



My Country, Our Outback

Voices from the land on hope and change in Australia's heartland

The Pew Charitable Trusts

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Pew's work in Australia aims to secure protection for all areas of high conservation value in the Australian Outback in partnership with scientific, government, environmental, pastoral, community and other organisations. In addition, we work with stakeholders to deliver effective management of adjacent areas that is compatible with the conservation of Australia's land and seascapes as a whole.

This publication is the second in The Outback Papers series, which Pew is commissioning to document one of the last extensive natural regions left on our planet: its value, the threats to its health and the opportunities that exist to create a modern Outback that values its nature and sustains its people.

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This report was written in two inter-connecting parts. The original research and analysis contained in the overview and conclusion was written by Professor John Woinarski, Threatened Species Recovery Hub of the National Environmental Science Programme, Charles Darwin University, while the profiles of land managers were written by Daniel Lewis. Additional expert contributions were made by Dr. Barry Traill and Dr. Ian Lunt.

External reviewers

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Fire is an essential management tool in Australia's Outback, re-generating and regulating native vegetation. However, fire can also quickly become a major threat to nature and people when, for example, it combines with dense and prolific introduced species such as gamba grass.



Glenn Campbell



Kerry Trapnell

Ann Ballinger, Stockholm Station, Western Queensland.

1. Overview

This is a book about people in a remote and sparsely populated land. It is about a special and impressive relationship between people and nature, in a place where the land needs people and where people, in turn, live, nurture and rely on the land.

Only a small number of vast natural landscapes remain on Earth – wild regions where ecological processes function normally and movements of wildlife remain largely unfettered by the fragmentation of habitats. These few places include the Amazon basin; the boreal forests and tundra of far northern North America and Siberia; the Sahara Desert; and the Australian Outback. It has become increasingly apparent that even in these large, natural ecosystems, the fate and condition of nature lies in the hands of the people who live on, know, respect and manage that land.

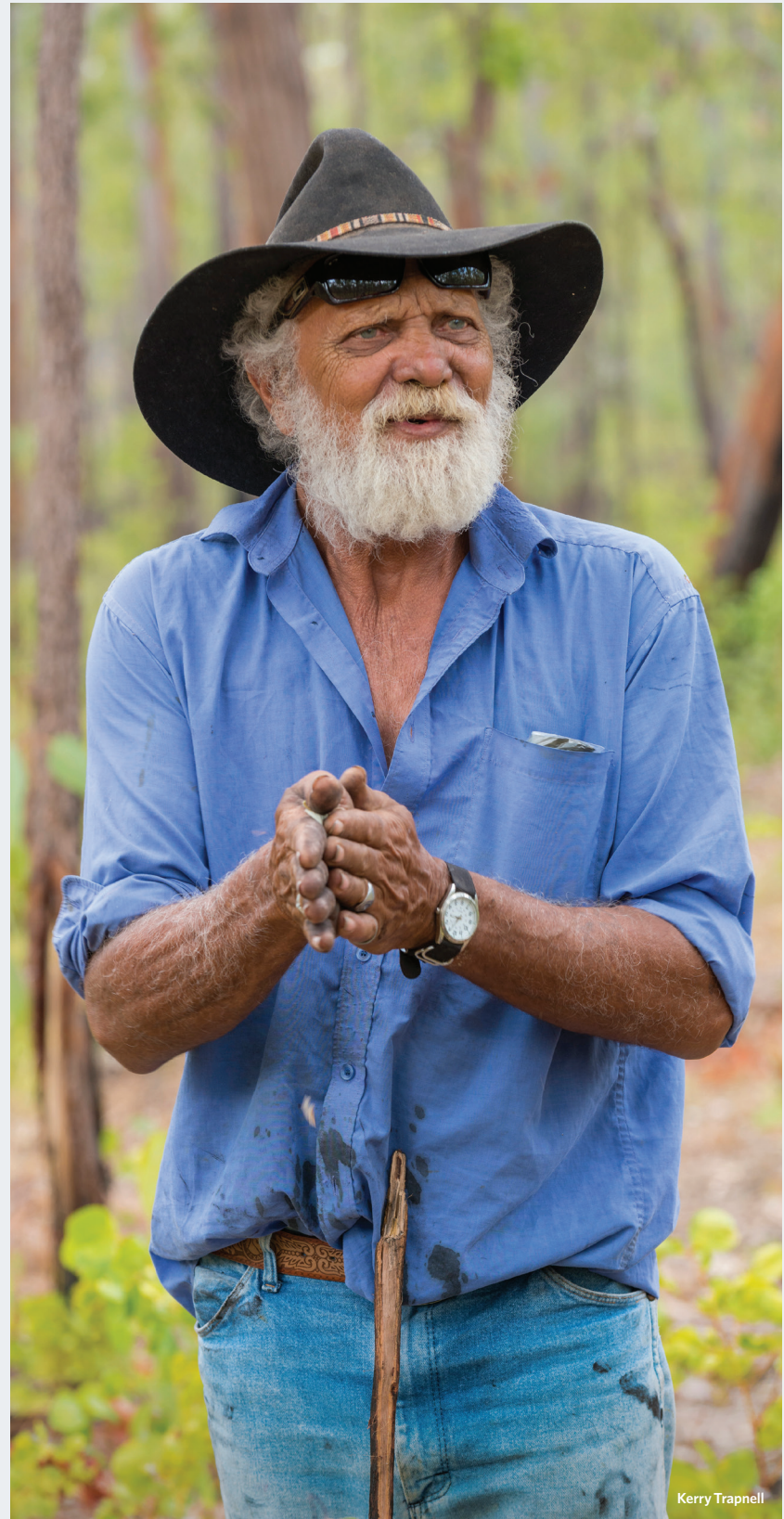
The Outback has been the home of Indigenous Australians for about 50,000 years. Over this period, Traditional Owners have tended, shaped and nurtured the landscape. Reciprocally, the landscape has helped to forge Indigenous identity and culture. This book celebrates that relationship and its modern manifestations – and also recognises that there are new elements in this landscape, and new people and enterprises are now responsible for caring for this magical country.

There are especially mysterious and spectacular places in the Outback – Kakadu, Uluru, the Kimberley – icons that draw visitors from the nation and beyond. These are parts of a whole, places embedded within a vast natural landscape and dependent upon the greater area for their ecological health.

Importantly, the Outback is now a modern landscape. Many graziers and Indigenous Rangers use helicopters to traverse their country. They use laptops and satellites to check for fires and the state of water tanks in distant paddocks. Some Outback stations now engage in carbon farming and tourism businesses as well as grazing cattle and sheep.

Today, however, the long-term health of the Outback is under threat. Across vast areas, there are fewer land managers now than at any time in the past 50,000 years. This is causing problems – such as the uncontrolled spread of feral animals, noxious weeds and wildfires – that, unless addressed, will result in a continued decline in the health of the heart of Australia.

With little understanding of the potential consequences to nature or future inhabitants, successive generations of settlers introduced a cavalcade of non-Australian plants and animals to the Outback. Many of these species, such as foxes and cane toads, have spread across vast areas and taken a substantial toll on native species. That toll will continue to rise unless these feral animals and weeds are controlled, which cannot happen without people.



Michael Ross, Olkola country, Cape York Peninsula, Queensland.

Kerry Trapnell



Kathy Wilson, Kakadu National Park, Northern Territory.

Since European settlement, much traditional management of the land by Indigenous people has been disrupted. Where once there was a careful, skilful and necessary manipulation of fire that was attuned to the environment, fire now occurs wildly with unprecedented ferocity, extent and detrimental impact (see 'Fire management', p. 14). Fire, which was a widely used tool for crafting a healthy, diverse and productive landscape, has now become an unregulated agent of destruction. It will remain so until people reclaim control.

1.1 A unique place with distinct needs

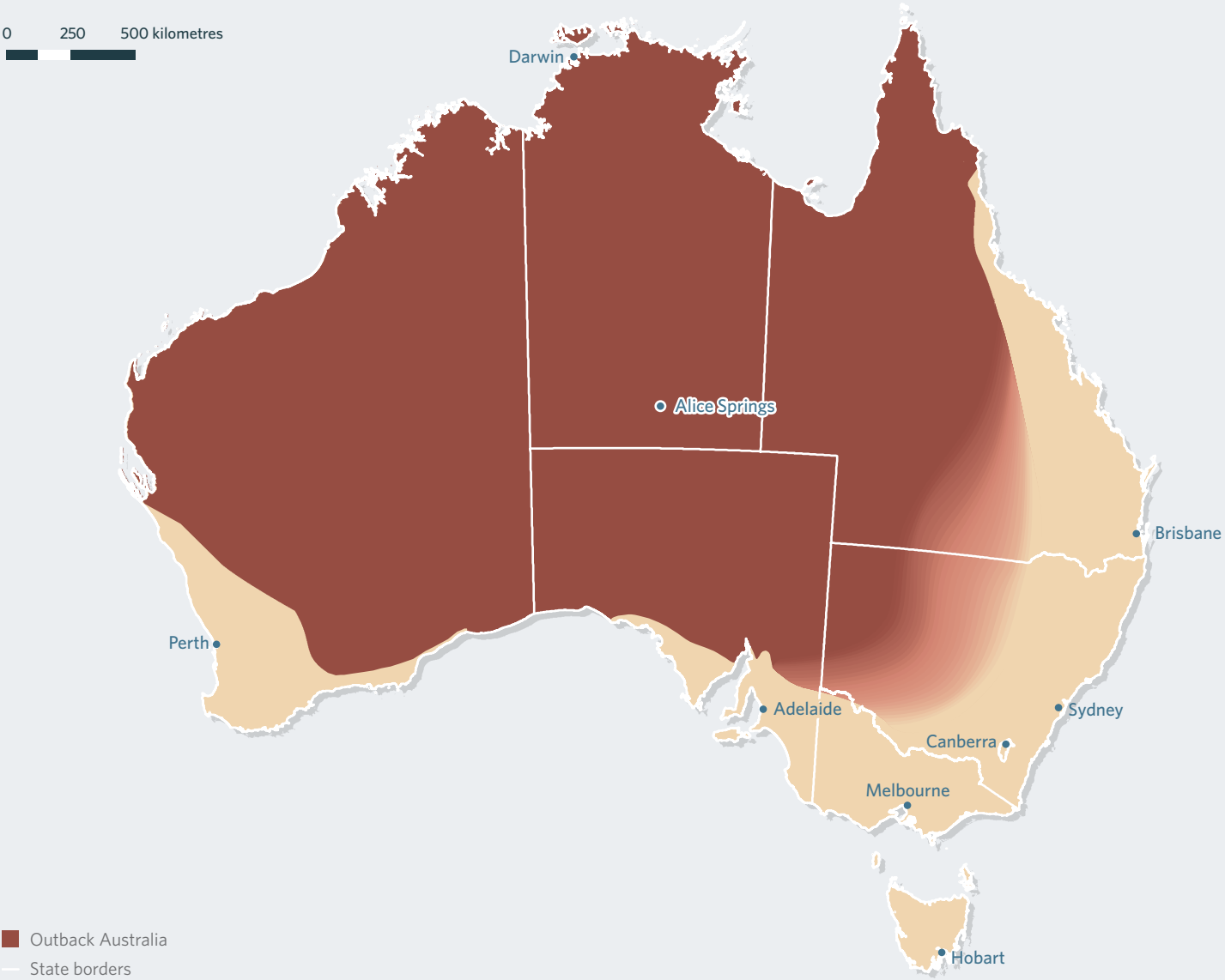
The Outback's remoteness from major population centres forces its residents to be adaptable and self-reliant. But it also engenders a sense of community that extends from a tight-knit local social network to a web of broader connections, linking people who face similar issues over hundreds and thousands of kilometres. This book engages with that web, discovering that voices from one part of the country may resonate with readers in other regions of the Outback far away.

This is not simply idle networking; many of the Outback's challenges need to be confronted in a coherent and integrated manner, with lessons learnt in one place likely to be applicable in many others. Ultimately, it is futile for a landholder on one property to attempt to control feral pigs or gamba grass or any of many other threatening factors if his or her neighbours – and all other landholders beyond them – make no such effort or are unaware of what works effectively.



David Bell, Dulkaninna Station, South Australia.

Figure 1
The Outback Occupies More Than 70% of the Australian Mainland



■ Outback Australia
— State borders

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Landscape management in the Outback (including biodiversity conservation) requires effective communication and coordination across all sectors, landholders, tenures and jurisdictions. In turn, such linkages create an intimate but wide-ranging sense of community among many Outback residents.

