural, economic and physical values of the Indigenous landscape are integrally connected
- Research is more effective when local issues and interests are included and local people have an opportunity to contribute their skills and knowledge
- Research approaches are most appropriate when they build on the existing capacities of the group and allow on-going group learning and adaptation
- Investment should be targeted towards long-term projects
- Research activities need to be integrated at various levels
- Research should create opportunities and employment for local people

Key principles for projects: data collection and knowledge management

- Establish clear working agreements with communities that protect their rights and interests, including fair and equitable benefit sharing with Indigenous organisations and communities.
- Research should facilitate intergenerational knowledge and language transfer for ongoing cultural maintenance
- Adopt a clear Traditional Knowledge protocol which defines and respects Indigenous intellectual property and associated intellectual property rights

- Develop resource materials and capacity-building strategies

The Desert Knowledge CRC has been developing a comprehensive Indigenous engagement and knowledge management strategy and protocol for Indigenous knowledge and intellectual property based on work by Smallcombe *et al*. (2005) and others.

Aboriginal Research Engagement Protocol
http://www.desertknowledgecrc.com.au/socialscience/socialscience.html

Guide to Intellectual Property in the DKCRC
http://www.desertknowledgecrc.com.au/partners/

5.4 Engagement of other groups

The importance of engaging other groups working or visiting remote parts of Australia should not be neglected or underestimated. The traveling tourist market particularly the 'grey nomads' and four-wheel drive enthusiasts who spend considerable time traversing the remote roads and tracks have shown great interest in conducting track-based monitoring. A trial training program conducted in the Simpson Desert in July 2007 found that a group of volunteers aged between 50 and 70 could be trained to identify basic mammal species within one to two days. More importantly, once they were trained to a certain basic level, volunteers showed considerable more interest in their surroundings and were motivated to continue learning themselves. Similarly, groups such as the Friends of Parks working in the Simpson Desert have already shown an interest in implementing the technique. The advantage of engaging these groups is that it generates goodwill towards conservation objectives, satisfies their willingness to contribute to make a difference for conservation and results in a considerable improvement in education and awareness of arid zone conservation issues.

Training and accreditation of consultants would be highly beneficial to increase the operational capacity of the track-based monitoring program and the data capture capacity. It would also assist in verification of results from mining and exploration surveys that at present may be conducted by inexperienced consultants.

Issues

- **There is a tension between the need to have a program's context specific and driven by a local agenda, and the need to ensure a robust, systematic and standarised program for comparison within and between regions (Jocelyn Davies, DKCRC).**
- **Specific community programs will be necessary to ensure that appropriate engagement, information feed-back and on-ground coordination is achieved.**
- **Protocols are needed to ensure that the collection of information is limited to the track-monitoring data and does not stray into the unauthorized collection of Indigenous ecological knowledge. Prior informed consent processes and**

benefit sharing negotiations are required before Indigenous ecological knowledge is transmitted to anyone by researchers.

- State and Territory and NRM organisations are having difficulty in meeting their responsibilities to monitor and manage biodiversity in the deserts and rangelands of Australia.

Solutions

- ✓ There are a considerable number of communities scattered throughout the rangelands and deserts of Australia all with the potential to act as hubs for track-based monitoring activities.
- ✓ There is capacity to attach qualitative data capture and capacity building activities to the core standardised technique.
- ✓ The core standardised technique can be applied flexibly to suit the lifestyle of communities and cultural schedules.
- ✓ Track-based monitoring should facilitate intergenerational knowledge and language transfer for ongoing cultural maintenance in Indigenous communities.
- ✓ The use of Indigenous 'know how' in track-based monitoring will help keep Indigenous ecological knowledge strong.
- ✓ There is already considerable interest from non-Indigenous groups wanting to apply the technique requiring the development of separate appropriate training modules. Engagement of these groups would help increase legitimacy of the program and data capture capabilities.
- ✓ Mining company consultants would readily adopt a technique that has broad application and acceptance by government agencies and within the scientific fraternity.
- ✓ Participation in track-based monitoring by tourist, pastoral and 4wd touring groups will improve education and awareness of arid zone conservation issues.

6 Track-based monitoring techniques

6.1 Background

Indigenous peoples throughout the world have traditionally used the interpretation of tracks and sign to hunt and avoid danger. Liebenberg (1990) argued that the intellectual processes used in tracking are identical to those that have allowed chemists, physicists and microbiologists to visualize or develop models of sub-particle organisation and interaction. In other words, he suggests that the art of tracking and conceptual thinking is the foundation to the origin of science. Whereas the theoretical physicist may ask 'what would I do if I were the particle', the tracker asks 'what would I do if I were that animal'. Both disciplines require a sophisticated understanding of the characteristics and behaviour of the components within an operating system.

In more recent times track and sign-based techniques have been adopted in wildlife science to record occurrence and estimate the relative abundance of animals (Catling and Burt 1994; Allen *et al.* 1996; Catling *et al.* 1997; Mahon *et al.* 1998; Stander 1998; Edwards *et al.* 2000; Paltridge and Southgate 2001; Southgate *et al*. 2005).

A broad range of factors affect the accuracy and precision of data and these need careful consideration in the development of a sampling protocol. Tracks indicate the occurrence of a species and also reflect the activity or behaviour of the individuals leaving the tracks. In some circumstances tracks can be used to provide a reliable indication of relative abundance. Low track abundance generally signals low animal abundance. However, high track abundance need not relate simply to high abundance and it is rare that absolute density can be derived directly from this type of index (Caughley 1977).

Nevertheless, an index based on animal sign has many advantages over direct counts of animals:

- Track monitoring often provides the only practical means to monitor elusive animals or those found in low density (Caughley 1977; Allen *et al.* 1996; Southgate *et al*. 2005; MacKenzie *et al*. 2005).

- Track monitoring can be simple to implement, take less effort, be more cost-effective and often easier to standardize between observers than direct counts (Caughley 1977; MacKenzie *et al*. 2002; Engeman 2005).

- It allows simultaneous monitoring of a number of species including both *pressure* and *response* indicators (Southgate *et al*. 2007a; Southgate *et al*. 2007b).

- Recording or counting tracks is a passive activity in that the act of observing does not affect the observed or, in other words, animal behaviour is not altered by detection (Caughley 1977).

- Surveys that sample passive sign overcome many of the animal welfare problems associated with live capture methods and some direct counts (Allen *et al.* 1996; Mahon *et al.* 1998).

Track-based data provide an indication of species occurrence, and occupancy, defined as the proportion of sample units occupied, can be derived from occurrence data (MacKenzie *et al*. 2006).

Occupancy is the foundation variable for studies of:

- species distribution and range
- community composition and assemblage
- species-habitat relationships and responses to management
- metapopulations
- broad-scale multi-species surveys

Like survey techniques that provide counts of animals, track-based surveys vary in their ability to procure accurate, precise and cost effective data. Accuracy refers to the closeness of a measured value to its true value and to precision as a measure of repeatability and sampling error (Krebs 1989). Precision may be increased by increasing sample size, improving sample tally and by rigid standardisation of sampling method (Krebs 1989; Caughley and Sinclair 1994). Monitoring efficacy takes into account the cost per unit of applying a sampling technique and the per unit variance of data.

There is a general aim to maximise precision and accuracy in wildlife monitoring but often a trade-off needs to be made between accuracy and precision to answer a particular question and to achieve greatest efficacy (Caughley and Sinclair 1994). Efficacy of data capture may be sacrificed to increase capacity building activities. Track validation and non-detection issues are important considerations in track-based monitoring techniques because these issues particularly influence technique accuracy.

6.2 Emerging techniques for track-based monitoring

The techniques used to monitor tracks can take a number of different forms and these can be practically separated into those where the tracking surface is manipulated to make the imprints more distinctive and easier to read and those where imprints are read from an unprepared tracking surface.

Manipulated tracking surface

This approach improves the registration of imprints after raking or brushing the substrate surface. A substrate such as sand may also be added to improve the registration of imprints. The surface manipulation removes existing tracks and provides the start of a distinct detection period. Strips of sand are raked across tracks at set intervals to form small plots (generally 1 x 2.5 m) and separated by distances up to a kilometre depending on the focal species being monitored (Catling and Burt 1994; Allen *et al*. 1996; Catling *et*

al. 1997; Engeman *et al*. 2000; Southgate *et al*. 2004; Southgate and Masters 2006; (**Fig. 6.1**).

Alternatively, sections of track are used as a transect and a number of set tracks are sampled (Southgate *et al*. 1994; Mahon *et al*. 1998; Edwards *et al*. 2000; Paltridge and Southgate 2001; Edwards *et al*. 2002; Southgate *et al*. 2005). The transects are often 10-20 km long and an ATV is used in the preparation and sampling of the transects (**Fig. 6.2**).

The small plot technique is being applied more commonly in the temperate parts of Australia and the track transect has been used in the drier rangelands in areas with sandy substrates. A substantial amount of effort needs to be invested in the initial preparation of the plots or transects and after each sampling period. The small plot techniques are increasingly being used in predator studies and in conjunction with an attractant lures or other methods to poison, trap or capture hair samples from resident individuals (D. Algar, pers. com.). A comprehensive description of applying the small plot and road transects with a manipulated tracking surface and reporting data is provided by Mitchell and Balogh (2007).

The plots are often sampled on consecutive days but data from consecutive days of sampling need to be pooled to overcome temporal autocorrelation issues. Directly controlling the quality of the tracking surface and the exposure period prior to sampling improves the sample precision of data collected from a plot with a manipulated surface.

The plots need to be small because of the effort required to form and prepare the tracking surface but the examination of a small sample area helps to focus attention of the tracker. However, there are a number of disadvantages associated with the use of plots with manipulated tracking surfaces:

- a small area is generally available to identify a species from their tracks and there tends to be greater reliance on the recognition of individual foot imprints and less on gait characteristics to identify a species.
- poor sun angle alignment and disturbance of tracks on the manipulated surface can create difficulties in reading the track surface.

Both these factors could act to reduce sampling precision but the ability to sample a larger number of small plots per day would help improve precision.

Fig. 6.1 A track plot with a manipulated surface prepared with a broom across a roadway

Fig. 6.2 A track transect with a manipulated surface prepared by dragging a chain behind a vehicle

Unmanipulated tracking surfaces

This approach relies on the existing substrate to register tracks adequately enough to allow an observer to identify the species and estimate the age of the tracks. The monitoring technique is generally restricted to sandy substrates which commonly occur and cover a vast area of the deserts and rangelands parts of Australia. Over 2.1 million km^2 of the rangelands and deserts of Australia are covered by sand dunes and ideal for monitoring with large plots (**Fig. 6.3**).

Various plot sizes have been used. Around 10-20 micro plots (20x20 m) per site were used to monitor the occurrence of bilby and other species at a series of locations throughout the arid zone in the mid 1980s (Southgate 1987). Large plots (300x200 m) were used to monitor occurrence of species in the Tanami Desert, NT in the late 1990s (Southgate *et al*. 2005) and applied in fauna monitoring by Walpari Rangers. More recently, a smaller version (200x100 m) of the large plot has been used to investigate the occurrence of the ampurta and other species in central and west SA in 2006 and 2007 (Southgate 2006; Southgate *et al*. 2007c). These plots were spaced at least 4-5 km apart (**Fig. 6.4**).

The broader exposure time used in the sampling of the large plots with an unmanipulated surface produces a pooled tally but skill is required to age tracks and eliminate track that fall outside a desired exposure period. The use of larger plots allows the observer to follow tracks until the imprints become clearer on the substrate or they can be viewed more clearly against a different sun angle. Both gait and foot imprint characteristics can be used in the track identification. These factors help to improve sampling precision. Although fewer large plots can be sampled per day, no preparation time is required.

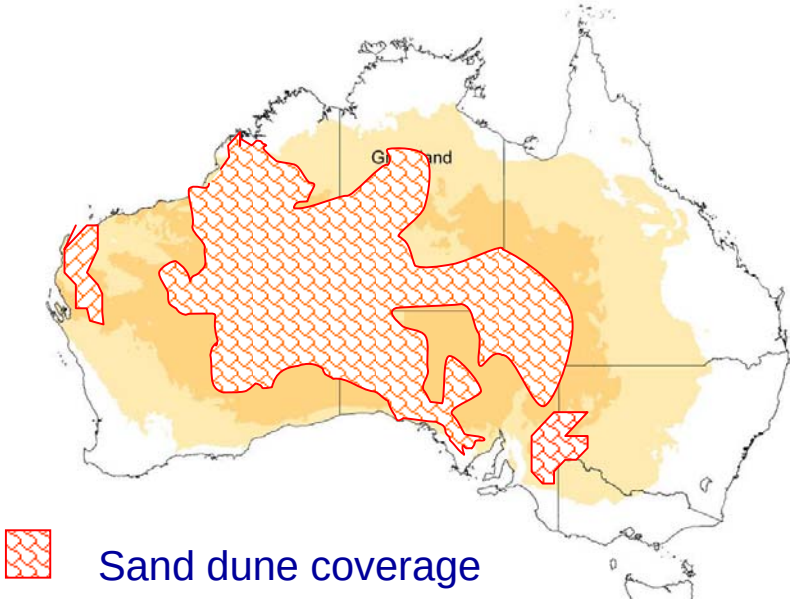


Fig 6.3 Main sand distribution in the deserts and rangelands of Australia (J. Benshemesh, pers. com.)

The technique of surveying unmanipulated tracking surfaces is currently being used by Indigenous people in some of the existing Indigenous land management programs. However, search area or search time used is often quite variable and can depend on what activity is found. A set number of plots are generally not sampled each time. Furthermore, people are more likely to go visit areas where they think the species is present. Animal presences are recorded but little attention is given to ensure absences are documented. The general use of the technique is more for "keeping an eye" on species or as a coarse prompt for management actions, e.g. put poison baits out in an area if lots of fox tracks are seen, rather than to give an accurate measure of change in abundance over time (J. Bice, pers comm.).

Fig. 6.4 A large plot with an unmanipulated surface covering part of a sand dune

6.3 Validation and detection, false positives and false negatives

Uncertainty pervades all our attempts to ascertain the truth about the natural and physical environment (Regan *et al*. 2002). Improvement of accuracy and reduction of error is a key consideration in the development of a monitoring technique because of the effect on data quality. The techniques to detect error can also be used in the development and design of training and accreditation programs.

Sampling errors arise using any monitoring technique but these errors are frequently ignored or overlooked, particularly with well established techniques eg. Elliott trapping. Efforts to reduce error rate require identification of the most common type of errors and an understanding of how these are propagated. There are four possible outcomes produced from track-based sampling using a plot (**Fig. 6.5**). True-positives and true-negatives are the desirable outcomes and false-positive and false-negative are the undesirable outcomes from monitoring. A false –ve occurs when the sign of a species is present but it is overlooked by the observer. A false +ve occurs when the tracks or sign observed are incorrectly attributed to the wrong species.

To attain true +ves and true –ves, equal effort needs to be expended while sampling a quadrat to ensure a species' presence or ensure its absence. Hence, a prior understanding and expectation of the range of animal species that might be detected at a site is extremely important to facilitate unbiased sampling.

In track-based sampling, false –ve and false +ve errors can originate from both:

- an observer incorrectly identifying or *validating* a species' tracks
- a species being incorrectly *detected* because of the plot size and distribution, the light conditions and substrate quality, and the presence of tracks from other species.

True-positive: Animal present Recorded present	***False-negative***: Animal present Recorded absent
False-positive: Animal absent Recorded present	**True-negative**: Animal absent Recorded absent

Fig. 6.5 The aim of tracking is to report **true-positive** and **true-negative** records and eliminate the chance of making ***false-positive*** and ***false-negatives*** records

Validation

The ability of the observer to correctly identify tracks can result in the propagation of false +ve or false –ve errors.

There are a number of ways to detect observer error and reduce its effect.

- Photographic evidence of tracks can be submitted to experts for verification
- The results of plot surveys can be regressed against plot variables including observer name to determine if significant associations are evident
- Trackers can be trained and accredited to reach proficiency in the identification of a suite of species
- Each plot can be sampled by multiple independent assessors and used to assess sampler error. This double-count approach is used in aerial surveys (Caughley and Sinclair 1994) and plot-based bird surveys.

Detection

Detection errors arise because the conditions at a monitoring site prevent the tracks of a species being correctly detected.

- Rain, wind and the tracks of other animals may obliterate the tracks of a focal species from the substrate prior to sampling.
- Substrate or vegetative cover may prevent the adequate registration of animal tracks. Sampling in areas with clayey surfaces, hard-pan or rocky substrate or where the substrate has high plant or litter cover may prove unsuccessful.
- Light conditions may be unsuitable to adequately detect tracks. Track imprints can be most clearly seen if backlit with direct, low-angle sunlight. Hence, time of day, time of year, cloud cover and direction of travel can potentially affect the identification of a species from footprints.

In addition, detection errors can arise because the monitoring technique is not suited to capture the activity of a particular species. In this instance, some monitoring sites may be temporarily vacated by a species that is highly mobile. Detection problems generally result in false –ve errors.

There are a number of ways to reduce detection error and estimate its effect.

- Ensure the conditions at monitoring sites meet prerequisite standards before sampling. Simple observational cues can be used to determine whether adverse weather conditions have resulted in the elimination of tracks at a monitoring site. For example, the presence of insect prints indicates the surface would be suitable to capture the prints of small and large vertebrates.
- Regress plots species occurrence against tracking conditions or substrate characteristics to determine whether substrate, weather, time of observation or observer associate with the pattern and type of tracks of observed.
- Conduct repeat visits to a plot and use analysis techniques devised by MacKenzie *et al*. (2002; 2003) to determine detection error.

6.4 A standardised track monitoring technique

The application of the large plot technique in areas where a suitable tracking surface naturally occurs is the main focus of this report. A number of considerations have gone into developing a standardised technique that would suit monitoring the composition of a terrestrial fauna community and hence a range of different sized species simultaneously. A field-ready monitoring protocol and data sheets is provided in **Part B**.

Animal data to be collected at plots

Record the presence and absence of terrestrial vertebrate species based on tracks or sign

mammals >35 g to species
mammals <35g as mice or small dasysurids
reptiles > 35 g to species or group

- dragons
- blue tongue, sleepy lizards etc
- pythons/ large elapid snakes

birds > 35 g to species or group

- corvids and magpies
- parrots

- Use a reference list of species likely to occur in a region to reduce the chance of overlooking species
- Make drawings and take photos and measurements of tracks unable to be identified to species. A better knowledge about the track characteristics of all species particularly birds and reptiles needs to be developed.
- The abundance of sign for a species can be recorded as described in the monitoring protocol
- The presence of juvenile animals based on track size should be recorded where possible

Other data to be collected at plots

Record factors that may affect track detection such as weather and tracking conditions including sunlight intensity and angle and trackable substrate extent as described in the monitoring protocol.

Record factors that may affect plot occupancy by a particular species such as vegetation composition, cover and structure, time since fire, distance from waterpoint and substrate type as described in the monitoring protocol

Ground truth spatial data layers that could be important in predictive modeling of habitat occupancy (Southgate *et al*. 2006).

Plot size

Plot size 2 ha (200 x 100 m) sampled in 30 minutes. A plot of this size is:

- Suited to capture the activity of species at low density or with large home ranges
- Suited for people less able to walk long distances
- Less risky to sample in remote shrubby localities

- Short sample period allows the sampling of several plots per day

Aging tracks

Age tracks and record the most recent track age of each species recorded within three age categories:

- 1-2 night window suitable for most species 35 g.
- 3-7 night window can included the detection of larger animals >5 kg
- >7 night window can include detection of large animals >100 kg or the tracks of smaller animals registered in dried mud

An accurate aging of tracks is important to:

- provide an opportunity to retrospectively filter data and to meet the needs of different types of analyses.
- prevent a bias against the detection of small animals
- increase the breadth of the sampling window for some species hence increase sampling precision

Distance between plots

Plots need to be spaced >5 km apart if conducting a general survey of fauna. This spacing distance is suitable to monitor small species and most medium-sized to 5 kg in arid regions to achieve data independence.

- Plot filtering to extend the distance between plots and to achieve sampling independence for larger and more mobile animals may be necessary.
- Plot spacing of < 5 km can be used when specifically sampling animals with low mobility.

Plot location

The following considerations are required in determining where plots are located

- Right of access to country must be granted before plot sampling is conducted
- A statistician should be consulted to help design a survey
- Restrictive stratified random sampling often provides an appropriate approach to sampling
- Restrictive sampling means that that plots are located in the vicinity of existing roads and bush tracks or more specifically in an area where a particular species is known to occur.
- A stratified sampling approach helps target specific habitat types eg. fire age or substrate type and a certain number of plots are placed in each habitat type of interest.
- The random selection of plot locations is a device for reducing bias creeping into monitoring or experimentation. Most statistical analyses have an assumption that observations are independent and randomization of sampling units is the best way to satisfy the assumption.
- A systematic sampling approach, say selecting plots locations at 5 km intervals along a roadway is simple and practical to implement but may be inefficient in targeting important habitat types restricted to parts of the landscape.

Repeat sampling

Plot locations should be resampled when possible:

- within a 'season' to determine detection error (MacKenzie 2002)
- over time to determine the affect of environmental variation or management.

Repeated sampling at the same plot location is preferable to random selection of plots each time.

6.5 Analysis considerations

Presence-only data, opportunistic data or data collected from plots sampled only in the vicinity of where a focal species is known to occur is considered inferior to presence-absence data collected using a stratified random approach (Wintle *et al*. 2005). Presence-only and opportunistic data can be used to indicate extent of occurrence (i.e. distribution or range) but not area of occupancy (i.e. habitat preference or effect of management).

Presence-absence data can be used together with measurements of habitat attributes to formulate a model of the relationship between a species and its environment. Logistic regression from the set of procedures called Generalised Linear Models perform as well or better than other regression methods that can use presence-absence data (Wintle *et al*. 2005). Once developed, the logistic model can be used to produce a predictive probability map of a species' occupancy if the habitat attributes are derived from spatial data layers.

Two examples are provided. One shows the outcome of predictive occupancy modelling of bilby occupancy in the Tanami Desert. Over 215 plots were sampled in a 230,000 km^2 region of the Northern Territory in the late 1990s (Southgate *et al*. 2007b). Indigenous people from four language groups participated in the sampling.

Fig. 6.6 shows the occurrence of the bilby in the Tanami Desert and predicted distribution based on occurrence data and its relationship with spatial data layers. The bilby distribution showed a strong association with substrate type and annual rainfall gradient, a positive association with dingo probability of occurrence and a negative association with fox occurrence (not shown in the figure).