1.2 A contract with country

One common thread in the accounts in this book is the unstated contract with the land. In different voices, the people here speak of reciprocal benefits – of the land providing for them, and of their working to manage the land, to give it succour and health. Many of the people here speak as custodians: They have a long-term vision for, and commitment to, maintaining their land’s natural values and ecological health for its own sake, and for future generations. It is a homeland that defines their lives, and that is worth investing their lives in.

Land has a story, power and value far beyond the superficial layering of topography, tenure or environment.

Most people speaking through this book have lived all or most of their lives in the Outback. They know their land and appreciate its distinctive character and special qualities. Its intricacies, the way it responds to drought, rain or fire, and its special, secret places are clear to these residents – for example, the places that hold water in a dry land, such as the *gnamma* rock holes and water trees described by Les Schultz in his Ngadju country (p. 84). They know what helps or hurts the land, and the limits to which it can be pushed.

For some, this empathy and intimacy with the land come not only from a lifetime lived on it, but also from the knowledge handed down to them from preceding generations, as with the Bell family on its Birdsville Track property (p. 136). For Aboriginal landholders in the Outback, the history is far longer, and land is the centrepiece of culture and existence, with deep spiritual resonance and intricate, profound and beautiful connections between places.

Land has a story, power and value far beyond the superficial layering of topography, tenure or environment. It gives meaning to life, as described in accounts in this book from Rarrtjiwuy Melanie Herdman (p. 26), Schultz and David Graham (p. 84) and Michael Ross (p. 124).

The Outback is notably different from that small, peripheral part of the continent in which the overwhelming proportion of Australia’s population

lives. It has different cultures, aspirations and economies and a separate sense of place. Many of the challenges and disadvantages facing people living in remote Australia are rarely considered or understood by the majority of Australians who live in, and are familiar only with, the continent’s coastal fringe.

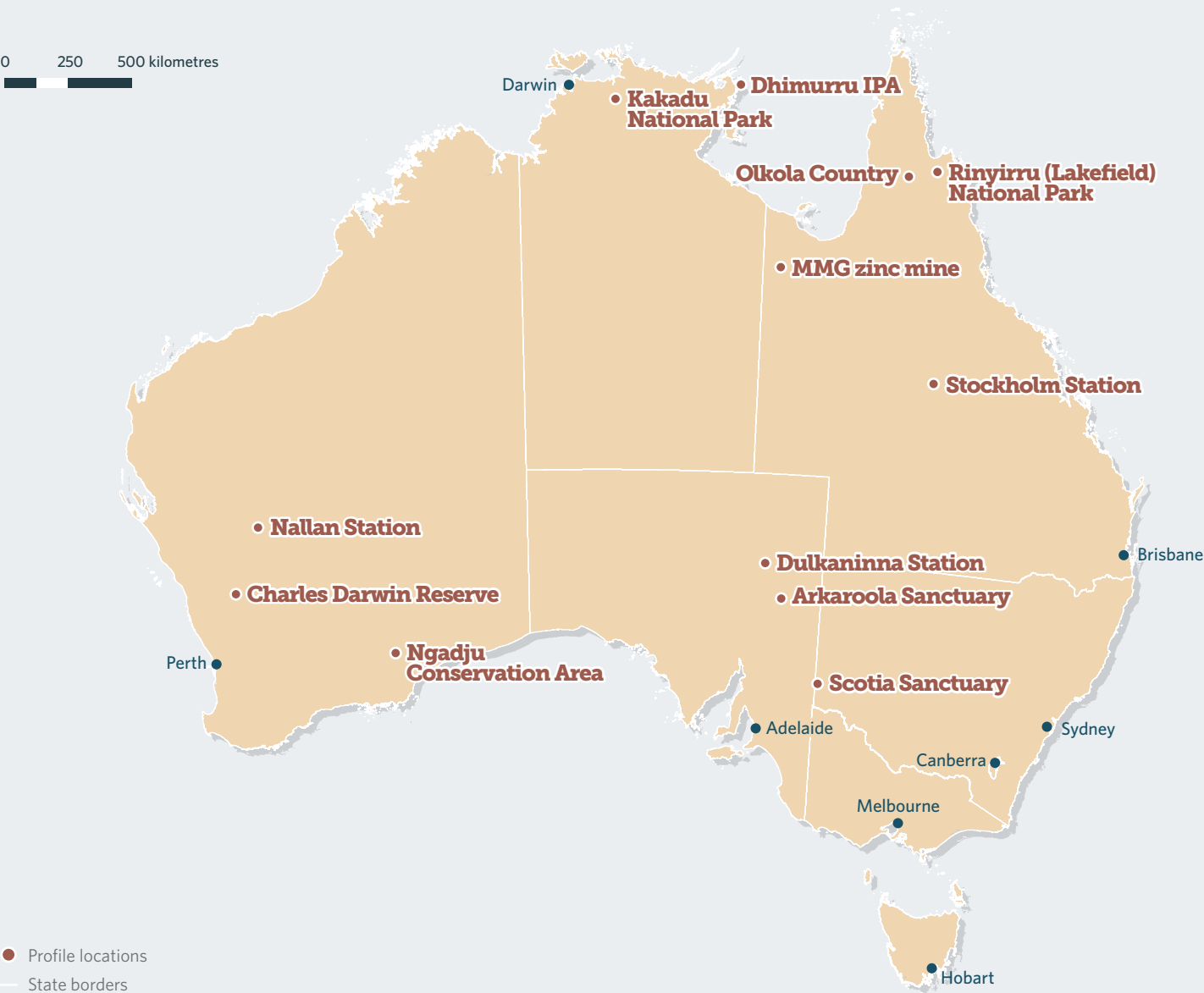
Outback residents need and seek a mutually respectful relationship with urban Australia. A better understanding by city dwellers of the lives and challenges of Outback residents would provide a foundation for such a relationship.

By sharing their stories here, the people in this book are helping others to see their country as they have learnt to see it. They are showing others why this land is valuable and needs to be cared for. They are sharing some of the familiarity, wonder and exultation that marks their relationship with country, and passing along the lessons they have learnt about how to respect and care for the land.



Rarrtjiwuy Melanie Herdman with her son Micah Wotjin Maymuru, Arnhem Land, Northern Territory.

Figure 2
Locations of the 12 Land Management Profiles Featured in This Book





"In many parts of the Outback, there are now fewer people managing country than there have been for tens of thousands of years, and yet the number, variety and near-intractability of some threats are unprecedented." Professor John Woinarski



2. The purpose and practice of managing country

All of the narratives included here are about land management in one way or another. Land management is purposeful, and the means for achieving a landholder's objectives.

Often the management activity itself, not the objective, is most obvious to outsiders. Many of the people profiled in this book spend much time controlling feral animals, poisoning weeds or manipulating fire. These activities occupy much of the ingenuity, energy and budgets of most land managers. But such activities are not done for simple gratification or recreation or as an end in themselves. These actions are a form of work with a larger purpose.

2.1 Long-term, large-scale benefits

While landholders of different tenure or geography may have different objectives, they all aim to deliver productive outputs or to constrain factors that reduce their outputs: to maintain the long-term health, productivity, integrity and resilience of the land and its resources. For rangers on conservation lands, the desired outcome may be an increase in the abundance of one or more threatened species, as described in accounts here by Felicity L'Hotellier (p. 62), Les Schultz and David Graham (p. 84), Michael Ross (p. 124) and Kathy Wilson (p. 150).

For pastoralists such as Michael Clinch (p. 40), it may be to increase livestock production in the short term, or to maintain or increase land quality and sustainable production over the longer term. For Indigenous landholders, such as Les Schultz (p. 84) and Michael Ross (p. 124), it may be to protect important cultural sites or increase the abundance of valuable food ('bush-tucker') resources. For those in the carbon market, it may be to optimise the amount of controlled fires and minimise the extent of uncontrolled ones.

In most of these cases, although the primary objectives may differ in nuance, there is much common ground in secondary objectives or in the mechanisms by which primary objectives are achieved. So some pests (such as feral pigs or feral goats), weeds (such as rubber vine, cactus or prickly acacia) and fire regimes (uncontrolled high-intensity fires) are considered undesirable by almost all landholders because they make their objectives more difficult to realise, and almost all land managers will benefit from attempting to control them.

For example, managing fire effectively is likely to benefit many threatened species, and biodiversity in general. It will also support pastoral productivity, help maintain cultural sites and values and reduce greenhouse gas emissions.

A long-term (and large-scale) perspective is important, because managing feral animals, weeds and fire and sustaining and recovering natural landscapes are long-term propositions. Most of the people telling their stories in this book have been on their lands for decades and have been engaged in, and gradually seen the rewards of, long-term campaigns against the threats posed by feral animals, weeds and fire.

Their activity and management responses are not fickle and ephemeral. When applied briefly, an intensive control effort may bring some short-term respite, but such gains may be rapidly frittered away if the effort is not maintained. As described in the accounts by Michael Clinch (p. 40), Les Schultz and David Graham (p. 84), Matt Lord (p. 96), Doug and Marg Sprigg (p. 110), the Bell family (p. 136) and Luke Bayley (p. 162), planning and management should be considered over at least decadal scales in Outback environments.

2.2 Different perspectives

Of course, we recognise that some users of Outback lands have different perspectives. Some industries (such as mining and horticulture) seek to transform Outback landscapes through intensive resource use and extraction. For such land users, management priorities and objectives may contrast markedly with those of many other landholders, although even people engaged in these intensive industries share concerns about weeds, feral animals and fire, as evident in the account by Matt Lord (p. 96).

But increasingly, even those involved in these transformative industries are linked with broader-scale environmental management. There are now many Outback examples of extractive enterprises contributing to regional-scale management initiatives well beyond their land boundaries to reduce the threats of weeds, fire and feral animals or to improve the conservation outlook for threatened species. And there are many examples, such as those described by Matt Lord (p. 96) and Luke Bayley (p. 162), of organisations working collaboratively with neighbours to achieve these broad land management objectives.

In other cases, different sectors may rate some factors differently. For example, most Outback landholders view introduced buffel grass as undesirable, largely because it fuels relatively uncontrollable fires and reduces biodiversity, and focus on it for management control, but some pastoralists value it.

An area of persistent, rancorous dispute among Outback landholders relates to the management of dingoes, or wild dogs. Most Indigenous landholders view the dingo favourably as an important participant in the country's storied landscape.



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

Planning for a healthy country in Olkola country, Queensland (top left). Citizen scientists and researchers monitor climate change at Charles Darwin Reserve (right). Michael Clinch monitors rangeland recovery at Nallan Station, Western Australia (bottom left).

Many conservationists also regard the dingo highly, largely because it has an important ecological role as a key predator. Today there is much evidence that many threatened native mammal species have persisted better in areas where dingoes remain abundant than in those where the dogs have been eradicated or reduced by sustained poisoning campaigns. This is because dingoes can reduce the abundance of introduced foxes and feral cats. These two feral predators exert far more destructive tolls on native wildlife than dingoes do. Dingoes can also reduce grazing pressure by overabundant kangaroos and feral goats.

Today there is much evidence that many threatened native mammal species have persisted better in areas where dingoes remain abundant.

Conversely, many pastoralists (particularly those grazing sheep and goats) regard dingoes as significant killers of their stock (as graphically described by Ann Ballinger on p. 72), and hence a serious pest that should be eradicated from their lands. Others, such as Michael Clinch (p. 40), are seeking new ways for pastoralism and dingoes to coexist.

This is one of the most difficult Outback land management issues to resolve. New management approaches – such as use of guard dogs and fencing and targeting of individual problem dingoes – rather than indiscriminate persecution hold promise for resolving the issue in many regions.

These diverse perspectives are given voice in this book; the Outback is full of people with different points of view. Not all will agree on issues, even when they may be pursuing the same objectives, and many will advocate strongly for their positions.

However, even contrasting opinions can be harmonised through a shared understanding of longer-term objectives related to sustaining the land's values, or through regulation that ensures that the actions of any one landholder should not bring detriment to a neighbour, such as the unintended spread of an invasive pasture grass to a neighbouring property. Furthermore, imaginative new techniques may help to resolve some of these long-standing conflicts.

2.3 Management of feral animals

This book presents many cases of landholders seeking to control weeds and feral animals. They are not seeking to return the country to a pre-industrial Eden. Rather, the country will be more diverse, productive

and resilient when and where managers can reduce such threats to its environmental integrity and functioning.

Pests come in many forms; they include foxes, cats, pigs, horses, donkeys, goats, camels, water buffaloes, rabbits, toads, fish and even exotic ants. Most were deliberately introduced, with little understanding of their likely risks, and most are now extremely abundant.