The other example shows the dingo and fox plot occupancy data from the Tanami Desert study in conjunction with plot data collected around Lake Eyre (North and South) and in the Maralinga Tjarutja region of South Australia (**Fig. 6.7**). In 2006, 135 plots were sampled in the Lake Eyre region to determine the occurrence of the ampurta and mulgara (*Dasycercus* spp.) (Southgate 2006) and in 2007, 300 plots were surveyed for fauna composition in 150,000 km^2 of the Maralinga Tjarutja region. Four Aboriginal women and eight men were employed to assist with the tracking work for periods of three to five days (Southgate *et al*. 2007c).

Fresh dingo and fox sign commonly co-occurred on plots in the two southern study areas where rabbits are common. Co-occurrence of fox and dingo sign occurred infrequently in the Tanami Desert where rabbits were less common. The few occasions where co-

occurrence did occur were mostly on plots where rabbit sign was also recorded. There results have important implications for the design of experiments to examine the role of dingoes in trophic regulation (Glen and Dickman 2005).

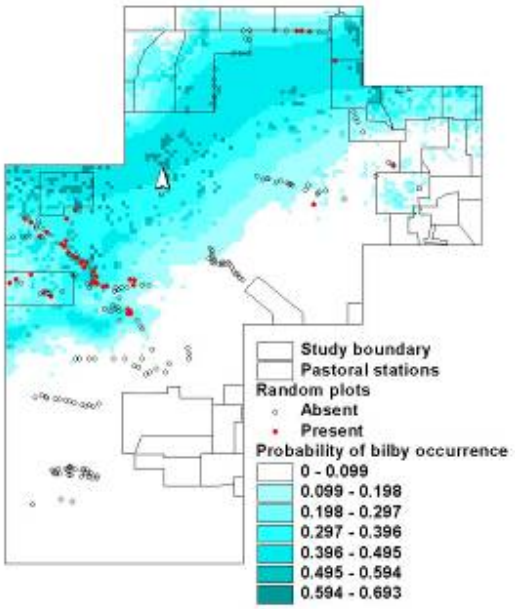


Fig. 6.6 The probability of occurrence of the bilby in the Tanami Desert based on presence-absence data derived from monitoring tracks on 215 quadrats

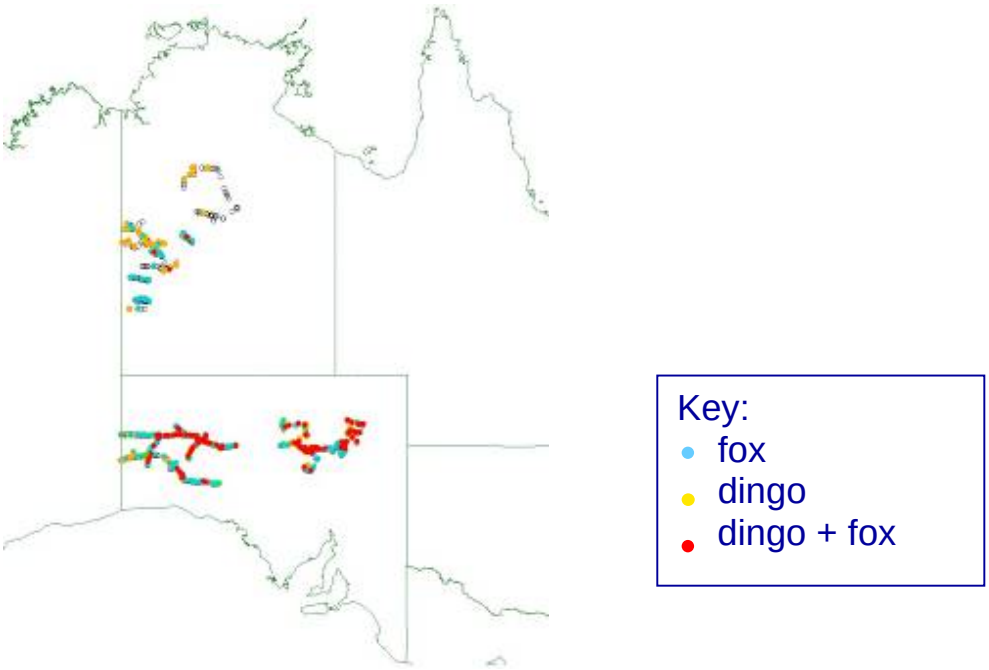


Fig. 6.7 Plot occupancy of dingo and fox sign and plot locations where the co-occurrence of both species was recorded.

Issues

- **Rigid standardization of a monitoring technique is required to produce data necessary to determine national changes in distribution over time and make informed management decisions.**
- **Concern over the validation of data is limiting uptake of the track-based monitoring methodology (WS).**
- **Reporting on detection error is becoming mandatory before study material is accepted for publication in peer reviewed journals (Ross Cunningham, ANU)**
- **Clear monitoring protocol, data sheets and track identification material is required to facilitate uptake of technique (WS).**
- **Repeat visitation and random sampling of plots is important to determine detection error and examine effect of environmental variability or management (Ross Cunningham, ANU) .**

Solutions

- ✓ **At least three teams of people in track-based monitoring are currently able to assist in the development of track plot monitoring at a community level.**
- ✓ **Validation concerns can be met with establishment of expert support to review submitted photographic material, training and accreditation programs.**

7 Training and accreditation

7.1 Background

Training has become highly regulated within Australia and careful consideration must now be given to the organization and effort that is required to develop a recognised training component for an activity such as track-based monitoring.

The Australian vocational education and training (VET) system has become responsible for defining all nationally recognized qualifications from Senior Secondary Certification (Certificate I-IV) to PhD. It sets standards nationally which assures nationally consistent, high-quality training and assessment services for the clients of Australia's vocational education and training system. It consists of two sets of nationally agreed standards:

- AQTF 2007 *Essential Standards for Registration*
- AQTF 2007 *Standards for State and Territory Registering Bodies*

Training organisations must meet AQTF 2007 standards to become registered. Only registered training organisations (RTOs) can issue AQF qualifications and deliver accredited training and assessment.

http://www.training.net.au/Summary

7.2 Existing track-based monitoring training courses

A module to provide student with the skills to use small track plots to survey pest animals has been developed as part of a Certificate III in Conservation and Land Management by Peter Fleming and Guy Ballard working in the NSW DPI. The course is being delivered by Tocal College located in NSW. The module covers and is run over three consecutive days and covers activities including:

- Carrying out PPE & OHS in field
- Locating and constructing standard soil plots
- Recording plot location using a GPS
- Recognising & identifying footprints of pest animals
- Entering data on a computer and calculating activity indices

No other RTOs are known to be providing modules for teaching tracking in Australia. However, the Gateways program in the APY lands in northern South Australia includes a module for species identification that includes trapping and tracking.

7.3 The Green Corp model

Green Corp is administered by DEEWR in consultation with DEWHA and delivered by a number of Service Providers including Greening Australia, Conservation Volunteers Australia and Job Futures Ltd. Green Corp projects are primarily located in remote and regional areas and provide assistance for existing environmental and cultural heritage projects being developed by a Green Corps Partner Agency. Most Green Corp projects consist of around 10 participants aged between 17 and 20 and a trained Team Leader. The

participants receive accredited training and structured work experience to improve career and employment prospects.

A number of the Green Corp Service Providers developed considerable experience in training young, Indigenous and non-Indigenous people 'on-the-run' and much could be learnt about the development of a training program suited to the delivery of track-based monitoring from these organisations.

7.4 Training for Indigenous trackers

Training of Indigenous trackers should be flexible, non-threatening and adaptable to ensure broad-scale adoption of the technique. Delivery should be provided by accredited personnel and ideally, with the assistance of a highly skilled Indigenous tracker while sampling track-plots in the vicinity of a community using a variation of the Green Corp model. The training should consist of the following:

- reasons for monitoring
- the importance of track and sign in monitoring
- what to look for when identifying tracks and sign
- datasheet use, GPS, Cybertracker and camera training
- quadrat location and sampling
- practise quadrats both in a group and individually
- recording unfamiliar track characteristics
- basic data collation and graphing
- understanding the data and using them to make informed management decisions
- discussion on what could happen to the data after collection and about intellectual property, database, verification and reporting issues

7.5 Training for consultants, Friends of Parks and grey nomads

Delivery of training for people with little familiarity with tracking but interested in developing tracking skills and applying track-based monitoring could be via a study camp and a self-training and remote assessment program. The study camps could be used to demonstrate the approach to tracking and using the monitoring technique. Trainees would then be expected to develop their tracking skills independently with the aid of an identification manual and training booklet. Expert support would be provided on-line to assist with identification queries. Drawings, photographs and measurements of the unverified tracks would need to be submitted during this process.

7.6 Models for Accreditation

An assessment program has been developed in South Africa to assess and rank a tracker's ability. It applies a qualitative and quantitative approach to score ability. Five aspects are evaluated and obviously not all are appropriate for Australian conditions:

- Spoor recognition and ability to follow tracks
- Spoor anticipation and the ability to read animal activity and direction
- Anticipation of dangerous situations
- Alertness to spot animals before being spotted by the animal

- Stealth to approach animals without being detected

Five different levels of tracker ability and four evaluator levels are recognized. Tracker level I must have the ability to interpret the tracks of medium to large animals and judge the age of tracks and interpret 70% of at least 35 different sets of tracks correctly. At the top level, a Master Tracker must have excellent knowledge of animal behaviour and be capable of highly refined interpretation of animal imprints and have highly developed intuitive abilities. The names and levels of qualified trackers are posted on the internet and pay scales are attached to levels of tracking ability.

http://www.cybertracker.co.za/TrackerEvaluation

There is scope to develop a quantitative accreditation procedure using detection probability models being developed by MacKenzie and colleagues (MacKenzie *et al*. 2006). This would require a plot to be sampled simultaneously by a small group of trackers but independently by each tracker and comparing the false positive and false negative results for a range of species with the true results determined by the group tally or an expert tracker.

Base line accreditation for people using the track-based monitoring technique should ensure they are able to accurately identify and differentiate the tracks of feral cat, red fox, dingo/dog, rabbit, camel, bird, lizard/dragon/goanna, hopping mice, and small mice/dasyurids. Higher level proficiency should be able to identify a greater range of species including less common threatened species.

Issues

- **A range of training approaches may need to be developed depending on focus group i.e. Friends of Parks, Indigenous communities.**
- **Development of an association with an existing RTO is required to expedite development and accreditation of the training modules.**
- **One accreditation program should be developed to suit all groups.**
- **Best success using Green Corp training model with Indigenous people has been away from large centres (Glenn McFarlane, Green Corp).**
- **Training of smaller groups (around 4-6 people) is more successful than larger groups (Glenn McFarlane, Green Corp).**
- **Further work is required to develop accreditation approaches.**
- **Accreditation should be used to ensure people applying the track-based monitoring technique have attained a minimum standard.**

Solutions

- ✓ **Well developed existing Indigenous land management and ranger programs in central and northern Australia.**
- ✓ **Much scope to learn from existing Indigenous training programs in other fields.**
- ✓ **A reasonable foundation to develop an accreditation program exists.**
- ✓ **The fact that tracks can remain recognizable sometimes for many days provides flexibility for the provision of training.**

8 Data management

8.1 Background

One of the prerequisites for natural resources management involves the establishment and maintenance of a database of relevant information in digital format. The successful development of an integrated information management solution requires careful planning and dedicated resources to achieve adequate data access, management, integration, analysis and communication. This development of a participatory information management structure with networks and agreements for sharing information, resources and knowledge is required in addition to standards for data type and quality.

Successful projects have generally adopted an integrated information management solution combining leadership, people, technology, applications and data into a framework that ensures tools and procedures are in place to maintain and transform data into useful information that support the needs of data producers and those of data purchasers and users. If data are not collected, stored and updated in a systematic fashion its utility quickly decays along with the credibility of the monitoring program.

From the data producers' point of view, data collation may fail because:

- The value of data from localized, short- life span projects are not fully appreciated
- There is uncertainty about existence of an appropriate data library and acceptable data format
- There is uncertainty about ownership of data or the legitimacy of data transfer
- Agreements to allow data sharing have not been adequately negotiated

From the data managers' point of view, data may not be adequately collated because

- There is uncertainty about data copyright or sensitivity, or authorization for dissemination
- Data fail to meet accepted standards
- Priorities for the data management system change or there are insufficient resources for maintenance of existing services
- One or more components of the collaborative framework developed to acquire, process and disseminate data and information fail

The Australian, State and Territory Governments are all currently involved in the development of the Australian Spatial Data Infrastructure (ASDI) which is a joint initiative of the National Land & Water Resources Audit and ANZLIC – the Spatial Information Council.

ANZLIC has produced a series of policy documents and support material on standards, including a Policy Statement on Spatial Data Management, and a Model Data Access and Management Agreement (with the Audit) which serve as useful templates for regional groups. All documents are available online from the ANZLIC web site at:

http://www.anzlic.org.au/policies.html.

The Natural Heritage Trust publication Australian Natural Resources Information 2002, produced by the National Land & Water Resources Audit, also provides useful background material. This report is available online at:

http://audit.ea.gov.au/anra/data/docs/national/Data_Contents.html.

A toolkit has been developed to assist regional natural resources management groups: http://nlwra.gov/toolkit/content.html

8.2 Responsibilities

A track-based monitoring program needs to ensure the following is achieved:

- A national coordinating body is established to set and maintain data standards through reviewing training and accreditation programs.
- A signed agreement with data providers outlining IP, data ownership and agreed use of the data
- Within the same agreement should be a commitment from the data collectors that data will be collated and disseminated back to data providers within an agreed format and timeframe.

Prior to commencing any data collection activities regional land management groups need to obtain information related to standards and recommended methodologies advocated at a State and Federal level but also establish a clear rationale for dealing with the different types of information. In many cases data collation activities at a State or Territory level are carried out to fulfill requirements of a regulatory act. Often this means that States and Territories have overarching policies, guidelines and protocols that determine the methodologies and standards used in data collection and management.

Issues

- **Consultation with State and Federal Government agencies required to determine suitability of track-based data and applicability of National standards**
- **Managers of regional projects need to develop and implement data policies at a local level based on the principles outlined in the /ANZLIC Policy Statement on Spatial Data Management to make data usable and relevant**
- **A capacity to filter and select data to suit scale: local/ region/national and intellectual property and sensitivity issues is necessary (WS)**
- **Independent assessment of the precision, accuracy and efficacy of data will probably be needed to gain broad legitimacy for the monitoring technique at a national level. This can occur once the technique has been applied by a range of community groups.**

9 Summary

9.1 Overview

Area of application, linkages and benefits to threatened species programs

The big plot track-based monitoring (TBM) could benefit threatened species conservation and invasive species management programs throughout the deserts and extensive parts of the arid rangelands of Australia in areas where sand plains or sand dunes are the dominant substrate and ground vegetation cover is sparse.

Broadening the scope of investigation in the future might include the techniques that use manipulated tracking surfaces. This would:

- stimulate comparison of the different small plot monitoring approaches and hopefully result in greater standardization
- result in a clearer fine-scaled identification of parts of Australia suited for large plot (unmanipulated surface) monitoring and where small (manipulated surface) plot monitoring can be conducted.
- identify where synergies for training, data collation and management can occur.

Relevant key stakeholders that would benefit from involvement in TBM

There are five main groups that could benefit from TBM:

- Indigenous land management groups operating within Indigenous Protected Areas or other Indigenous managed Lands
- Other land managers operating within arid and rangeland NRM regions
- Consultants contracting the services to mining, pastoralists and government
- NGOs and pastoral businesses responsible for the management of vast blocks
- Grey nomads and Friends of Parks who frequently traverse the sandy parts of Australia

Benefits could be derived from:

- a greater appreciation and understanding of the composition and distribution of fauna within a region
- a more informed understanding of the effects of introduced species and management actions on fauna
- employment gained through applying TBM techniques
- information on national changes in threatened species distributions over time and the impact of climate change.

Current use of big plot TBM

There is range of big plot TBM techniques currently being applied. Most of the consultants are now using a 2 ha plot but the 6 ha plot is still being used in the Tanami Ranger programs. Similarly, there is a range of small plot TBM techniques being used in arid and temperate parts of Australia. Plot spacing is highly variable between projects and attractants are used in some situations and not others

Data management procedures are also highly variable among users of TBM techniques

- Virtually all data collected are retained by those who produce and analyse the data.
- Data are generally not being shared between producers.
- Most State and Federal agencies responsible for management of data are unaware of the TBM data characteristics, quality and coverage and hence have not made efforts to collate data.

Characteristics of the standardised TBM technique

A TBM technique has been developed that is suitable for application by a range of Indigenous and non-Indigenous groups. The technique has been:

- field tested with Friends of Parks and volunteers
- developed in consultation with Indigenous people
- readily adopted by environmental consultants

Standardisation of the technique provides an opportunity to:

- monitor both pressure and response indicators
- monitor the status and distribution of rare and elusive species that in the past have proved difficult to monitor
- produce information of great relevance to regional, state/territory and national governments

The technique can be applied flexibly and combined with other capacity building activities.

A track-based monitoring technique will provide Indigenous communities with:

- work opportunities, particularly for women and older people, many of whom have low literacy skills and little chance to compete for existing jobs
- a means to help retain Indigenous ecological knowledge, intergeneration mentoring and information flow
- a means to allow Indigenous people to systematically contribute to our national understanding of biodiversity
- a means to allow Indigenous people to obtain information relevant to the management of biodiversity in their region
- significant health and social welfare benefits that have relevance to regional, state/territory and national governments

However, training is needed by all participants to achieve standardized results and bring people up to a similar minimum proficiency level.

Training program models

Training programs will need to be developed to suit different groups applying the TBM technique

- A Green Corp model delivered by a coordinator plus an experienced tracker from a community to a small group (2-4) of trainee trackers will most likely be of greatest benefit to Indigenous people living in remote regions. Ongoing development would be the responsibility of the experienced tracker and the land management leader for the community.

- A study camp approach combining practical demonstration, proficiency development tasks, explanatory seminars and informal assessments will probably be more beneficial for people from Friends of Parks, grey nomads and consultants. Ongoing development of these people's skills would require support from a records officer/ data manager to provide feedback, collate and process data and assist with identification queries provided that photos, drawings and measurements of tracks of suitable quality can be submitted.

Data verification and application of the 2 ha plot

Data verification is best achieved through training of participants and subsequent assessment of proficiency. The efficacy of other evidence-based verification procedures through submission of track photos etc. will need to be assessed.

One accreditation procedure needs to be developed to ensure minimum proficiency levels are attained by all trackers using the TBM technique. This could be achieved using a qualitative and quantitative approach to determine the ability of trainees.

Data collection protocols, management and use

Several guiding principles are needed to ensure that the 2 ha plots are monitored in a systematic and standardized manner:

- Presence-absence data should be collected. These are powerful data and required for threatened species recovery efforts; presence-only data are inferior.
- The selection of plot locations using a stratified random sampling approach is preferable to systematic sampling which is often less efficient. An opportunistic or targeted approach is inferior, producing biased and difficult to analyse data.
- The effort applied to collect presence data needs to equal the effort applied to collect absence data. A list of species expected to be found in the region is a useful starting point.
- Plots should be revisited at least every 3-5 years in order to gain information on long term distributional trends and the effect of climate change.

There is a range of protocols to guide the collection of data and to protect the intellectual property rights of data providers and to assist data managers collate and share data appropriately. Engagement protocols ensuring ethical research practice and equitable sharing of benefits have been developed specifically for work with Indigenous communities. TBM techniques will need to abide by these principles when operating on Indigenous and non-Indigenous lands.

- Clear information, discussion and agreement about the ownership and use of data need to be agreed before track-based data are collected.
- The TBM technique is designed to collect track-based data and not Indigenous ecological knowledge. The collection of Indigenous ecological knowledge will require additional approvals and the application of appropriate procedures.

Potential partnerships

Without high-level Federal Government support, the big plot TBM program will continue to languish and to be applied in an *ad hoc* fashion by environmental consultants and Indigenous land management groups. The full potential social welfare and biodiversity outcomes will remain unrealized.

High-level support from the Federal Government would require alignment with a major NGO, CRC or University to meet governance and administrative requirements. Potential institutions with a charter or interest in biodiversity monitoring and Indigenous community engagement include:

- The Invasive Animal CRC or Desert Knowledge CRC
- Advocacy-based NGOs like the Nature Conservancy, WWF Australia or the Wilderness Society
- The Charles Darwin University or Canberra University

9.2 Current situation and vision

At the moment three consultants working in the Northern Territory and South Australia, two government and NRM organisations in South Australia and Indigenous ranger groups working in two areas of the Tanami Desert apply a similar technique (A. Nano, pers. com.). The approach is not compatible, the technique is not standardized and there is no collation of data.