Many people have particular affinities for some of these species, as Kathy Wilson notes of buffalo in Kakadu (p. 150). However, where they have built up large and unmanaged populations, the environmental detriment caused by these species may be very substantial.

Effectively controlling feral animals in much of the remote and sparsely tracked Outback involves humanely killing individual animals. Many Outback land managers love animals, and it can be a difficult moral choice to achieve conservation through the destruction of individual pest animals.

Indeed, for some sectors of society, the welfare and lives of individual animals are paramount. However, without effective and humane control, the feral animals will continue to proliferate, native plants and wildlife will retreat and diminish, and the health and values of the country will be degraded and lost.

Because many Australian environments have had no evolutionary history with large hard-hooved animals, they are sensitive to them – especially when those introduced animals occur in large aggregations. Some native plant species are sought as food sources by feral animals but are highly susceptible to grazing and are now much depleted. The decline of these plant species may also affect many native herbivores that formerly relied upon them. For example, in the Flinders Ranges and elsewhere in the Outback, rock wallabies have declined catastrophically in areas where goats are not effectively controlled. Fortunately, inspirational managers such as the Spriggs have worked for many years to reduce goat numbers and protect rock wallabies and their habitat (see p. 110).

The European red fox and feral cat are now common (numbering in the millions) and widespread across the Outback. These two introduced species place unsustainable predation pressure on many native species, particularly small mammals, but also birds and reptiles. As illustrated in accounts in this book, especially that by Felicity L'Hotellier (p. 62), there has been some limited success with controlling these introduced predators, with several broad-scale cat- and fox-baiting programs in parts of the Outback and smaller areas of predator-proofed enclosure fencing.

In some Outback regions, the abundance and impacts of cats and foxes may also be moderated through the reintroduction of dingoes (or at least stopping their persecution), and through improved fire management.



Kerry Trapnell



Kerry Trapnell



David Blood

Josh 'Macca' McAllister controls feral cats at Scotia Wildlife Sanctuary (top). Landholders control feral goats across the Outback (bottom right). Scotia has developed innovative cat traps (bottom left).

Collectively, the management examples here demonstrate that many native species can recover if feral cats and foxes are effectively controlled.

Indigenous Ranger groups in some remote parts of the Outback form the front line in surveillance efforts, looking for new incursions of these and other feral animal and weed species and then promptly seeking to control those incursions while it is still relatively practicable. Such front-line biosecurity effort is cost-effective because it eradicates a problem when it is still small and controllable.

To understand the effects of feral animal species and control them successfully, land managers need to adopt integrated whole-of-landscape approaches. ‘Rewilding’ – an attempt to restore the major ecologically important native species to a landscape that is degraded or from which those species have been lost – offers such an option.

2.4 Weed management

Some parts of the Outback are now degraded by a diverse set of weed species, including non-native grasses, herbs, shrubs and trees. Many weeds are now widespread, many are still expanding and many species with limited distributions may move far more widely with future climate change.

Some weeds arrived in the Outback accidentally or inadvertently. But many were introduced deliberately and have been assiduously propagated and spread by their supporters: In a few cases, some proponents continue to see them as wonderful assets—as pasture grasses for stock, for example.

Many weed species present formidable management challenges and may require the investment of considerable time, money and personnel to control. Ann Ballinger’s account of her ongoing battle with prickly acacia is typical (p. 72).

Weed impacts vary: They may out-compete native plants, poison stock or wildlife, reduce food resources for native wildlife, change habitat structure and diversity, infest crops, reduce productivity, degrade cultural sites, constrain access, choke waterways or alter hydrological function.

However, across large areas of the Outback, the most significant effect of weeds is on fire regimes. In some cases, the combined effects of these weeds and the fire regimes that they support render them ‘environmental transformers’ capable of markedly reshaping the natural landscape (see Insight 1, following page).

Weed management in the Outback is a formidable challenge for many of the same reasons that make controlling feral animals so difficult. The size of the landscape may render it difficult to find outbreaks, identify priority

areas to control, and stop new incursions. Nevertheless, despite these challenges, controlling weeds is a clear priority for many of the managers profiled in this book.

Across large areas of the Outback, the most significant effect of weeds is on fire regimes.

The main features of weed management are comparable to management of feral animals. Managers need to know their opponents’ strengths and weaknesses through:

- knowledge of the chemicals or other control options, their efficacy and cost-effectiveness and when they should be applied;
- understanding which priority assets – sites, areas or native species – should be most protected from threats;
- vigilance in detecting and preventing new incursions, and determination to engage in long-term campaigns of control or eradication;
- collaboration with neighbours and government agencies to share costs and operational capability. The Desert Channels regional group described by Ann Ballinger provides a good example of such regional landholder collaboration (see p. 72);
- long-term and large-scale strategic planning;
- agility in seeking external support;
- careful consideration of the current and future harm that different weeds may cause against the costs and feasibility of controlling them in order to prioritise management of species that may be most damaging and are possible and affordable to control.



Dhimurru Ranger Georgina Gellett removes an abandoned fishing net.

Insight 1

Weeds that transform environments

Most people don't immediately think of grass as an agent of environmental destruction. But in the mid-20th century, agricultural scientists and the pastoral industry developed and implemented a strategy to transform landscapes in much of Australia by replacing native plants with introduced ones, especially grasses (Cook and Dias 2006; Cook 2008, 2009; Cook and Grice 2013).

With scientific precision, they scoured the flora of other continents to seek the fastest-growing, most robust plants that would perform best in Australian environments and climates and spread them widely. Although the broad strategy may now be recognised as irresponsible, there are still those who continue to deliberately spread introduced plants over substantial areas. The legacy of these and earlier introductions has become a serious and increasing problem for land managers.

Many of the introduced plant species are now among the worst weeds in the Outback, with detrimental effects on natural, cultural and sometimes grazing value. The very traits that were seen as favourable by those who introduced them – such as rapid growth, robustness, ability to spread and rapid and high reproductive rates – are also the markers of weeds.

Gamba grass is perhaps the most infamous of these unwelcome invaders. It was repeatedly introduced (from West Africa), mostly to the Darwin-Katherine region of the Northern Territory beginning in the 1930s in hopes of supporting higher-productivity pastoralism.

With high densities of cattle, this may occur, but with lower densities of cattle, gamba grass leaves become coarse and not palatable as feed. Gamba grass spreads rapidly and has widely extended its range beyond pastoral properties to conservation reserves, Indigenous lands and rural residential properties, where it grows in very dense stands up to 4 metres in height.

Whereas native grasses typically produce about 3–5 tonnes per hectare of dry leaves and stalks, gamba grass attains three to five times that amount (Rossiter *et al.* 2003; Williams *et al.* 2003).

Fires in savanna woodlands infested by gamba grass now burn five to 20 times more intensely than fires in areas without gamba grass (Setterfield *et al.* 2010). Fires in gamba grass-infested areas leave few unburnt patches and burn through the tree crowns, killing trees (Rossiter *et al.* 2003; Setterfield *et al.* 2010).

With repeated fires, tree cover disappears, and a native woodland is transformed into a monoculture of gamba grass (Williams *et al.* 2009; Petty 2013). These high-intensity fires also pose risks to infrastructure and human life.

Costs of controlling gamba grass (about \$43 per hectare annually for control and \$120 per hectare for eradication) exceed most available management funds (Adams and Setterfield 2013). Landholders in gamba grass-infected areas may not be able to reduce fires and qualify for the resulting carbon farming dollars (Setterfield *et al.* 2013). Only consistent quarantine work by landholders will keep gamba grass out of those regions across the north where it has yet to take hold.



Exotic gamba grass generates intense fires in savanna woodlands.

2.5 Fire management

Across almost all areas of the Outback, fire is a fact of life, a caprice of nature, a nuisance, an agent of destruction, a cultural practice, a useful tool and a means of revitalising land. For Les Schultz in his Ngadju country, 'fire is culture' (p. 84). It is clearly a complex and contentious factor.

Although there may always be some unpredictability in its incidence and impacts, fire used carefully and skilfully is a necessary management tool for maintaining the condition, resilience and diversity of most Outback environments.



Indigenous Ranger Eddie Phillips burns savanna woodland in Arnhem Land.

The climate and vegetation of much of the Outback lends itself to fire, or at least makes it almost inevitable that there will be some fires sooner or later.

Once ignited, fires may be vast. Some recent single fires in the Outback have extended over tens of thousands of square kilometres – far larger than any of the recent catastrophic bushfires of south-eastern Australia.

Outback fires may not only be large, but they may also be very frequent. This is especially true in monsoonal northern Australia, where the extreme annual seasonality dictates a pattern of rapid growth of vegetation, particularly tall annual grasses, in the wet season, with this understorey vegetation then becoming tinder-dry during the following dry season.

In these Australian tropical savannas, the same piece of land may now be burnt every year. More typical regimes result in any area being exposed to three to five fires per decade, or – to describe the regime in a different manner – for 30 to 50 per cent of land area to be burnt each year.

In lower-rainfall areas, vegetation (and hence fuel) growth is far slower, so intervals between fires are accordingly much longer – typically up to several decades in some environments. Nonetheless, even in arid and semi-arid regions, years of plentiful rainfall will stimulate extensive vegetation growth, with much of this unusually high plant biomass drying off when dry times return, leading to predictable periods of extensive and relatively high-intensity fires.

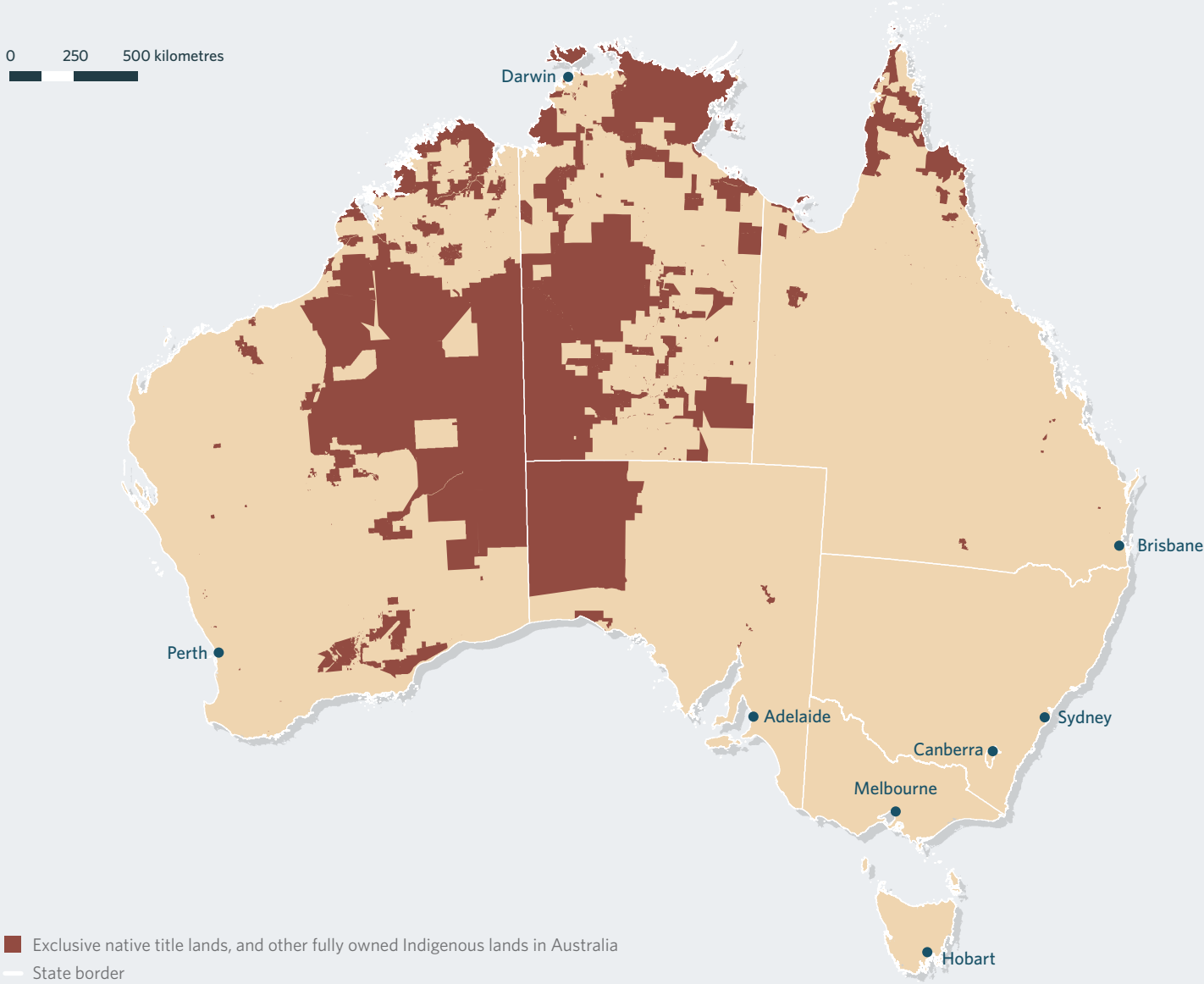
On pastoral properties with high stocking rates, the current occurrence of fire may be low, because livestock consume much of the ground-layer vegetation (reducing fire fuel loads and hence the likelihood and spread of fire), and because many pastoralists actively manage their land to avoid fire because it may destroy infrastructure and reduce food resources for their stock.