Ultimately the goal would be to develop a program to achieve long-term sustainability, integration and legitimacy

- Sustainability: to retain operational capacity through continued public and political support
- Integration: to maintain relevance and a useful function for stakeholders
- Legitimacy: to participate in discussion and engage with decision makers and help influence social welfare and environmental outcomes

This will require development of an organisation tentatively referred to as 'Tracking Australia' with a range of components and structure similar to those outlined in **Fig. 9.1**

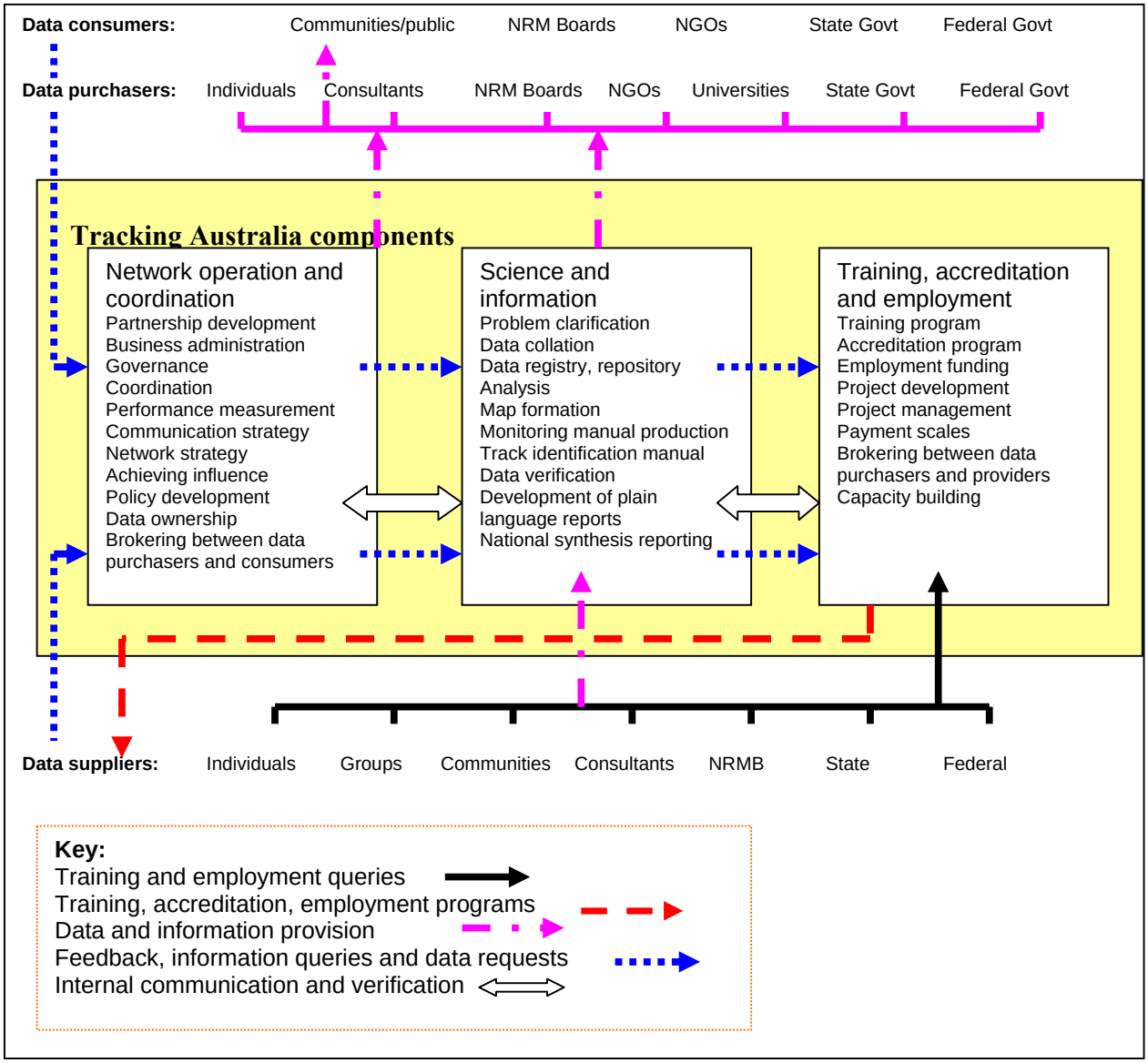


Fig. 9.1 Conceptual structure of the 'Tracking Australia' organisation

10 A plan for development

10.1 Immediate steps

- More clearly define where TBM can fit within in the new Caring for our Country program
- Approach the NGOs, CRC and Universities identified to determine their willingness and capacity to act as the support agency for the program
- Identify champions within government, media and business who would support the program
- Approach companies and NGOs for funding to support employment of a network development officer and a project development officer.
- Once a business plan is developed, approach DAFF and DEWHA with policies and protocols to encourage the use of standardized track-based monitoring, training, accreditation and employment program in NRM and IPA programs
- Approach other organisations and companies responsible for land management over vast areas to implement a similar program.

10.2 Network development

The following actions are required:

- Business plan development including clarification of the purpose, roles and responsibilities, budget and performance measurement for the program
- Reconnaissance to determine roles of other organization with overlapping interests
- Communication strategy development
- Development of marketing material appropriate for the print, radio and television
- Develop of partnerships with business, government and the community
- Partnership development with RTOs and accreditation of training modules

10.3 Project development

The following actions are required:

- Determine interest in conducting TBM from Indigenous and non-Indigenous groups
  - Contact NRM officers, Friends and Touring associations
  - Contact land managers on IPAs and other Indigenous lands with details of protocol and costing to determine funding availability for TBM start-up
  - Assess the capacity of trainers to meet potential training demand
  - Form a coalition of interested groups
- Consult with managers of national biodiversity data sets for guidance to develop track-based data capture and use.
- Refine training and accreditation modules
- Determine if broader inclusion of small plot TBM approaches would assist the adoption of the program.
- Provide data collation services and assist with track identification and monitoring technique enquiries.
- Continue development of track identification material

Part B: Approach to implement track-based monitoring with Indigenous communities

Program delivery and expected outcomes

A Green Corp-type training model is used.
Two vehicles work in tandem to meet occupational health and safety requirements for work in remote areas. This provides space for up to 4 Indigenous people, preferably including at least one experienced Indigenous tracker and the remainder as trainees. Generally, a field trip of 3-4 days provides a good introduction to the technique for Indigenous people.

- It is possible to sample 6-7 plots per day accompanied by Indigenous people if access conditions are good and moving from A to B with plots spaced 5 km apart. Fewer plots can be done (probably 5-6 plots per day) if back tracking along roads is necessary.
- Procedures for training and accreditation can occur in the field. Each trainee will be required to sample of 10-15 plots during a trip. This will provide the trainee with a background technique, data collection and collation and an opportunity for an evaluator to access the tracking skills of the trainees
- Each plot can be monitored by multiple trainees
- A repeat visit to plot locations is advised to determine detection error and ensure data quality
- All the trainees will have the opportunity to participate as a group to examine and discuss the data collected and assist in the preparation of a plain language community report

In general, a two-week visit to a community would provide the opportunity for two groups each with 4 Indigenous people to participate in two field trips each of 3-4 days. Overall this would amount to 8 individuals gaining employment and training for 8 days. In total, up to 112 plots in the vicinity of the community would be sampled on two occasions.

Draft monitoring protocol and data sheet to implement big plot track-based monitoring.

TRACKING AUSTRALIA – DATASHEET PAGE 1

Name_____

Contact details (Phone and email)_____

Date_____Time started_____Time finished_____

DATUM_____Easting_____Northing_____Map grid_____

Location: distance and direction from nearest named place_____

Distance from freestanding water_____

Habitat (please circle): Sand dune Sand plain Creek line Other (please specify)

Main long-lived veg. type (if known)_____

Time since strong wind/rain_____Time since fire_____

1) Visibility (circle one)

Distinct shadow Slight shadow No shadow

Length of shadow (as a % of your own actual height) = _____%

Hint: Stand with your back to the sun and look at your own shadow

2) How good is the tracking surface? (circle one)

3 - (if present you would be able to distinguish camel, human, dingo, emu, kangaroo tracks only)

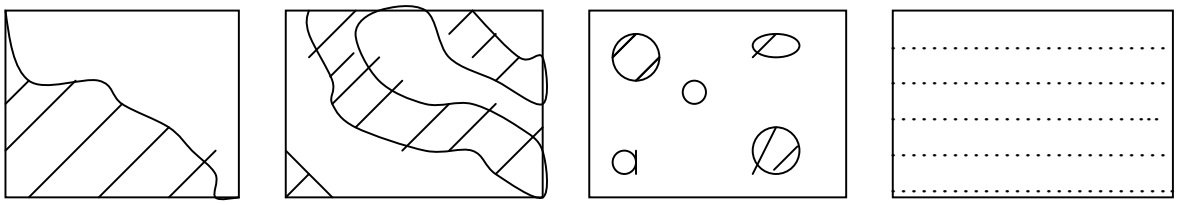
2 - (if present you would be able to distinguish all of the above plus fox, cat, rabbit, echidna, large reptiles, goannas etc)

1- (if present you would be able to distinguish all of the above plus hopping mice, rodent, small bird, insect etc)

Hint: only look at the parts of the substrate where you would be able to see tracks.

3) What percentage of the quadrat is actually suitable for tracking ? (Areas not suitable include rock, bushes, lichen, green pick etc)_____%

4) What is the continuity of the tracking surface like (circle one below- the hatched area is unsuitable substrate)

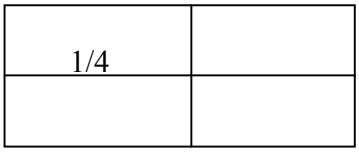


1 2 3 4

TRACKING AUSTRALIA - DATASHEET PAGE 2

Species	Tracks	Animal (or skeletal remains)	Burrows/ Diggings	Scats	Abundance of all sign (1,2,3)	Age of most recent sign (1,2,3)	Comments (gait length and width, juvenile sign etc.
NATIVE							
Echidna							
Bilby							
Bandicoot							
Mulgara/ampurta							
Quoll							
Bettong							
Wallaby							
Kangaroo							
Rodent/dasyurid <35g							
Hopping mouse							
Stick-nest rat							
Emu							
Bustard							
Corvids							
Other birds							
Dragons							
Large skinks							
Pythons/ large elapids							
Other reptiles							
Dingo							
INTRODUCED							
Fox							
Cat							
Camel							
Cow							
Horse							
Donkey							
Goat/sheep							
Rabbit							
Other							

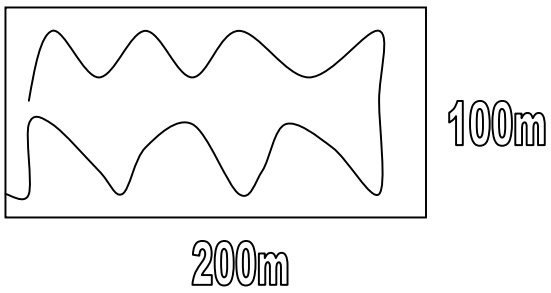
Abundance
1= sign in all four quarters and super abundant
2= sign in half to ¾ of quarters of quadrat
3= one individual only or sign only found in ¼,



Age of sign
1= fresh 1-2 days old
2=older, 3 days to 1 week
3= imprinted in mud or hard substrate, older than 1 week (scats- white and crumbly, no smell)

TRACKING AUSTRALIA – DATASHEET METHODS

Area of search = 2 hectares. A two hectare area (100m x 200m) should be walked in 30 minutes. If there are two observers you can do 15 minutes each. Try and cover most of the 2ha area by zig zagging up one side and back down the other. Record all tracks, burrows, diggings, sightings or scats of each species. Make sure you age the sign as well as estimate abundance. If the sandy substrate is along narrow sand dunes you can reduce the width of the search area and increase the length as long as the total area is 2 hectares.



Try to walk into the sun as tracks are easier to see with your shadow behind you. Don't depend on a single print for identification of a species, look at multiple gaits of an animal and follow it until you are certain of your ID. Look for large areas of good substrate, this allows you to see more than one gait of an animal at a time and helps with accurate identification. If in doubt, take a photo, draw the tracks with distinguishing features and measure the gait width and length and width and length of track imprints (see below).

Photographs

If possible take a photo of the quadrat to provide a permanent record of the vegetation and store the photo with the datasheet. Photos can also be a good way of verifying tracks and provide a permanent record for future use. When photographing tracks it is important to remember that shadow is needed to give the track depth and allow you to see detail. Do not use a flash as it removes the shadow. Angle the camera so as to get the best and deepest shadow on the track, often an angled shot rather than one taken from directly above can work best. Look at the position of the sun and take the photo towards the sun if possible. The most important thing to remember is to include a scale in your photograph. A matchbox is ideal and preferred but if not available you can use a ruler, coin or credit card. Your hand or footprint can also be used as a last resort.