Across almost all areas of the Outback, fire is a fact of life, a caprice of nature, a nuisance, an agent of destruction, a cultural practice, a useful tool and a means of revitalising land.

Given the damaging potential of fire, as well as its usefulness for reinvigorating country, what fire regimes are best for Outback lands? The first part of an answer to this complex question is that a managed fire regime is likely to be better than an unmanaged one.

As the accounts by Tony Cockburn (p. 50) and Les Schultz and David Graham (p. 84) attest, fire regimes can be manipulated. Such manipulation is more about the practice of proactive use of fire than it is about the reaction to unplanned fires. But fire management needs to be done strategically, with careful consideration of the objectives.

Figure 3
Indigenous Freehold Lands in Australia



Note: Fully owned Aboriginal lands in New South Wales, Victoria and Tasmania were not mapped due to lack of data availability in New South Wales and difficulty of showing the small reserves in Victoria and Tasmania on a national map. Such Aboriginal lands in these states represent less than 1 per cent of total area.

Source: National Native Title Tribunal, Department of Aboriginal Affairs WA and Department of Lands, Planning and the Environment NT. See the appendix for more details.

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In most Outback settings, the outcomes desired from deliberate fire management include:

- protecting infrastructure from uncontrollable fire;
- protecting culturally significant sites from uncontrollable fire;
- contributing to greenhouse gas abatement by reducing the incidence of extensive uncontrollable fire;
- protecting fire-sensitive ecological communities (such as rainforests, heathlands and mulga woodlands) from uncontrollable fire, with such protection not necessarily always aimed at exclusion of fire, but rather ensuring that where fires occur, they occur at intervals that allow those communities to attain maturity;
- creating firebreaks (burnt areas with relatively low fuel loads) to reduce the likelihood of extensive spread of subsequent uncontrolled fires;
- creating post-fire 'green-pick' (lush new plant growth) or other suitable habitat for desired plant and animal species (including livestock, some 'bush-tucker' plants or animals, or particular threatened species) that responded positively to recent fires;
- crafting a more variable environment that may be more likely to maintain or increase local-scale diversity;
- helping to control weeds or feral animals;
- increasing accessibility (it is usually much easier to traverse burnt country); and

- contributing to productivity and reducing risks of loss of productive soil through erosion after extensive uncontrolled fire.

One fire regime may not necessarily meet all of these objectives, and the best fire management approach to meet some objectives may be unsuitable for others. Furthermore, marked variation in climate and vegetation means that there is no single optimal fire regime across the varied environments of the Outback.

As described in Insights 2 and 3 (on pp. 17 and 18, respectively), in many Outback regions, the fire regime that best achieves conservation (and many other) objectives is one of carefully considered and tended small fires that collectively create a fine-grain mosaic of burnt and unburnt areas, or of patches that differ in time since the last fire.

Such intricate fire management should also seek to craft natural firebreaks around environments that are sensitive to fire. Unsurprisingly, such a regime is comparable to that used in traditional Indigenous fire management, and returning to such a management approach is now leading to the recovery of many previously degraded environments and declining species.

Many Indigenous landowners and conservation managers are working together to manage fires to achieve cultural and conservation goals in areas as far afield as Cape York Peninsula (see p. 53) and south-western Australia (p. 87). This work will provide a robust foundation for resolving many of the Outback's environmental, enterprise and social challenges.



Controlled burns create patchworks of burnt and unburnt areas.

Insight 2

The art of fire

For millennia, Aboriginal people have carefully used fire to manage their country.

Fire was used for many purposes, but traditional fire management usually created a fine-scale mosaic of small patches of burnt and unburnt lands, or of small patches of different ages since the last fire.

Such a patchwork provides landscape variety and offers a broad spectrum of habitats that may maximise an area's suitability to the highest possible number of plant and animal species. 'Breaking up' the country also helps to protect it from large, extensive, uncontrollable and more destructive fires.



Flames colour the evening sky in Kakadu National Park.

For various reasons, European settlement led to the collapse of such intricate and purposeful fire management across much of the Outback. And with that loss, fires became unmanaged and markedly different in character and began causing far more damage to vegetation, wildlife and other values.

One of the starkest indicators of this change has been revealed by interpreting historical aerial photography and imagery of the Great Sandy Desert and Little Sandy Desert in Outback Western Australia. Aboriginal people moved off most of their lands there in the 1950s. Imagery from 1953, just before the loss of this traditional management, showed landscape scars (signs of recent fire) appearing as 846 patches with an average size of 64 hectares across a desert area of about a quarter of a million hectares.

Comparable analysis for 1981 showed just four burnt areas, the average size of which was 52,000 hectares. In this 'abandoned' state, far more of the country was being burnt, with fires that were more extensive and of far higher intensity (Burrows *et al.* 2000; Burrows *et al.* 2006).

The Martu people (Traditional Owners) returned to actively manage this country during the mid-1980s and have restored the intricate burning pattern, so the country again is characterised by small and controlled fires that have been purposely lit (Bliege Bird *et al.* 2012; Bliege Bird *et al.* 2013).

The evidence suggests that since this return to careful fire management, some wildlife species have shown signs of recovery (Bird *et al.* 2003; Bliege Bird *et al.* 2013).

Comparable examples exist across many regions of the Outback. In a few cases, the traditional Indigenous fire management has continued uninterrupted (Yibarbuk *et al.* 2001). Other cases are similar to that of the Martu, with a return to country and an attempt to reinstitute skilful controlled fire management.

Other areas of the country have remained without any effective fire management, and large uncontrollable fires are common there (Yates *et al.* 2009; Russell-Smith *et al.* 2010).

Insight 3

Indirect cat control

Feral cats are a major threat to native wildlife and are notoriously difficult to control effectively.

Extensive baiting may kill many cats (and possibly other animals), but it is expensive, needs to be undertaken repeatedly, and requires licences and some specialised skills. It also may present some animal welfare issues.

Researchers and land managers are working on ways to reduce the damage from feral cats. One promising management option is the manipulation of fire regimes.

Fires that are extensive and of relatively high intensity tend to remove all ground-layer vegetation and fallen logs. This leaves little or no shelter for native mammals such as bandicoots, native rats and mice, small wallabies, quolls and some possums, rendering them more prone to predation.

Also, because most of the ground vegetation has been burnt, native mammals that survive fire probably have to spend more time and take more risks looking for food, leaving them even more vulnerable to predation. Cats prefer to hunt in open areas, where they are more effective (McGregor *et al.* 2015).

Recent studies in the Kimberley have used radio collars on cats to show that they may travel up to 12 kilometres in order to focus their hunting effort in recently burnt areas. Multiple cats were recorded making similar journeys, meaning that many cats may congregate in extensively burnt areas (Leahy 2013; McGregor *et al.* 2015).

Hence, extensively burnt areas become predation traps for some wildlife, with predators (notably feral cats) effectively mopping up ground-dwelling wildlife that survive the fire. These studies have demonstrated that few native mammals are directly killed by fire.

The rate of decline for native mammals is far lower in unburnt areas or in areas subject to patchy fire of relatively low intensity (Leahy 2013).



Controlling feral cats is an ongoing task at Arkaroola.

So predation impact is likely to be less – and therefore wildlife is more likely to be maintained – in areas with little or no fire, or in areas with a regime of fine-scale patchy burning, than in areas subject to extensive and high-intensity fire.

Recent studies suggest that a similar effect may also occur where relatively high densities of livestock (farmed or feral) remove much of the ground-layer vegetation, leaving native ground-dwelling wildlife more susceptible to predation (Legge *et al.* 2011; McGregor *et al.* 2014; McGregor *et al.* 2015). So predation impacts are likely to be less, and native mammal survival better, in areas with lower stocking pressures.

One other indirect means of reducing predation pressure on some native wildlife involves the manipulation of top-order predators. Many recent studies in the arid and semi-arid Outback have found that in areas where dingoes have been controlled (or excluded), foxes are more abundant, with net higher losses of many native wildlife species (Dickman *et al.* 2009; Letnic *et al.* 2009; Letnic and Koch 2010).

Continued on next page.

Dingoes kill or exclude foxes, and foxes tend to exert more predation pressure on many wildlife species, so more dingoes equate to more wildlife. In higher-rainfall areas of the Outback (notably northern Australia, where there are no foxes), the evidence so far is less substantial for the relationship between dingoes and feral cats, but some evidence suggests a comparable pattern (Wallach *et al.* 2010).

These management approaches do not lead to the eradication of feral cats. Indeed, no such eradication method is currently available in extensive mainland areas. However, they do provide some mechanisms that can reduce the effects of feral cats and better allow the persistence of native wildlife.

With the likelihood of a drier and hotter future for much of the Outback, water use and availability will become even more of a touchstone issue.

2.6 Water management

Australian poet Dorothea Mackellar got the feel of the Outback right – it is more than cliché that this is “a sunburnt country, a land of sweeping plains, of ragged mountain ranges, of droughts and flooding rains”. Nature can be capricious in the Outback, and climatic extremes are a defining feature of, and fundamental challenge for life in, much of the Outback.

Water is precious for all enterprises and for those living and working in the Outback. This is most strikingly illustrated in the account of Les Schultz in the dry Ngadju country of the Great Western Woodlands (see p. 84), where survival depended upon intricate knowledge of the location of individual trees whose hollows stored water, and of carefully nurtured rock holes.

The centrality of water appears in many other accounts here, including that of pastoralists such as the Bell family (p. 136). Several accounts also express concern about water security and the potential for regional-scale decline in water sources because of the intensification of extraction by other users.

With the likelihood of a drier and hotter future for much of the Outback, water use and availability will become even more of a touchstone issue, and emblematic of the need to understand and carefully nurture the life-giving resources of this land.

We cannot live sustainably in this land without such knowledge and thoughtful management.

2.7 Grazing management

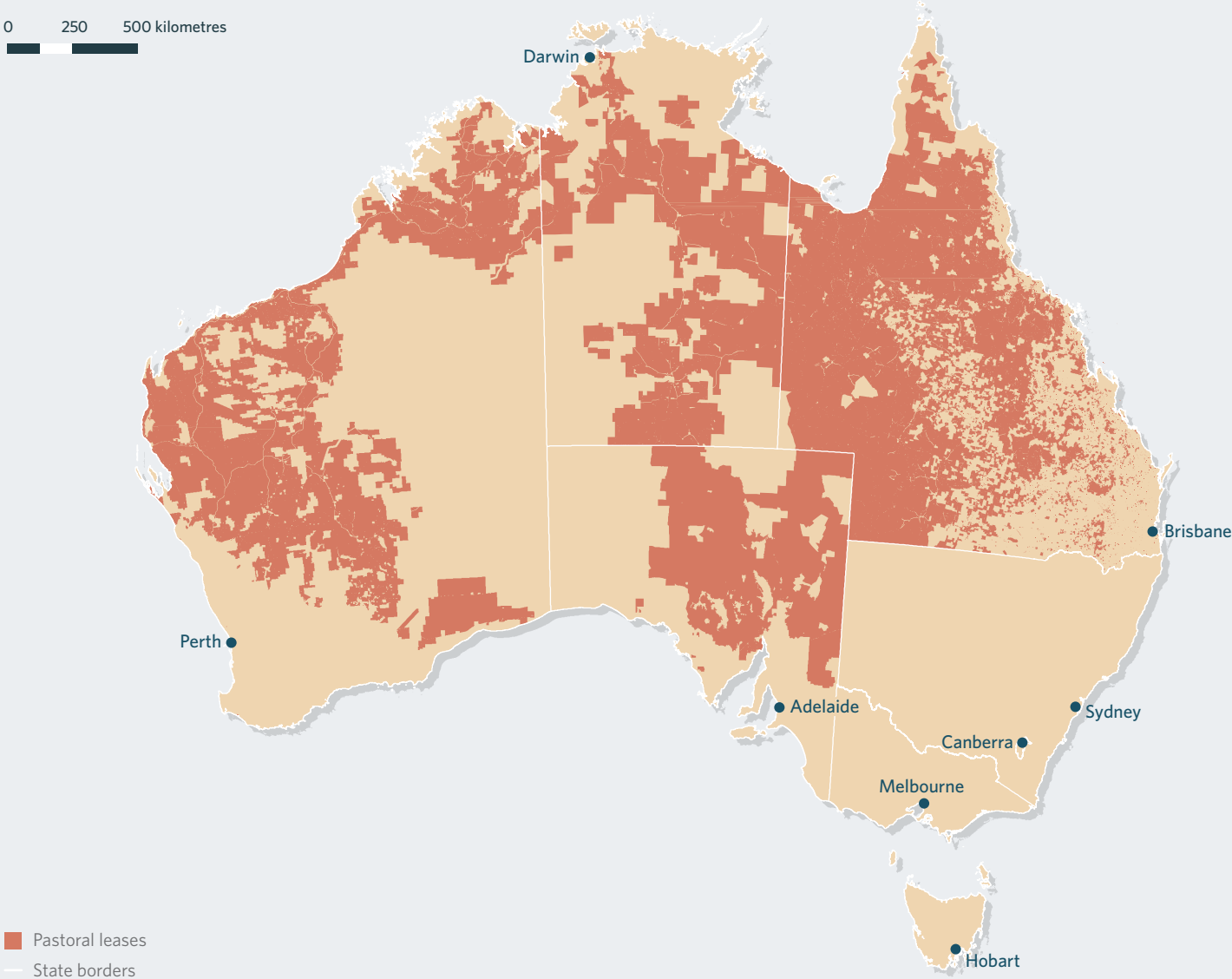
Pastoralism (mainly for cattle and sheep, but also goats in some areas) is the primary land use across about 40 per cent of the Outback. Given this extent, the long-term future of nature in the Outback is contingent on the management of pastoral lands, and the collaboration of pastoralists in management campaigns for feral animals, weeds and fire that transcend property boundaries.



Ann Ballinger cleans a water trough at Stockholm Station.

Figure 4
Pastoral Leases in Outback Australia

0 250 500 kilometres



■ Pastoral leases
— State borders

Note: Pastoral leases are not shown for New South Wales, Victoria and Tasmania.

Sources: State government departments. See the appendix for details.

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Dulkaninna Station and nearby cattle properties are fully organic accredited (top). Matt Lord revegetates the Century Mine in north Queensland (bottom).

As demonstrated in the profiles of Michael Clinch (p. 40) and the Bell family (p. 136), many pastoralists are good environmental managers, regard sustainability as the foundation of their enterprise, have a remarkable and enduring affinity and feel for their country and tend it carefully through substantial investment and expert management of feral animals, weeds and fire.

But this does not mean that all pastoral activity is environmentally benign. The extent to which pastoral managers have a net beneficial or detrimental effect on nature varies, depending on:

- how much they seek to modify their country through manipulative actions;
- the stocking rates and regimes they set relative to levels that are thought to ensure long-term environmental sustainability;
- the extent to which they leave some ungrazed or lightly grazed areas on their properties that provide refuge for native plants and animals that can't tolerate grazing;
- whether their operations are focused on short-term economic outputs or long-term sustainability;
- the extent to which they engage in strategic management of weeds, feral animals and fire for objectives that relate to outcomes additional to pastoralism;
- their ability to know, see and respond appropriately to the condition and capability of their country; and
- their resourcing and other capacity.

Furthermore, these characteristics may be substantially influenced by government legislation and policy, particularly the extent to which such regulation imposes a 'duty of care' on pastoral managers to maintain the environmental condition of their lands, or offers resourcing opportunities for environmental stewardship actions over and above management actions related to pastoral productivity alone.

Concern about maintaining the health of country under pastoral production is important, because good and sustainable management renders that country more resilient to the inevitable cycles of extreme weather, provides for long-term sustainability and protects a wide range of natural and cultural values. Well-considered sustainable management may also result in the reward of premium prices for stock production, as described in the account here by the Bell family (p. 136).

2.8 Restoration

Much of the management work – such as controlling feral animals and poisoning weeds – described by those in this book may, on the surface, seem negative and destructive. But these activities result in the repair and recovery of nature, and such replenishment is an affirming reward for effort.

Accounts here by Michael Clinch (in previously overgrazed lands, p. 40) and Matt Lord (restoration after mining, p. 96) describe the gradual recovery of nature through careful restoration activity.

Restoring degraded country and waterways is necessary in some Outback sites. Increasingly, the licence to operate mines or other resource extraction industries requires companies to restore disturbed landscapes to a vegetation structure, with composition and functionality approaching that of the natural state.



Felicity L'Hotellier protects and monitors endangered bettongs at Scotia Sanctuary.

In recent decades, the state of such restoration ecology in the Outback has advanced greatly, as evident in the account by Matt Lord for Century Mine (p. 96). Whereas previously introduced plants (and in many cases,

weedy introduced plants) were often the principal means for revegetation, now rehabilitation efforts are based on detailed knowledge of the ecology and use of native plants, and most restoration is closely monitored to try to ensure ecosystem recovery, including its functionality.

Probably the most exciting example of restoration is that of translocation, whereby long-lost native plant and animal species are being carefully and lovingly brought back to lands they formerly inhabited.

However, there are still many examples in the Outback of unrehabilitated lands left as a legacy of mining operations, as mentioned here by David Graham (p. 84) when referencing mining's imprint on Ngadju country.

Restoration is also required to return productivity to overgrazed and degraded pastoral lands. The techniques used and their success rates vary, depending upon the intensity and extent of degradation and the use of the restored land.

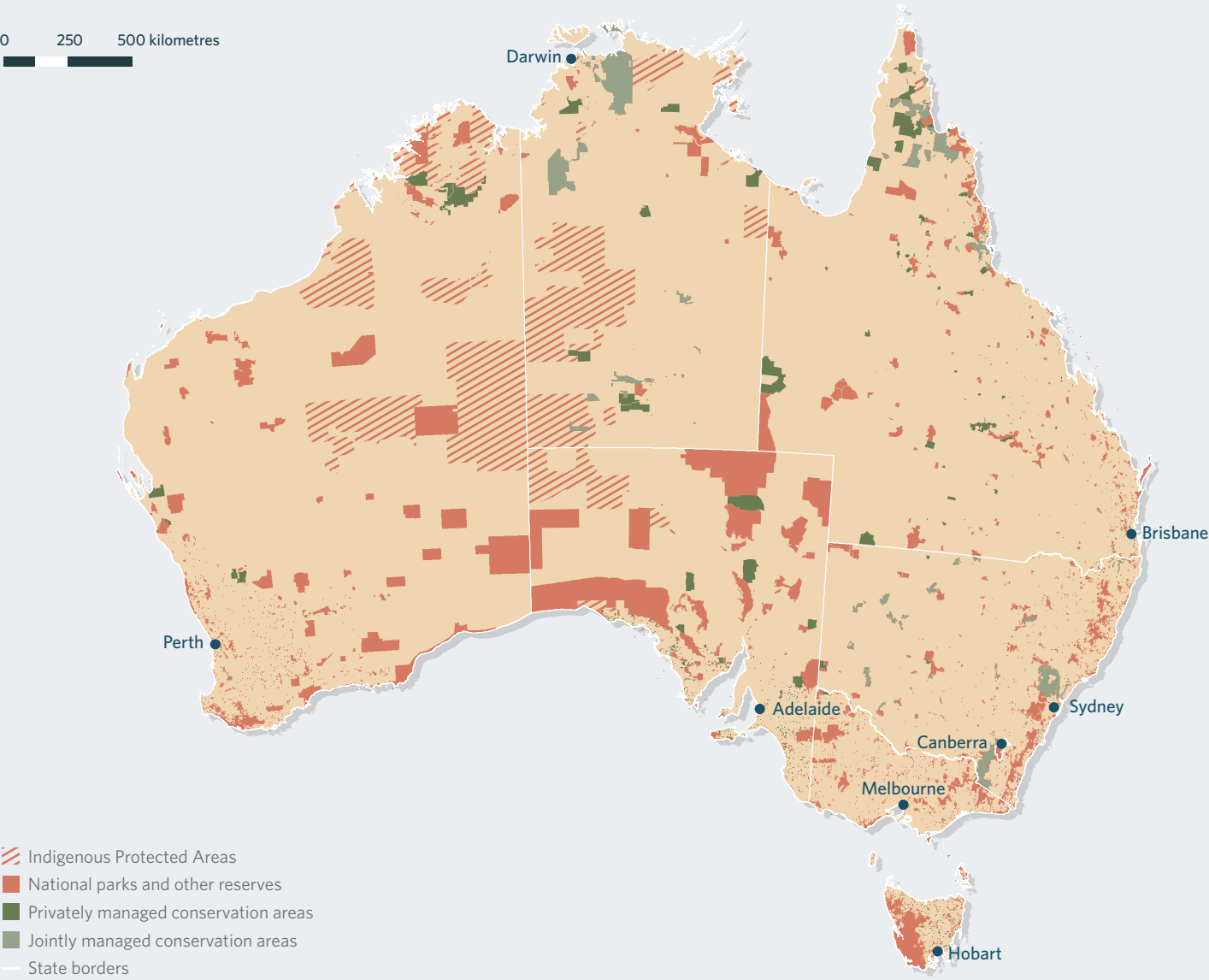
As evidenced in Michael Clinch's account (p. 40), these restoration actions include spelling the land from grazing, controlling feral herbivores, physically manipulating land or waterways to reduce the likelihood of erosion, carefully managing fire and reintroducing selected native plant species.

Probably the most exciting example of restoration is that of translocation, whereby long-lost native plant and animal species are being carefully and lovingly brought back to lands they formerly inhabited. This is a particularly critical component in the Outback's conservation landscape, because so many formerly widespread wildlife species suffered extraordinarily extensive declines.

There are several examples of reintroductions for threatened plant species in the Outback, particularly in Western Australia. But the most successful examples to date are a range of threatened mammal species being returned to their former haunts, albeit typically to sites where introduced predators have been excluded (by fencing) or otherwise intensively managed.

The account of Felicity L'Hotellier (p. 62) describes such a site at Scotia Sanctuary in western New South Wales, managed by the Australian Wildlife Conservancy. In such carefully managed areas, native mammals now prosper and their populations have built up to densities not seen for more than 100 years. These mammals are once again performing the vital ecological roles the country had long lost, such as dispersing seeds and turning over soil.

Figure 5
Indigenous Protected Areas and Government and Private Conservation Reserves in Australia



Note: Only terrestrial IPAs are shown.

Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.

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Kerry Trapnell



Kerry Trapnell

The Clinch family sees a long-term future in sustainable grazing (top). Dustin Clinch enjoys life at Nallan Station (bottom right). Tourists enjoy stunning scenery and wildlife in Kakadu National Park (bottom left).

These sites offer a vision of the Outback in a healthy and diverse state, as it was before the multiple changes introduced with European settlement. Although the area constitutes only a minute proportion of Outback lands, there is a growing number of such sites in the Outback, with an increasing variety and population of restored native mammals.

Furthermore, these reintroductions have now been embraced by diverse landholders and other groups, including state agencies, Indigenous Rangers, community groups and several non-government conservation organisations. In some cases, the reintroduction programs have been financially supported by mining companies or other major Outback enterprises. This is land being nurtured and replenished – with remarkable success.

2.9 Showcasing country

One other important aspect of management considered in this book involves tourism. In the Outback, tourism is an important industry, and one of the main opportunities for employment. This is evidenced in Marg and Doug Sprigg’s account of Arkaroola Wilderness Sanctuary (p. 110), an enterprise where tourism is the main component, and in the description by the Bell family of Dulkaninna (p. 136) of diversification on pastoral lands.

Domestic and international tourists come mainly to see wild nature and vast natural landscapes and to experience Aboriginal culture. Most rely on guides who know and love their lands and can communicate about its value, complexity and challenges.

We only scratch the surface in this book, but these interpreters of the Outback come in many forms, including private commercial tourist operators, rangers in national parks and Indigenous Rangers or tourism ventures on Aboriginal lands.

Increasingly, tourists are not simply passive voyeurs: many also stay for longer periods as volunteers who contribute to land management programs through government and non-government conservation organisations, as described by Michael Ross for Olkola country (p. 124) and Luke Bayley for Charles Darwin reserve (p. 162). These represent important contributions directly to Outback land management challenges and also help to disseminate understanding and respect for the Outback lands more widely.

2.10 Stories of heritage, hope and change

Establishing a modern Outback that values and respects nature is fundamental to protecting its wildlife and sustaining its people.