Suggested quadrat spacing and sampling frequency

Quadrats should be spaced far enough apart so they are independent i.e. an individual animal should be registered on only one quadrat during a survey. For small animals like hopping mice a spacing of 1 km is generally adequate. For medium-sized animals like bilbies and feral cats, a spacing of 5 km is generally adequate and for large and for highly mobile animals like camels and dingoes, a spacing of 20-30 km may be required. The spacing chosen depends on the specific aims of the survey. A quadrat spacing of 5 km apart is appropriate for a general survey of fauna composition. Frequency of monitoring will also be dependant on survey aims but for long term national trends in species distribution it is recommended that quadrats are repeated every 2-5 years. More frequent monitoring could be used for species-specific projects or smaller areas.

The datasheet explained

Visibility

Visibility refers to how much shadow is present during the track search. In general, the more shadow the easier it is to see tracks and track detail. Walking into the sun increases the shadow and improves visibility. On the datasheet you need to record whether there is a dark shadow (distinct), slight shadow (generally in poor light such as overcast etc) or no shadow (the sun is directly overhead or is entirely blocked by cloud). Measuring the length of your shadow as a proportion of your height gives a less subjective measure of visibility. Stand with your back to the sun and look at your shadow. If it is taller than you it is more than 100% of your height and if it is shorter than your true height it is less than 100% of your height. Give an estimate.

How good is the tracking surface?

The quality of the tracking surface is another factor which influences accurate identification of tracks. If the surface of the sand is soft, powdery, dry and comprised of fine-grained sand then it is possible to distinguish tracks of even the smallest insects. Conversely if the sand is coarse, wet, compacted or wind driven it may only be possible to distinguish tracks of large animals such as camels. In this section you must decide what sort of animals would be able to be identified if they were present. ie if insect tracks were present would you be able to see them or is the surface too hard or wet? This gives an indication of what type of species may be missed during your search and allows researchers to determine false negatives (chance of a species being present but not seen by the recorder).

Percentage of quadrat suitable for tracking

Although the substrate may be perfect and the shadows long and distinct, some parts of the quadrat will be still be unsuitable for tracking. Trees, rocks, bushes, hard ground, leaf litter etc will all obscure tracks. Estimate the percentage of the 2 ha area that is able to be used for identifying tracks.

Continuity of the tracking substrate

It is not just the percentage of the quadrat that is suitable for tracking that is important but also the distribution of that suitable substrate. It is easier to accurately identify a species if multiple gaits can be viewed. If all of the suitable areas for tracking on a 2ha quadrat are less than half a metre wide it can be difficult to see and distinguish tracks. Thick vegetation cover, carpet cover of small ephemerals or extensive lichen coverage can all reduce the continuity of the tracking substrate to very short sections.

Age of tracks

It is important to estimate how much time has elapsed since the animal passed and a range of clues need to be used to judge track age. Generally, very fresh tracks in good substrate (a tracking surface score of 1) have crisp edges and you can make out the individual pads and their features or see distinct claw marks. As they age, the details of the track become blurred and finally only the general gait can be seen with none of the track detail. The condition of tracks from small, common animals such as insects and mice can be used to benchmark last night's activity and compare with older looking tracks and sometimes these tracks may pass over an existing track. Another tip is to look at the other tracks in the quadrat and see if you can see any tracks that look fresher.

Age of scats

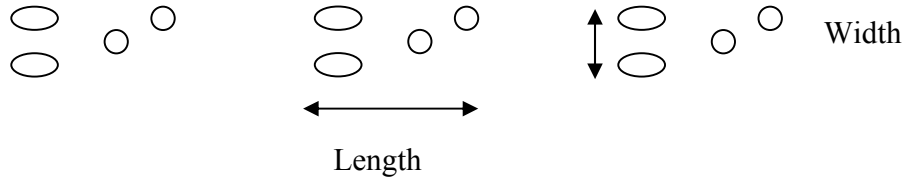
Fresh scats are usually dark, moist, soft, smelly and often will have some sand grains stuck to them. As they age they become lighter in colour and harder, very old scats will crumble easily and have little or no smell. Only record scats as age score 1 if you are sure they are VERY fresh.

Age of burrows

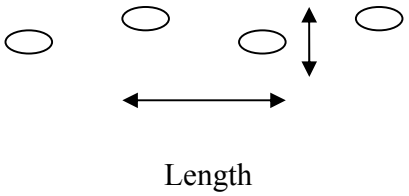
Active burrows that are being used by animals can still look old. However, in general, active burrows have fresh tracks and/or scats outside their entrance and have a clean hole that is not blocked by spiderwebs or vegetation. Always search for multiple entrances to a burrow as some entrances may be fresh and others old in the same warren system.

Gait Length and Width

Gait refers to the pattern of feet placement used when an animal moves and these gait characteristics can be used to help identify a species and indicate an individual's activity. Some animals can move bipedally (move on two legs) whilst others are quadrapedal (move on four legs).. Measurements should be taken using a tape measure or ruler and recorded to the nearest millimetre. Width of the gait is recorded at the widest point whilst length is the total length of one set of tracks. Ten separate measurements should be taken where the animal is travelling on flat ground at an even pace. Avoid measuring tracks that are travelling up or down hill or where there is a sudden change in pace. Also record whether the tracks are placed on top of each other (superimposed) or slightly offset.



Gait width and length of a rabbit/ampurta/bilby



Gait length and widtn oɪ a caɪ/ɪox/dingo

Track length and width

Track width and length refers to the measurements of a single spoor (print) rather than the gait. These measurements can still be important for identification and can help to verify species. Front and hind feet will usually have different measurements so it is important to measure both.

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Appendix 1 Terms of Reference

Objectives

The objective of the scoping study is to outline how a national track-based monitoring program could be developed to survey a range of threatened and invasive species to aid recovery efforts across the sandy desert regions of arid Australia.

To achieve this objective the study will need to report on previous efforts to develop a standardized survey methodology and outline how this could be incorporated into a national program.

The study must also involve widespread consultations to identify potential program partners and recommend appropriate strategies for managing issues such as intellectual property rights etc that may arise through consultations.

Activities

Identify and scope key project components including the following:

1. Identify the geographic region where a track-based monitoring program could be applied.
2. Identify the relevant key stakeholders that could be involved in a track-based monitoring program and undertake targeted consultations to document the potential benefits to these stakeholders, including socio-economic benefits, and the contribution they could make to threatened species recovery by involvement in the program.
3. Report on consultations with relevant experts and literature review on previous use of track-based monitoring methodologies, data management processes, and data analysis techniques.
4. Outline standardised track-based monitoring techniques and data collection methods suitable for a range of indigenous and non-indigenous users.
5. Investigate and recommend suitable processes for data verification, storage, analysis, and reporting to inform threatened species recovery efforts.
6. Review appropriate protocols for the management and use of data to protect intellectual property rights and culturally sensitive information.
7. Identify the training needs of potential users/contributors and recommend models to develop and provide training packages.
8. Identify how the program could link with and benefit threatened species and other programs in relevant NRM regions (identified in item 1).
9. Identify potential partnerships and linkages with government and non-government organisations and programs that would aid the adoption of a track-based monitoring program across a wide geographic area.
10. Outline a plan for developing and funding the proposed track-based monitoring program.

Outputs

- Draft and circulate an initial discussion paper by the 12th of March to provide background information for the project workshop.
- Present background of scoping study at workshop to be held on the 2nd of April 2008 at the Alice Springs Desert Park as part of the joint Arid Zone Recovery Teams meeting.
- Distribute a complete draft of scoping study for comment by relevant stakeholders.
- Submit 5 hardcopies and two CD's of final scoping study to WWF by 30th June 2008.

The contractor will liaise with the Threatened Species Coordinator (Arid Rangelands) during the life of the contract, and assist with any requests for progress reports to enable WWF to fulfil its reporting requirements.

Appendix 2a Participants of a workshop held in Alice Springs 2/4/08

People	*Organistation*
Michelle Rodrigo	Commonwealth NRM Facilitator
Andy Vinter	TSN
Richard Southgate	Envisage Environmental Services
Katherine Moseby	Ecological Horizons
Amber Clarke	DEH SA
Matthew Ward	DEH SA
Peter Copley	DEH SA
Reece Pedler	Arid Lands NRM
Rodney Edwards	APY Land Management
Thalie Partridge	APY Land Management
Anika Dent	APY Land Management
Malpiya Davey	APY Land Management
Nincuta Edwards	APY Land Management
Inpiti Winton	APY Land Management
Margaret Winton	APY Land Management
Tjaria Stanley	APY Land Management
Kim Webeck	Central Land Council
Jocelyn Davies	Desert Knowledge CRC; CSIRO Sustainable Ecosyst.
Chris Pavey	NRETA
Danae Moore	AWC
Rachel Paltridge	Desert Wildlife Services
Joe Benshemesh	Latrobe Uni/ NRETA
Bill Low	Low Ecological Services
Ada Nano	CLC
Jim Clayton	UKTNP
Kerrie Bennison	UKTNP
Steve McAlpin	Consultant
Gordon Sanders	Ngaanyatjarra Land & Culture Unit
Jo Miller	Ngaanyatjarra Land & Culture Unit
Alex Knight	Ngaanyatjarra Land & Culture Unit
David Pearson	DEC
Ian Kealley	DEC
Lesley Polomka	Kanyana WRC
Jacqui Richards	AWC
Phil Palmer	KLC
Peter McRae	EPA Qld
Simon Nally	DEWHA
Veronica Ritchie	DEWHA
Sharon Warne	DEWHA
Ross Cunningham	ANU
Annika Everaardt	ARAZPA

Appendix 2b People interviewed (non-attendees of the workshop)

People	*Organistation*	*Method*
Gary Bastin	ACRIS/ CSIRO	pre Workshop
Alaric Fisher	ACRIS	Email/phone
John Lumb	ACRIS	Presentation
Catherine Robinson	CSIRO	Email/phone
Neil Burrows	DEC	Phone
Anthony Esposito	Wilderness Society	Phone
Sarah Eccles	Bush Heritage	Presentation
Samantha Vine	WWF – Australia	Conference
Michael Looker	The Nature Conservancy	Email/phone
James O'Connor	Birds Australia	Interview
Andrew Silcocks	Birds Australia	Interview
Glenn McFarlane	Conservation Vol., Darwin	Interview
Will Dobbie	CLC	pre Workshop
Chris Dickman	University of Sydney	Conference
Jon Altman	CAEPR, ANU	Phone
Sarah Holcombe	ANU	Email
Stephen Garnett	CDU	Conference
Mike Braysher	Canberra University	Conference
Mike Weston	Deakin University	Phone
Barbara Bell	Working on Country	Presentation
Luke Ingram	IPA	Presentation
Jennifer Rahmoy	IPA	Presentation
Ivan Haskovec	IPA	Presentation
Phillipa Carmichael	IPA	Presentation
Bruce Rose	IPA, WoC	Presentation
David Foster	Working on Country	Presentation
Tess Ward	DEWHA	Presentation
Jeff Tranter	ERIN	Presentation
Felix Schlager	DEWHA	Presentation
Andrew Nott	DEWHA	Presentation
Glen Edwards	NRETA	Conference
Charlie Zammit	DEWHA	Conference
Peter Fleming	NSW DPI	Conference
Guy Ballard	NSW DPI	Conference

Appendix 3 Key problems and priorities identified for NRM regions.