The Outback has a range of potential futures. One possible future – a ‘do nothing’ or business-as-usual approach with patchy engagement and little

strategic investment – would risk the continued decline of the Outback, a reduction in its importance to the national economy, an increase in failing communities in many of its regions and a diminishing of its international significance.

There is a different future that instead recognises the extraordinary existing value of the Outback and supports development that adapts to and works within the environmental and other constraints of remote lands.

This approach recognises that the Outback must pay its way and that it is in the national interest to further develop some of its areas but acknowledges that the scale of such efforts needs to be carefully managed. It should, above all else, be a sustainable approach that does not damage the broader ecological health that defines and underpins the area. Such development should also contribute more specifically to local communities and to broader regional land management, providing longer-term security for land management activities to grow and function effectively. Such development should also be rooted firmly in the knowledge and aspirations of those who live in, love and care for these lands. The Outback is distinctly Australian, a national icon, and should be preserved for future generations through sustainability.

For a land with so few occupants, there are many extraordinary people in the Outback. Each one has a story to tell, and lessons from the land to share.

The following 12 profiles showcase the experiences of land managers in the Outback – caretakers who may represent their sectors or regions but are also distinctive voices in their own right. In the Outback, they all make a difference: as innovators, as community leaders and as venerable sources of knowledge and wisdom.

Their stories offer perspectives and insights about what it means to look after this country and what the land means to those who live in and depend on it for their livelihoods and their futures.





3. Case studies

3.1 Looking 'both ways' to honour tradition and care for country

Rarrtjiwuy Melanie Herdman

*Chair, Dhimurru Aboriginal Corporation,
Arnhem Land, Northern Territory*

“ Be firm and strong for the land and the strength of your solidarity will sustain your cause. Our country will exist forever. It must be protected so that it will remain the same, so that it can be seen in the same way that the elders saw it in the past. Our vision and hope is that Yolngu will continue to use our country for all the generations to come.”

– Dhimurru founder, Roy Marika

Dressed in the red of his Dhalwangu clan, their foreheads coated in white ochre, the Yolngu people of Arnhem Land have gathered at the old mission settlement of Yirrkala to honour the passing of their beloved elder, Mr Wunungmurra.

Mr Wunungmurra was just a teenager in 1963 when he became the youngest of 12 Yolngu to sign the famous Yirrkala bark petition, the first traditional document ever recognised by the Australian Parliament.

It was a Yolngu cry for justice, because their ancient land and sea country was about to be divided for bauxite mining; they believed their sacred sites would be desecrated. The petition sought Commonwealth recognition of Yolngu rights to traditional lands on the Northern Territory’s Gove Peninsula. Although it was unsuccessful at the time, the petition laid solid foundations for the Indigenous land rights movement.

Mr Wunungmurra was the last surviving petition signatory until he died in 2015 at 70. The former head of the Northern Land Council – one of the most powerful Indigenous land councils in Australia – was honoured by a state memorial service. He was remembered as a land rights pioneer, a “kind and beautiful man”, and an intelligent and dignified leader of his people.

Northern Territory politician Francis Kurrupuwu said Mr Wunungmurra understood that land and culture underpinned the survival of Aboriginal people, and he “made the rest of Australia sit up and take notice of Aboriginal people and Aboriginal rights”. The federal Indigenous Affairs Minister, Nigel Scullion, also attended the memorial service. He applauded Mr Wunungmurra as a Yolngu hero, saying the bark petition had been a “first shot against the injustice of Aboriginal dispossession”.

Because of leaders like Mr Wunungmurra, Aboriginal people now own about 50 per cent of the Northern Territory landmass and about 85 per cent of its coastline. The Yolngu are once again the official owners of much

of their traditional seas and lands. And with ownership has come the responsibility of management.

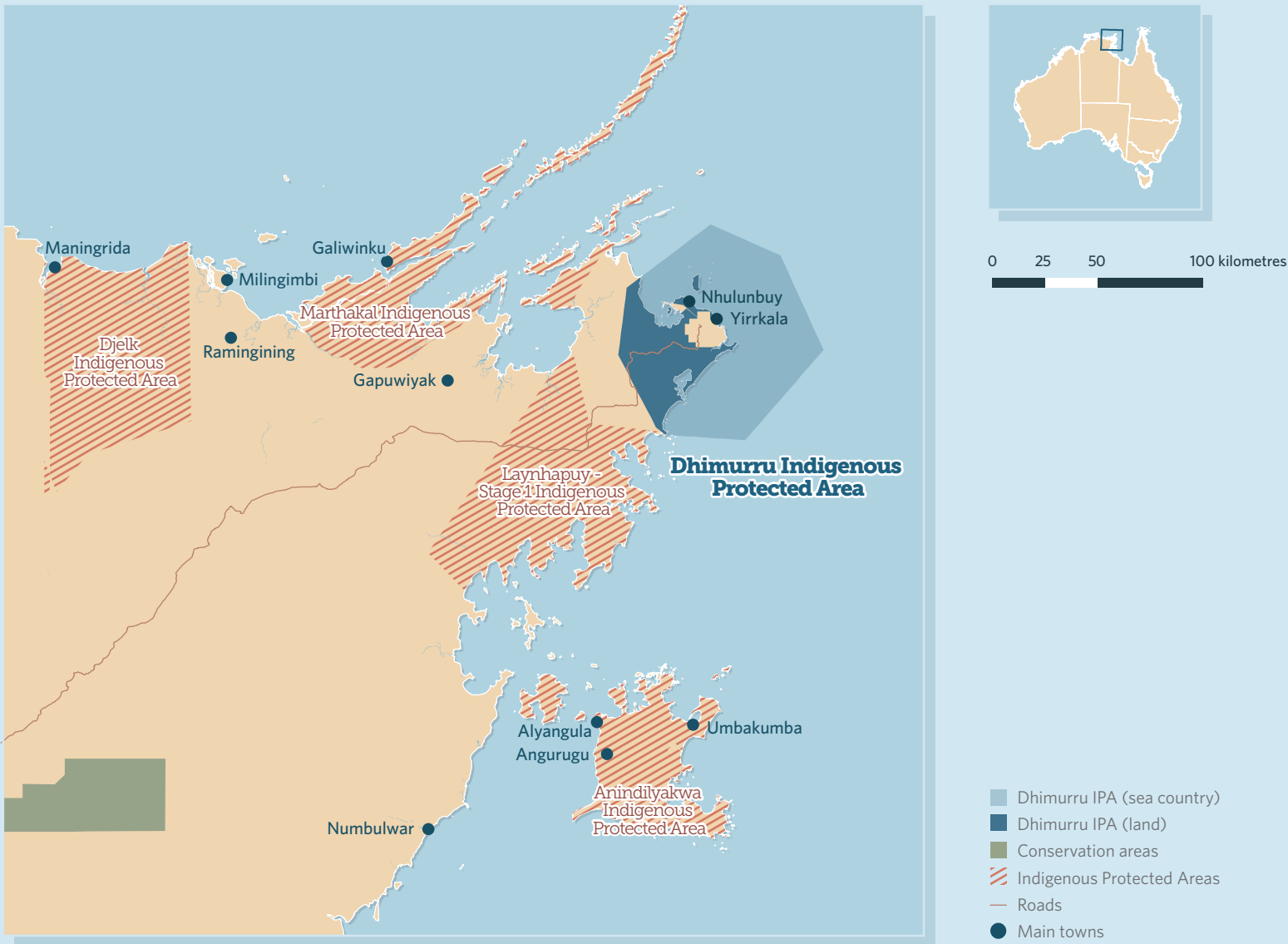
Among the big crowd at Mr Wunungmurra’s memorial service were the people now shouldering that responsibility: board members, rangers and administration staff from the Dhimurru Aboriginal Corporation (Dhimurru).

Saddened by the changes they saw happening to their country, Yolngu elders formed Dhimurru in the early 1990s to manage, care for and protect their traditional land and sea country. The corporation has since grown to become one of Australia’s most successful and respected Indigenous land management bodies.



Palm trees (top) and sand flats (bottom) characterise the bountiful Arnhem Land coast, which has supported the Yolngu people for millennia.

Figure 6
Location of Dhimurru Indigenous Protected Area, Arnhem Land, Northern Territory



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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Speaking for land and people: In 1963, the Yirrkala bark petition, signed by 12 Yolngu, became the first documents to bridge Commonwealth law as it then stood, and the Indigenous laws of the land. The petition was the first traditional documents recognised by the Commonwealth Parliament and, as a result, the documentary recognition of Indigenous people in Australian law.

The Chair of Dhimurru's elected Board, Rarrtjiwuy Melanie Herdman, believes the elders' original vision has been achieved over the past 25 years and that, with the necessary support and resources, the next 25 years can be even more successful. She wants political powerbrokers "to see what we're doing here, how we're managing the land and why we're doing it".

"They need to understand our connection to this land and sea," Herdman says. "And if we're going to move forward, they need to support us in looking after this land, because if they don't support us, we're not going to be able to maintain this land.

"Our elders had the vision of making sure that this land they once lived off would stay exactly the same for us as it was for them, and we also want that for our kids and the next generations," she says.

The 27-year-old mother of two, from the Galpu clan, works in human resources at the local Aboriginal health service. She previously worked at Dhimurru as a permits officer. When not working, Herdman likes being with her partner and their children, hunting, painting and learning from elders – enjoying life, the land and the sea in this remote coastal community.

This is saltwater country, where the Outback meets Australia's northern shoreline, where the red dirt of north-east Arnhem Land meets the sparkling blue waters of the Arafura Sea. To understand how rich and diverse this country is, you need only to walk a few minutes from the heart of the main population centre, Nhulunbuy, past the crocodile warning signs, to experience the stunning Gaynguru paperbark wetland.

It's alive with ducks, sea eagles, brolgas, magpie geese, jabirus, ospreys, herons, egrets, kites and cormorants. Beside the lagoon, a huge metal trap baited with fish is a reminder that the croc warning signs are deadly serious. The Yolngu would once feast here along the shore on birds and fish, using the bark of the trees to wrap their catch for cooking.

This wetland is part of the territory that makes up the Dhimurru Indigenous Protected Area (Dhimurru IPA), which was first declared in 2000 and has since been greatly expanded in size. It now covers about 550,000 hectares of the Yolngu land (100,000 hectares) and sea country (450,000 hectares), with the boundary extending to waters up to 40 kilometres from the coastline.



Paperbark wetlands are one of many diverse ecosystems in the Dhimurru Indigenous Protected Area.

Dhimurru was the first IPA in the Northern Territory and the first in Australia to include both terrestrial and marine areas. The Yolngu's dreaming stories recount events dating back to the last Ice Age, when much of that sea country was dry land.

There are now over 70 IPAs across Australia, collectively accounting for over 40 per cent of the land managed for conservation purposes in the National Reserve System. Because of its success, many other IPAs have looked to Dhimurru as the model on which to base their own Indigenous Ranger programs.

Dhimurru rangers are fortunate to manage an area notable for being so intact environmentally, compared with much of the rest of Australia. The Dhimurru IPA contains five sites with natural values that placed them on the Register of the National Estate. It's home to at least 18 threatened species, six of the world's seven marine turtle species (four of them nest here), 54 migratory bird species, dugongs (*yinytjapana* in the Yolngu language), snubfin dolphins (*buku yolngu*), saltwater crocodiles (*baru*) and the Gove crow butterfly (*bonba*). It contains rainforest, mangroves and savanna woodlands. There are 35 mammal species but, as in much of the rest of northern Australia, the numbers of many small mammals are declining.

A constant theme in the eulogies delivered at Mr Wunungmurra's memorial service was that he was a passionate champion of a philosophy referred to as 'both ways': taking the best of the *ngapaki* (non-Indigenous) world and the Yolngu world to create the best future possible for the Yolngu people. "He knew how to embrace two worlds," Northern Territory Opposition Leader Michael Gunner said at the service. "That's why he could deliver for Yolngu people."

The 'both ways' philosophy – often referred to as *bala ga lili* in the Yolngu language, which references the tide going one way, then the other – also lies at the heart of the Dhimurru's operations and permeates everything they do. 'Both Ways' is even the name of the news and blog section of the Dhimurru Aboriginal Corporation's website.

"There are two systems that we use," Herdman explains of Dhimurru. "One system is the Yolngu system – our kinship system to land and how we look after our country. And then on the other side we use the tools from the *balanda* world – the western world.

"We use both those systems to work out how we will go forward; how we will look after our land and make sure it's still going to be here for our children.

"If we can continue to work together, it will work, because we Yolngu have our dictionaries, our encyclopedias, our resources here, and the western world's also got theirs. If we bring that knowledge together, we can

maintain this environment just as it was for our elders, and our ancestors before them."