Areas in which track-based monitoring could assist are shown in red

SA Aboriginal Lands

The key priorities identified by the region are: building community capacity to live on and manage the lands; minimising total grazing pressure through feral animal control and stock management; weed control; identifying and developing sustainable natural resource industries or enterprises; identifying and sustaining healthy water supplies for community use and for water dependent ecosystems; controlling soil erosion; protecting and managing priority areas for biodiversity; and maintaining and protecting social and cultural values.

SA Arid Lands Region

The region is being challenged to maintain and improve the ecological and productive health of its natural resources. The key problem areas identified by the region are:

- impacts of weeds and feral animals on both grazing and ecologically important areas;
- impacts of total (native and introduced) grazing pressure on native pastures;
- competition for and decline in the quality of surface and groundwater resources; and
- degradation of the region's soil resources.

WA Rangelands NRM

The Rangelands region is being challenged to maintain and improve the ecological and environmental health of its natural resources. The key priorities identified by the region are:

- Balancing ecological imperatives with social, cultural and economic needs;
- overcoming the social barriers of physical isolation;
- uncertainty with respect to land tenure arrangements, flexibility of land use and the requirements for developing alternative industries in the pastoral industry;
- working within the seasonal limitations of feed for stock to achieve ecological sustainability in the pastoral Rangelands;
- managing increasing visitor pressure at key attractions and on coastal areas and marine resources;
- working within the seasonal nature of the tourism industry;
- the need to plan and manage a range of alternative land uses, including tourism in a sustainable manner;
- an historical legacy of significant change in vegetation and condition of pastoral lands;
- decline in biodiversity values across the region as a direct consequence of the presence of high numbers of feral herbivores and foxes and feral cats;
- Indigenous land management and involvement in traditional lands; and
- managing sustainable use of marine resources.

NT NRM

The Northern Territory is being challenged to maintain and improve the ecological and environmental health of its natural resources. The Landcare Council of the Northern Territory has identified the following priority issues for natural resource management:

- Fire management
- Feral animal management
- Weed management
- Developing best practice natural resource management

Appendix 4 Transcribed notes of discussion and outcomes from the Track-based monitoring workshop held in Alice Springs

Track-based monitoring workshop: transcribed notes

Prepared by Richard Southgate
April 2008

Requests

- Please make sure my interpretation of the information provided at the workshop (scrawled down on butcher paper) is accurate
- Please make additions to the list of workshop attendees

Introduction

A workshop was held in Alice Springs on Wednesday 2 April 2008 to examine issues related to the development of a national monitoring program using animal tracks and sign.

The workshop was held at the Alice Springs Desert Park and facilitated by Michelle Rodrigo with assistance form Andy Vinter.
A briefing paper was developed and distributed to participants several days before the workshop.

This report presents the notes transcribed from the workshop
Comments from the workshop participants are shown in pink
Material copied from the Discussion Paper prepared prior to the workshop is shown in blue italics.

Desired workshop outcomes

Cross-border 'buy-in' on development of standarised monitoring protocols
A way forward for cross-border commitment to engagement of Aboriginal people
Cross-border support for sharing data, pooling data for analysis
Endorsement of a strategy to establish the program
Agreed methodology/ agreed components and structure of the sampling technique
National coordination of program – what's the role of a coordinating body?
Agreed monitoring skill sets needed and training required
Agreement on general process for data storage, IP, verification etc

Comments from participants:
What's in and what's out
Define key drivers
Clearer understanding of tracking methodology
Broader outcomes for engagement of Indigenous people
Clearer understanding of whether data from the technique can provide needs at national level

Comments after presentations by Katherine Moseby (technique characteristics) and Ross Cunningham (statistical considerations)

Key components:
Simple reference material
Quality control on data
Capacity to engage data producers and users
Approach to achieve scientific rigour without producing volunteer/participant fatigue

Key drivers:
Definition of questions to test
Specific objectives
Statisticians
Tapping into existing passion in remote communities
People on lands: volunteers, visitors, Indigenous people, land managers, scientists
Commitment form funding agencies
NGO advocate or champion

Components and support needed to achieve continuity over long term to deliver program security
Key issues:
Confidence in data collection (verification) required
Widely adopted single sampling method useful
Must provide value adding for land managers
Must return results and information to observers and data providers
Needs a from of database coordination
Opportunity to explore additional parameters

Comments after presentations by Richard Southgate (issues for overall program) and Jocelyn Davies (Indigenous engagement and DKCRC perspectives)

Need to maintain engagement with procedure while collecting presence and absence (negative result) data
Recognise multiple motivations/outcomes and unwillingness to engage with program
Embedding and attaching to indigenous governance structures
May need cost benefit analysis and a case study eg. Working on country
Need a means to measure social effectiveness of program
Need robust monitoring tool that provides feedback on results
Identify minimum standards
Importance of feed back processes
Adaptive /flexible systems of program delivery

Workshop discussion phase

The workshop divided into three groups to discuss each goal under four headings:

1. what would be desired in 5 yrs time
2. essential components
3. sticking points
4. how and who was going to drive the process

Then the strengths and threats identified in the Discussion Paper were considered

Goal 1

Development of a monitoring technique that can deliver data of sufficient quality, density and extent to examine questions relating to the distribution of selected threatened and invasive species and the effects of climate change, broad-scale forms of land management and meso-predator and predator-prey interactions in arid Australia.

Technique limited to monitor animals or broadened to monitor plants and animals
Role of technique in ground truthing other landscape features
National government problems
Data deficient spp.
Unclear distribution of spp especially in remote areas
Trends over time
Is management working?

5 yrs time:

Each community to choose a number of sites based on stratified and random selection process, surveying by veg. communities (or substrate) with ?clustering of sites. (RC)
Want to be able to use the data to guide management and have good feedback loops and feel like the data collected is worthwhile by field operators and investors
High quality data on the persistence of species is available

Essential components:

Need good outcomes to aid management otherwise wont be attractive to NGOs or agencies
Must be shown to be good at showing regional and broader (national) trends
Fixed area, fixed time search (RC)
Detection/ non-detection of species determined by 2 teams of 2 operating on a site with no communication between teams (RC)
Data needed on change of distribution and trends over time and to assess the response to management.
Even if not repeated survey, the technique would be good for determining spp distribution and useful for government agencies
If threatened species are targets then might also need to survey specific areas non randomly
Also need flexibility and ability to sample lots of sites for those species who have large home ranges and have great capacity to move (RP)
Need a scientific committee to steer project development

Problems sticking points:
Uncertain about what the technique can and cant do – this effects practicality and framing of questions
Main questions:
For threatened species: whether or not it is persisting at a landscape scale (DP)
For invasive species: presence/ absence of predation threat or other threatening processes (DP);
whether distribution is changing and demonstrate effectiveness of management to ensure ongoing funding (SN)
Use of unswept v. swept plots (MW)
Use of 2 ha 200x100 plots v. random walk of unspecified length
Single visit v. revisit of plot locations
Abundance of species v. presence/absence (JB)
Monitoring of threatened species (localised) v. threatened species (non-localised) v. invasive species (non-localised)
Use of photos for verification v. use of training and accreditation
What to do about very rare species or species not near communities (or road access)
How many sites can you have (do you need)?
If you don't have reasonable abundance you may not get suitable data on some species and need to discard eg. BA discards species with less than 5 records (RC)
Need good reasons to explain need for replacement of existing monitoring
Type of site information to include i.e. fire age, vegetation type
How to record age of sign and does it matter
Perhaps use other indicators to indicate suitability of substrate to have registered tracks in the previous day(s) eg. Presence of insect tracks
Need a decision framework to guide when photos of tracks in the following circumstances:

- cryptic, rare or unusual species
- when people are becoming accredited
- out of range species

How? Who?:
Section not considered by group

Review of Strengths:

Track-based monitoring of threatened and invasive fauna

- *A sampling technique has a well developed structure and format with some clear advantages:*
  - *Provides a snapshot of multi-species assemblage*
  - *Non-invasive, passive monitoring technique*
  - *Temporal window for data capture can be broadened depending on certain species*
  - *No site preparation is required*
  - *Minimum technique gear requirements are GPS and data sheet*
  - *Suited to record other site attributes*

- *Suited for single or repeat visits*
- *Suitable for examining long term changes in species occurrence*
- *A data sheet with instructions has been developed and tested with some potential user groups*
- *Data has been collected on the gait and footprint dimensions and characteristics of some species and this can be used to help identify species and indicate presence of young*
- *Excellent field guidebooks on mammal tracks and sign available from southern Africa and north America i.e. well documented techniques exist*
- *Techniques to analyse presence/ absence data, assess non-detection rate and for predictive mapping of species distribution are well developed (see papers by MacKenzie, Elith, Wintle etc plus approaches developed by Ross Cunningham)*
- *Majority of arid inland Australia has suitable sandy substrate for technique*

Identified strengths (outlined in workshop document) were endorsed. Additional strengths include:

- Ability for lots of different people to use the data for a range of applications
- Photos are a good way of verifying track data

Review of Threats:
Track-based monitoring of threatened and invasive fauna

- *Value of data and potential of technique not fully appreciated by researchers and land managers*
- *Data not accepted and considered useful by some groups or States*
- *Proof of concept not sufficient to convince agencies or investors*
- *Geographic scope of the technique not clearly defined or adequately described (i.e. sandy deserts of Australia or inclusion of sandy substrates in semi arid areas, pastoral areas and or Aboriginal land)*
- *Inadequate training or accreditation: people with poor identification skills able to submit dodgy data*
- *Inadequate data screening and validation: dodgy data collated and analysed*
- *Data not matched to questions*
- *Data gaps: temporal and spatial*
- *Land access issues affect data collection and continuity*

Identified threats (outlined in workshop document) were endorsed. Additional notes on threats include:

- People don't use the technique as often than it should be because people don't understand its value
- Monitoring needs to be associated with actual on-ground management outcomes to affect the species outlook
- Technique not perceived as any good because not good for monitoring rare species or species with very restricted habitat requirements eg. Rock wallabies
- Photos not a good way to verify track data of some species and if poor photographic conditions

Goal 2

Development of structured program to provide Aboriginal people with well-developed tracking and bush skills a range of training, employment and accreditation opportunities to apply the monitoring technique as contractors.