Magpie geese fly in to feed at a shallow wetland.

Putting 'both ways' into action involves engaging in many partnerships to combine Dhimurru's traditional Yolngu knowledge with the additional insights, skills and resources needed to get the job done. Partners include the Northern Land Council; the Australian Border Force; the Australian Department of the Prime Minister and Cabinet; the Northern Territory's fire and rescue, and parks and wildlife services; the Northern Territory Department of Primary Industry and Fisheries; the Northern Territory Seafood Council; Rio Tinto Alcan, and The Pew Charitable Trusts.

Dhimurru's expanded IPA Sea Country Management Plan was launched in 2013, following a declaration that significantly extended Dhimurru's sea country. It embraces the concept of the Yolngu working with government agencies, commercial and recreational fishing bodies and other stakeholders to look after the sea country as a 'Collaborative Management Zone' incorporated into the Dhimurru IPA.

Together with Australia's leading science research organisation, the CSIRO, Dhimurru is working on a biodiversity monitoring program to assess the impact of fires. Twenty-six long-term biodiversity monitoring sites have been established within different vegetation types. The project is also looking at Yolngu cultural burning priorities and promoting increased community participation in Dhimurru fire management for biodiversity conservation benefits.

The 'both ways' philosophy: taking the best of the *ngapaki* (non-Indigenous) world and the Yolngu world to create the best future possible for the Yolngu people.

Other research partnerships with universities and government agencies have looked at seagrass monitoring and mapping, biosecurity, biodiversity surveys, northern quoll relocation, control of yellow crazy ant infestations, Gove crow butterfly management and cultural seascape mapping. In a project funded by the Australian Marine Mammal Centre, Dhimurru is working with James Cook University to get a better idea of the numbers and distribution of inshore populations of dugongs and dolphins.

At Dhimurru, the 'both ways' philosophy also applies to cultural background and gender. The organisation employs around two dozen Indigenous and *balanda* (white) staff members and aims to have a 50-50 split of male and female rangers.

Herdman wants the organisation to continue to grow, with more people and better equipment. She says people see the success of Dhimurru and want it to do more. "I think if our elders were still here, they would be

saying we need to grow," she says, adding that she's certain this can be achieved by applying the 'both ways' approach.

Dhimurru works hard to get the resources it needs to manage this growth. Fees from permits to visit the IPA are one important source of income. The need to have a permit is now widely accepted by the non-Indigenous community of Arnhem Land, particularly in light of the quality of land and sea management work being done by Dhimurru. But since the suspension of operations at Rio Tinto Alcan's Gove alumina refinery in mid-2014, the local population has ebbed, putting a dent in Dhimurru's finances.

In 2013, Dhimurru signed a memorandum of understanding with Rio Tinto Alcan Gove, which operates the mine and the now-dormant alumina refinery, seeking to improve their mutual collaboration in research, data sharing and capacity building. Dhimurru has also invited Rio Tinto Alcan to consider having its mining leases incorporated into the IPA.

Inclusion of Rio Tinto Alcan's massive bauxite mine complex in the IPA is the biggest expansion option in Dhimurru's 2015-2022 management plan. Herdman says the mine has another 20-odd years of forecast life and will become Yolngu land again eventually, so she would like to see Dhimurru start to manage it now with extra funding from the mining company to work on its rehabilitation "rather than waiting until they pack up and go".

The 'both ways' philosophy also presents many challenges for Dhimurru, Herdman explains. Human resources management is one of them. In addition to holiday leave, the Indigenous staff members receive up to two weeks of 'ceremony leave' to help them fulfil cultural obligations. However, even with this extra allowance, getting satisfactory work attendance can be difficult, although there are definite signs of improvement. "Most of our current team has improved their attendance and give 100 per cent towards work," she says.

And they certainly have their work cut out for them.

The whiteboard in Dhimurru's bustling meeting area is crammed with jobs to do that paint a picture of the organisation's varied roles: marine debris survey at Wanuwuy, prep for Bremer Island coffee bush control trip, major clean for toilets, field trip with Northern Land Council to Crystal Springs, fire workshop presentation, prep for beach volleyball event, weed chemical refresher course, fix up Middle Beach walkway, concrete fence at Banambarnga, Gove crow butterfly survey, weld quad bike trailer, replace barbecue at Manangaymi, fix the sign at Perkins boat ramp, clean vehicles, empty bins, mulching and weekend patrol to check permits.

Dhimurru also plays an important role in helping to reinforce cultural practices and protocols that support the sustainable management of natural resources for, and by, Yolngu. One example is making sure any hunting of marine turtles by Traditional Owners takes place with



Kerry Trapnell

Lighting small, low-intensity fires can help prevent large wildfires.



Kerry Trapnell



Kerry Trapnell

Indigenous Rangers Georgina Gellett and Rakrakpuy Marika use new technology to map abandoned fishing nets (top). Dhimurru Ranger Anthony Crafter sprays invasive weeds to keep his country healthy (bottom).

appropriate cultural permission and uses only traditional hunting techniques. Traditional Owners have also established their own conservation areas where they have agreed to not hunt turtles.

This role involves providing ongoing community education, which is a major focus for Dhimurru. The rangers and other staff work closely with local schools to educate children about the way Yolngu people live on and care for their country. “We teach them about the seasons, what we do, what we hunt, when we do burn-offs, those sorts of things,” Herdman explains.

Getting a job with Dhimurru is now highly valued among the Yolngu people, and many local kids want to join the rangers for work experience.

Getting a job with Dhimurru is now highly valued among the Yolngu people, and many local kids want to join the rangers for work experience. They want to protect their country and share it with others by erecting fences to preserve sand dunes, building walking tracks to cultural sites, controlling feral animals, spraying weeds and conducting strategic burns. Yolngu people are proud to be working on country and caring for country.

In 2013, Dhimurru and the Yirrkala School began the Learning on Country program. Its aim is to make school more engaging for students by using Yolngu knowledge, the rangers, and their management of land and sea as an inspiration and a resource for literacy, numeracy and science study. According to Dhimurru, the program is improving school attendance and students’ readiness for work while also preparing the next generation of Yolngu landowners for the task of caring for their internationally significant estates.

At the start of the dry season, around April, the south-easterly ‘*dhimurru winds*’ start to blow across the coastal waters onto Yolngu country, replacing the monsoon trade winds from the north west. The arrival of these winds marks the return of the ‘ghost nets’ – nylon fishing nets abandoned to the oceans. This is the time of year when Dhimurru rangers find the greatest number of turtles washed ashore, dead or dying after becoming entangled in the nets.

Dhimurru ranger Gatha Mununggurr says: “That wind, it brings in those ghost nets that come in from Indonesia and wherever they come from. We sing that east wind. It’s also the time that turtles come for nesting, with this east wind.

“Ghost nets are fishing nets that get cut loose, and they don’t sink,” Mununggurr explains. “They float up with the currents, and the reason they’re named ghost nets is because they’re silent killers of our marine animals, including turtles and dolphins.”

For six to eight weeks each year, the insidious nets wash up on the coastline of Yolngu country in big numbers, along with other marine debris. Cleaning this debris from the 230 kilometres of coastline in the Dhimurru operations area is a job that never stops during the dry season. The Dhimurru rangers do such effective work that they helped the Nhulunbuy township win the national Keep Australia Beautiful clean beach award in 2014.

Dhimurru rangers have been clearing ghost nets and untangling marine life from them since 1996. As part of Australia’s longest-running marine debris survey, which began in 2000, volunteers come from all over the country to help collect and sort rubbish washed up along a 3.5-kilometre stretch of Cape Arnhem coastline.

Recruited through Conservation Volunteers Australia, the teams of conscientious beachcombers carefully document everything collected and try to determine the origins of the mass of debris – usually from places such as Indonesia and Thailand.

Some years they collect as much as a tonne of rubbish per kilometre of beach. The 2015 survey included 51 toothbrushes, 610 cigarette lighters, 2051 bottle caps, 120 squid jigs, 307 buoys and floats and 1161 thongs or flip-flops. There were 20 ghost nets, some of them containing the bones of turtles that had been caught up and died in them. While the nets trap many

marine animals, turtles seem to be the worst affected, and Cape Arnhem – Wanuwuy to the Yolngu – is an important turtle-nesting site. It’s also a place of great cultural importance to the Yolngu, dotted with more than 50 sacred sites.

From May to June, when the most ghost nets are blowing in, Dhimurru rangers take to helicopters to spot turtles trapped in nets along the coastline.

The ghost nets program works with the federal and Northern Territory governments and GhostNets Australia, while locally based industries such as Rio Tinto Alcan help fund the visiting teams of volunteers. It’s hard, dirty work for the volunteers, but they love their time with the Dhimurru rangers and keep coming back year after year.

From May to June, when the most ghost nets are blowing in, Dhimurru rangers take to helicopters to spot turtles trapped in nets along the coastline. They found about 30 such turtles in 2015. They stop to release them if they are still alive and record data as part of a research project with scientists from Charles Darwin University.

Together, the rangers and researchers hope to better understand the ghost net phenomenon, track where they’re coming from, and develop ways to prevent them from becoming lost at sea in the first place.



The Cape Arnhem coast is an important breeding area for sea turtles (left). Dhimurru Indigenous Rangers remove washed-up debris to keep the northern beaches clean (right).

The 'both ways' philosophy of Mr Wunungmurra and Dhimurru is nothing new to the Yolngu. Before the arrival of Christian missionaries and then the mining industry, the Yolngu had another landmark event in their history – the arrival of the Macassans. From what is now Indonesia, these voyagers started to appear on the Yolngu coastline in the early 1700s to harvest trepang (sea slugs) and were annual visitors until 1907.

The Yolngu would work for the Macassans and in return acquired new technology that revolutionised their lives: metal fishing hooks, dugout canoes, woven fabrics. The Yolngu language is sprinkled with Macassan words such as *rupiah* (money) and *balanda* (white people).

One of the most incredible cultural sites that Dhimurru manage is Garanhan. There, the Yolngu used stones to produce a picture guide to life with the Macassans. It includes detailed images of the trepang treatment process and the dugout canoes the Macassans brought with them. It also

depicts front and side cross-sections of the Macassan ships showing food storage areas and the crew's and captain's quarters. The Macassans would arrive with the north-west trade winds of the monsoon season and return home when the south-east *dhimurru* winds began to blow.

During the week of Mr Wunungmurra's memorial service, Dhimurru's board of directors took out an ad in the local *Arafura Times* to pay their respects to him. "He was a man of vision and action, and we acknowledge his tireless, outstanding and distinguished leadership in many important areas including the establishment and development of Dhimurru," they said in the ad. "He has been an inspirational mentor and role model to us all."

Though rich in Yolngu culture, Mr Wunungmurra's memorial service was also a deeply Christian affair – yet another celebration of his 'both ways' philosophy. The gathering sang *The Lord Is My Shepherd*, *Amazing Grace* and *How Great Thou Art*.



Saltwater country—where the Outback meets Australia's northern coast.

Breakout 1 *Dhuwa* and *Yirritja* – the dual moieties of the Yolngu



The Dhimurru Aboriginal Corporation logo adorns the Indigenous Rangers' uniforms.

The Yolngu people's relationships with one another and everything around them are intricately calibrated by a complex clan system governed by the separation of everything into one of two fundamental divisions, or moieties: *Dhuwa* and *Yirritja*.

For example, plant and animal species, areas of land and water, spirit beings and every member of the Yolngu community are either *Dhuwa* or *Yirritja*. Within each moiety, people belong to smaller clan groups that have their own languages and cultural traditions. Children belong to the same clan and moiety as their father, and their mother belongs to the other moiety (and another clan).

On the Gove Peninsula and surrounding areas, most Yolngu belong to one of 16 clans, split evenly between each of the two moieties – eight clans being *Dhuwa* and eight being *Yirritja*. The moieties and their associated clans give structure to the highly complex and spiritual connection between the Yolngu and their country, which extends back to what they refer to as 'Wangarr Time' or, as referred to in English, the 'Creation Time' or 'Dreamtime'.

During Wangarr Time, portions of the land and water were bestowed on each clan by Wangarr spirit beings. These sacred and powerful beings created the many features of the landscape and seascape, such as rivers, rocks, islands and trees. They also 'sang'

the names of everything they created or encountered, making those species sacred to the clan on whose land or in whose waters the naming took place. Today, many clans still hold sacred their long-held 'totem' species, such as the water goanna or shark.

As these ancestral creators crisscrossed the surrounding land and sea, breathing life into all living things and naming them and the important places they inhabit, they provided the Yolngu with their names, identity and way of life. They passed on to each clan their unique language; law; cultural traditions such as songs, dances and ceremonies; and creation stories.