5 yrs time:
A number of community groups engaged
Certification program and career structure developed
Young people involved
$$ continue for wages
Capacity developed for Indigenous people to train others
Ownership continues
Feedback continues to and from Indigenous people
Program continues regardless of external support staff
Leadership of project taken over by Indigenous people
Public awareness of project through own website
Own office etc for training to whitefellas and young people

Essential components:
Time given to process
Public awareness
Ongoing involvement of Land Councils
Coordination and involvement of staff
Long term and multiple sources of funding
Logistics handling the large number of trackers who are available with existing skills
Dedicated officers to run project
A sustainable model for engagement
Concrete benefits and outcomes relevant to all goals
Include wider audience
Identify desired locations/lands. This determined stakeholders/ users

Problems sticking points:
Recruitment issues for coordination i.e. short term staff
Aged skilled work force – mobility, illness
Competition with busy community agendas
Engagement is influenced by the technique
How to protect data
More training needed
Don't want other people to get benefit from the data and they (the people collecting the data) get nothing
Need protection of data

How? Who?:
Review process and continue feedback
Use accepted guidelines for IP rights before work starts eg. DKCRC CLC work
Establish an Indigenous Reference Group to advise the consultants

Longterm commitment through funding

Review of Strengths:

- *Aboriginal people can be highly valuable collaborators*
  - *Most people have some skill in tracking and animal and plant identification; some people have exceptional skills*
  - *The program is well suited for participation by older people and women*
  - *People generally know their country well*
  - *People enjoy visiting country and looking for tracks and sign of animals*
- *Helps retain traditional knowledge and skills, promote self-esteem*
- *Broadens mentoring capacity for older people and provides training opportunities for younger people*
- *The short field trips and mobile nature of fieldwork suit the indigenous community lifestyle*

Strengths not considered by group

Review of Threats:

- *Fail to engage leaders in Aboriginal communities, Aboriginal organizations and Land councils*
- *Indigenous intellectual property issues are not clearly resolved*
- *Loss of control over traditional ecological knowledge or culturally sensitive information*
- *Organisations eg CAEPR and DKCRC over-committed with existing programs and don't want to participate*
- *Indigenous organizations seeing this program as competition for other resources*
- *Indigenous organizations seeing this program as a low priority*
- *Failure to inform people on communities about survey results*

Threats not considered by group

Goal 3

Establishment of a national coordinating body to facilitate project development, assist in data collation, management and analysis and provide a brokering role between investors and data providers.

5 yrs time:
Acceptance of method as a robust and useful technique to collect data and info by LW Audit, ACRIS, SoE
Want increasing buy-in and support
Need good engagement across science and culture
Web-based data entry and return reporting
National coordination body to work with organizations and in community capacity building

Essential components:
Support training for local people
Uniform set of tools
Accessibility of technical components
Scientific rigour
Support and training support from national coord body
Marketing tool
Long term program
Philanthropic support
Demonstrated core business of government
Feedback loops
Clear questions to address
Centralised data management/ quality verification/ analysis/ reporting
Capacity to cut data to suit scale: local/ region/national

Problems sticking points:
Choosing best and understanding implications of adopting a governance model
Fragmented nature of focus and funding sources
Uncertain about implications and advantages of a stand-alone or piggy-back with existing organisation
Short to medium term capacity is very limited and will depend on education focus. Therefore, capacity building must be ongoing
Intellectual property: clarity about why collecting data and who has access

How? Who?:
DEWHA
    IPAs, SoE, NRM, NL&WA
DWC
    Climate change
DEWR
NGOs
    Nature Conservancy

Birds Australia
WWF
Bush Heritage
AWC
CSIRO
University
State/Territory agencies
DKCRC
Invasive animals CRC

Review of Strengths:

- *The proposed program has easily identifiable environmental and social welfare outcomes*
- *People from a broad range of socio-economic and cultural backgrounds can apply the monitoring technique and generate useful data*
- *There are existing structures or models for the employment of people from Indigenous Communities, leader/mentor programs and community participative monitoring schemes operating at a national scale*
- *Program will lead to a national coordinated approach to data collection and analysis allowing national trends to be identified*

Identified strengths (outlined in workshop document) were endorsed. Additional notes included:

- Environmental outcomes are clear and social welfare outcome types are readily recognizable but measuring is problematic
- A place where science/ indigenous knowledge/ skills meet – contribute to same national goals with strong cross-sectorial and intergenerational linkages
- Provides an important ingredient, component and support for Indigenous ranger programs

Review of Threats:

- *Program strengths and opportunities not sold appropriately or adequately*
- *Failure to engage key consultants, state and federal departments and agencies*
- *Possibility of disintegration of the program in future and no consideration of dissolving/succession strategy*
- *Scientific intellectual property issues remaining unresolved*
- *Failure to reach national agreement on monitoring technique could lead to some states or organisations withdrawing from program*
- *Failure to reach agreement between government and indigenous groups over ownership/coordination of program*
- *Failure to provide useful digestible information and keep volunteers and supporters informed*

Identified threats (outlined in workshop document) were endorsed.

Role-play: Why should I be interested?
Hypothetical needs and responses from a corporate boss, community advisor and a politician

Dear business /mining company executive (Joe Benshemesh)
Considerations from a corporate/ business point of view:

- Would investment in the monitoring program be well spent?
- Is there a means to assess whether investment has positive returns?
- Does the investment address matters of national significance?

The advantages of the program:

- developed by highly esteemed scientists working in various state agencies and NGOs
- national community based program to monitor threatened and invasive species
- provides meaningful work and engagement on Indigenous communities
- apply scientific approach to Indigenous programs

It would provide your organization:

- positive stories for media attention
- simpler and cheaper work by environmental consultants and more comparable reporting because unified method
- show you where there are matters of environmental significance on lease land and this will alert you to your obligations
- show the impact of your mining operations in a national context
- show the difference you are making
- improved access to sites

It will help provide the public/ shareholders an indication your commitment to

- build networks across Indigenous lands
- produce a skilled Indigenous workforce or free-up workforce for employment in mining industry
- environmental management $s are being well spent
- clear outcomes for stakeholders
- your organization will be seen to be innovative

Dear remote community program officer (Matt Ward)
Considerations from a community officer's point of view:

- How does the program work?
- How do we learn about the program
- How do we ensure our needs are considered and incorporated

The advantages of the program for your organisation:

- provide a capacity for your organization to compare monitoring results at a broader scale

- provide confidence that existing monitoring is adequate to capture biodiversity composition at appropriate spatial and temporal scale. Funding bodies are requiring a landscape approach to monitoring
- better able to position your organization for dealing with encroaching threats
- provide access of data/ information to provide feedback to community and groups
- risk free data backup or storage
- leverage $ by participating in national program
- access to other data to allow comparison
- keep staff morale high, give broad relevance to environmental monitoring initiatives
- provide more streamlined and easier approach to dissemination of information

Provide your organization with:

- skilled trackers can work on other lands for fee-for-service and provide consultant services
- don't have to teach new staff new techniques because training and accreditation program attached to monitoring technique
- improved networking with neighbouring communities and groups
- staff will have clearer rationale and incentives for up-skilling
- help meet national monitoring obligations
- acknowledgement and recognition for community participants

Dear politician (Simon Nally)

Considerations of the politician's point of view:

- Is something similar happening already?
- Can the program be abused or give negative press?
- What are our national/ international obligations?
- What is currently happening?

The advantages of the program:

- better understanding of populations and trends
- great community outcomes involving many groups
- ability to report on national and international obligations
- provide a tool to improve Indigenous engagement in current programs i.e. IPAs
- coordinated approach will give government better data access
- program can be used to form part as job readiness program
- potential opportunities for mining and pastoral industry to produce skilled people
- opportunity to work with NGOs and achieve conservation/ management outcomes

Promises of ongoing assistance and support in development of the track-based monitoring (TBM) methodology

Proponent	Support offered
1. Communication and 'prospectus' development	
TSN: Andy Vinter	Support development of program communication materials
Ngaanyatjarra Council: view of Alex Knight Country	Support/ review development of prospectus from the point of engaging with Indigenous land managers/ IPA/ Working on
SA DEH: Peter Copley	Put sales pitch to DEH Programming, Policy and Executive & to regions
CSIRO:	Help raise awareness and identify its importance to remote area
Jocelyn Davies	sustainability; advocate to CSIRO, CSIRO Science Education, Desert People Centre, Desert Knowledge Australia for this to be a science education effort for remote Australia
2. Preparation of scoping study	
TSN: Andy Vinter	Distribute and promote the scoping study
SA DEH: Clarke, Copley & Ward	Provide comment on scoping study report
DEWHA: V. Ritchie	Provide feedback on draft documents addressing statutory requirements, data management, synergies with other programs, direction and focus
3. Methodology & design of track-based monitoring (TBM) methodology	
ANU: Ross Cuningham	Advise on methodology, design and monitoring of TBM
Low Ecology: Bill Low	Assist in development
CLC: Ada Nano	Can provide input into methodology on behalf of clients
Desert WS: R. Paltridge	Contribute experience in on-ground logistics of implementing TBM
Qld EPA: Peter McRae	Assist in development
Ngaanyatjarra Council: Gordon Sanders	Field test TBM methodology wih Indigenous field staff
4. Monitoring using the TBM methodology	
WA DEC: Dave Pearson	Assist in explaining methodology to colleagues & develop training materials & programs for staff, Indigenous & public
SA DEH: Peter Copley	Monitoring using TBM on parks and support Aboriginal land mgt groups to engage/ train/ monitor
Ngaanyatjarra Council: Gordon Sanders	Assist in implementation of TBM by Indigenous field staff
Desert WS: R. Paltridge	Trail TBM in field
Low Ecology: Bill Low	Use methods in monitoring
Qld EPA: Peter McRae	Use methods in monitoring

SA ALNRM: Reece Pedler	Use methods in monitoring, encourage others to use methodology
AWC: Danae Moore	Use TBM methodology on New Haven and Kalamurina Stn
CLC: Ada Nano	Continue using TBM in Tanami and other regions
Steve McAlpin	Monitor using TBM
UKTNP	Trial TBM methodology and provide feedback re willingness
etc	
Bennison & Clayton	
Kanyana: L Polomka	Promote TBM as an activity for Kanyana volunteers

5. Indigenous and wider community engagement

TSN: Andy Vinter	Contact point for potential program contributors
SA DEH:	Facilitate training & employment eg. Links to co-
management of Clarke, Copley & Ward	parks and/or Aboriginal Partnership Units
APY Land Management:	Assist in coordinating Anangu for Reference & Planning Group
Partridge & Edwards	Help implement field trials using TBM
Low Ecology: Bill Low	Contribute information on employment methods
CLC: Ada Nano	Continue to train rangers & promote development of TBM among clients
Ngaanyatjarra Council:	5 full time Indigenous land mgt officers
Gordon Sanders	Regular senior traditional owner consultation
	Regular work with other community staff under CDEP & other programs
SA ALNRM: Reece Pedler	Gain support of other potential beneficiaries of TBM including Indigenous, pastoral, mining and field naturalist groups

6. Program development and coordination

TSN: Andy Vinter	Support program development
SA DEH:	Statewide -> National: program development and
coordination	
Clarke, Copley & Ward	Statewide -> Regional: communication, coordination, buy-in, reporting and review
Ngaanyatjarra Council:	Engagement of Working on Country Indigenous coordination
Gordon Sanders	WoC Program coordination
CSIRO:	Co-invest in local case study
Jocelyn Davies	Social learning dimension and linkages to livelihood outcomes plus provision of methods to track effect
	Given resources ($), CSIRO could be an IT provider
	Willingness to have a role in coordinating a group to move idea forward

Appendix 5 Critical components of community programs

(adapted from the Canadian Monitoring and Assessment Network 2006

The following factors have been identified as critical for successful "on-the-ground" implementation of community participative monitoring programs.

- Engage the community
  - the benefits of monitoring need to be understood
  - approaches are appropriate and context specific
  - ongoing support and commitment can be demonstrated
- Collaborative approaches are implemented
  - build mutual confidence & benefit
  - expectations for participants must be clear
  - reward structure must be clear & fair
  - local knowledge & Indigenous ecological knowledge confidentiality is respected
- Information and feedback delivery mechanisms established and maintained
  - meaningful results are communicated in plain language
  - up-to-date information provided
  - new information is integrated into decisions and policies
- Coordination is critical
  - communication, facilitation, negotiation and mediation skills are developed
  - volunteer groups and participants are coordinated at a local scale
  - broader partnerships and networks among communities are maintained