This deeply spiritual relationship with one another and everything around them, dating back thousands of years, is why Yolngu clans are not considered to be just 'owning' or 'caring for' the land. Instead, they prefer to say they 'come from' the land or they '*are* the land'.

The badge of the Dhimurru Aboriginal Corporation (Dhimurru) embodies these dual moieties. It depicts the black and white cockatoos found in the area, enclosed in the *Mawuka* (morning glory) vine. The white cockatoo, *Ngerrk*, is from the *Yirritja* moiety, while the black cockatoo, *Natili*, is from the *Dhuwa* moiety. These birds were chosen because of their friendliness and intelligence. They face each other on the badge, emphasising the balance between them and giving the impression of sharing and learning from one another.

The beach vine is also from the *Dhuwa* moiety. It's a coastal plant that flowers as the annual *dhimurru* winds come in from the south east. It's important for judging the season and as a source of food and medicine and is referenced in cultural songs and dance. *Mawuka* also symbolises life, power and beauty and how the two moieties are intricately connected despite the differences between them.

Dhimurru emulates this cross-cultural and cross-clan relationship approach and extends it in its 'both ways' approach, which brings *ngapaki* (non-Indigenous) and Yolngu knowledge together in managing country.

Breakout 2 **A traditional life with a modern twist**



Senior Dhimurru Ranger Gathapura Mununggurr.

Senior Dhimurru ranger Gatha Mununggurr is a young man who appears destined to be a leader of his people. His approach to life epitomises the 'both ways' philosophy.

Mununggurr is a fully initiated Yolngu man and is passionate about his language, his people's songlines, their dances, caring for country, hunting stingrays with a spear and devouring their delicious liver. He also loves playing footy and is following in the footsteps of an acclaimed Yolngu band, Yothu Yindi, with his own band, East Journey, which puts a modern twist on traditional Yolngu song and dance. He's the drummer of the band, which has toured Australia and produced a CD.

Mununggurr has been with Dhimurru for seven years and now has qualifications in conservation and land management, firearms use, four-wheel drive handling, chemical use and firefighting. He's also qualified to act as a Northern Territory fisheries officer and is a Uniform Shipping Laws (USL) coxswain.

Mununggurr says he loves working at Dhimurru because it's an organisation that is "a strong statement from the elders" and provides an opportunity for young Yolngu to step up and adopt the 'both ways' philosophy.





3.2 Reviving a worn-out landscape

Michael Clinch

*Owner and Managing Director,
Nallan Station and Kindillan Pastoral Company*

Henry Lawson once wrote that most men who have been in the bush for any length of time “are more or less mad”. Michael Clinch says that’s what his neighbours in the Western Australian (WA) Outback think of him. Sometimes, when things are tough, he briefly wonders if they might be right.

Clinch is a veteran stockman who has been on bush stations pretty much his whole life. And on Nallan Station, with 100,000 hectares of Outback to play with, why is he running only 100 head of cattle at a time when the prices are sweet and the official carrying capacity is 1100?

“There are days you wonder why you’re doing it,” Clinch says philosophically. In his view, many other pastoralists are simply not walking the walk when it comes to doing what’s best for their land and the Outback as a whole. For Clinch, on the other hand, creating an Outback that’s environmentally as well as economically sustainable has become a guiding passion.

“Locking up our land and leaving it has been proven to not be an option,” he says. “The landscape simply needs controlled grazing to re-establish the future of our rangelands.”

The country around Cue, in mid-west WA, has been changed by more than a century of gold mining and pastoralism. Overgrazing has stripped the more desirable vegetation, compacted the soil, led to erosion and created great crusts of toxic salt across the landscape. The miners have dug holes, spread sterilising mullock heaps and removed vast stands of trees to line their mine shafts and fuel their boilers.

The rocks of the Murchison subregion are some of the oldest on Earth, their age measured in billions of years, and as a consequence, its soils are relatively thin, infertile and fragile. These legacies have left the rangelands ragged and the livestock industry struggling to be profitable.

Clinch declares: “We’ve got to try and stop the bleed. The Murchison is on its knees. It’s been overgrazed and exploited. A lot of people can’t make money because of the state of their land. This is not waste country; it’s just country that’s been wasted. The problem’s been a hundred years in the making.”

Clinch grew up on a remote Outback station where an Aboriginal mentor taught him to not just look but to really see what is going on with country. And what he saw was that he needed to take his land on “a journey of redemption.” It’s a long journey, and trying to revive the health of Nallan Station while also earning a living from it is almost impossible.

The solution to restoring the land’s health is simple, but so many find it hard to implement: Match stocking rates with the needs of the land, and make decisions using evidence-based science, not wishful thinking.

Clinch says Outback pastoralists have to learn to “graze, not erase”. “We must stop the degradation now,” he says. He reckons that in order to keep the landscape healthy, many of the grasses that livestock feed on should remain uneaten.

He constantly assesses how much feed he has, sets critical dates for decisions and makes the hard calls, even if that means selling young livestock with the best genetics in his herd. It’s a case of “sell them before you smell them”, referring to taking action before livestock become too old or die, and it’s a tough decision he has made three times in 16 years rather than praying for rain and holding on against the odds, as others too often do.



Colourful wildflowers bloom in regenerating grazed areas at Nallan Station.

Figure 7
Location of Nallan Station in Western Australia



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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When he did it the first time in 2005, he was angry but told himself: “Michael, you can buy back genetics; you cannot buy back six long years of perennial grass rehabilitation.”

“I finally accepted it,” he says. “I started to sleep a whole lot better. I felt happier, prouder, and I would even laugh. I felt a better person, certainly a better stockman. I know now in my heart that what I did was by far the best stockman-like decision that I have ever made.”

Clinch says the secret to proper management of stocking rates is simply “being honest with yourself” – knowing when you need to destock and doing it instead of holding on in the hope of rain and the feed it creates but that often doesn’t come. “It is better for the landscape and livestock to wish that you hadn’t, rather than to wish that you had,” he adds, explaining that foresight is better than hindsight.

In a paddock near the old shearing shed – a paddock plundered by too many sheep for many decades – Clinch can see signs that he’s on the right track. He has kept livestock out of the paddock since 2006, and shrubs and annual grasses – mulla mulla, cannonballs saltbush, flannel bush, cotton bush, blue bush and native geraniums – have started to come back in the bare patches between the mulga.

Stark and beautiful against the red dirt is parakeelya – a succulent ground cover plant spreading its bulbous tentacles like an Outback octopus. Beneath the mulga, leaf litter is again gathering and composting to provide a seed bank and host little island gardens.

The district’s hardest perennial grass, woolly butt, had all but vanished from Nallan Station when Clinch bought the property in 1999. “If there’s no woolly butt, you’re doomed,” he says. “That’s the toughest grass. If you have woolly butt degradation, it’s all over.”

But even near watering points – the most heavily grazed parts of his property – Clinch is now seeing woolly butt, along with other more desirable perennials, come back, and that gives him a “hallelujah moment”.

“It’s amazing how forgiving this country is,” Clinch says of the comeback. But in many places, the ground is still bare. He stomps his boot into a hard crust of red, naked earth and angrily declares: “We’ve got to do better than this!”

And he’s determined to do it. “We’ve come to a crossroads where it’s either stand up or be taken down. This country has been stripped of its grass-growing energy by overgrazing.”

Clinch has also switched livestock to improve the sustainability of his land. The Murchison has historically been in the wool-growing game, and Nallan was a sheep station, running up to 10,000 merinos in its prime.

But Clinch was certain that cattle were the way to go, because they don’t graze vegetation as severely as sheep. They can also cope better with wild dogs. And this is where Clinch’s fellow pastoralists really question his sanity. He’s a fan of the dingo, the animal that’s “the root of all evil” to every other grazier in the district.



Michael Clinch inspects a grass tiller. Healthy perennial native grasses are the mainstay of grazing operators at Nallan Station.

Clinch believes the dingo, if carefully managed, can coexist with cattle. He says having dingoes around helps the cattle maintain a stronger herding instinct. And it’s an animal that can do far less harm to his business and the environment than the kangaroo, which he accuses of “undesirable grazing” because the pastoral industry has created conditions that allow kangaroos to exist in much higher numbers than they would naturally.

Dingoes can help his business and the landscape by keeping kangaroo numbers in check so there’s less competition for feed, he says. Clinch adds that dingoes also prey on foxes and feral cats, which benefits threatened wildlife. He believes pastoralists can at times wrongly blame wild dogs for many of their problems when it’s their own management practices that can be equally responsible.

“He’s a worthy partner,” Clinch says of the dingo. “Get your stocking rate and feed budget right. Don’t just blame the dingo. Hungry gut disease [Michael’s term for starvation] can kill far more sheep than dingoes have.”

These views have made him unpopular in the Murchison. “We’re pioneers, so you put yourself up in the shooting gallery,” an unrepentant Clinch says. His passion for what others see as “strange ideas” has even led to his dogs being poisoned in retaliation, he says. “You do get ostracised,” he says. And it hurts him.

In another patch of paddock, Clinch shows how 'whoa boys' – simple dirt mounds built across station tracks – have slowed down the water flowing across his landscape and spread it out rather than letting it channel and erode the land. The slow, soaking sheets of water are trapping organic matter and putting moisture and carbon back into his soil.

Clinch hopes that, as the perennial grasses come back, selling carbon credits might earn him some income to help fund further investment in a healthy Outback. He needs more cells fenced off so he can better manage his rotation grazing. He would like to install more whoa boys. He would like to trap more feral goats. He would like to try guard dogs watching over his young cattle as an alternative to baiting, trapping and fencing out dingoes.

We could turn it around in a lifetime. It took 100 years to do this damage. At the rate we're going, it's going to take at least that long to turn it around.

But those things are just dreams, Clinch says, unless the people of the Outback develop a partnership with the people of urban Australia to help fund pastoralists as "Outback conservation managers". It's the kind of funding that could enable him to have all three of his sons working on Nallan Station instead of just one. With manpower like that, he says, "we could turn it around in a lifetime. It took 100 years to do this damage. At the rate we're going, it's going to take at least that long to turn it around".

Clinch would also love to have scientists visit Nallan Station to determine what native animals once lived there, what animals are left and what can be done to better foster native animal biodiversity. He sees the tiny footprints of the native wildlife that has survived and says: "Those little critters are crying out, 'Help me!' I'd love to help them, but I need people to help me do that."

Clinch would like to see partnerships between pastoralists and the Outback mining industry. He imagines miners doing their bit for conservation by carting their overburden onto pastoral lands to build whoa boys instead of just piling it up into mountains on their mine sites.

On another of Nallan's scalded claypans, you can see how a single fallen mulga branch has the power to trap enough surface water, blown top soil and seeds to create a vibrant micro-community of annual grasses and shrubs in its shadow, slowly claiming back the bare earth.

"We're still chasing the pot of gold at the end of the rainbow here, and that's perennial grasses," Clinch says. But then he spots something hidden

among other vegetation: some slender stipa, "a Rolls-Royce of perennials". Clinch can barely contain himself. "This is exciting. This is saying, keep doing what you're doing. This is huge!"

Nallan is a word of Aboriginal origin meaning 'food bowl' or 'good eating', and a visitor to the station's flood plain country can see why that name was so apt. "When we came here, it was mostly a bare piece of ground covered in salt," Clinch says. It had been overgrazed to the point that it was "absolutely ground zero".

Now, thanks to control of grazing and erosion, it resembles an arid rangelands version of the Garden of Eden – carpeted in flowers, grasses, herbs and vines. The air has a sweet nectar perfume. Insects buzz and birds sing. There is "a smorgasbord of food" for his livestock, says a grinning Clinch.

Nallan is a classic Outback station, all corrugated iron, homestead palm trees, red dirt, chutneys, stock whips, saddles, dusty boots, water tanks, windmills, an old shearing shed and a cleared strip for the Flying Doctor to land on. A couple of times each week, a busload of backpackers stops there to enjoy its charms.

They stay a night in the old shearers' quarters and party around an Outback campfire. Clinch also helps manage pastoral operations on neighbouring Peedamulla Station, a lease run by the Ashburton Aboriginal Corporation. However, these extra income streams are not enough to allow Clinch to fully restructure his grazing operation and make it environmentally sustainable.

He and his fellow pastoralists manage 40 per cent of the Outback and need outside help to turn its health around. "The Outback, to me, is the cathedral of Australia," Clinch says. "We're desperate to reclaim the quality and value of the Outback, and to achieve that vision, we need support. We accept that there's a problem and that we're part of that problem; however, we also want to be part of the solution.

"We're not asking for a handout, but by jeez, we're asking for a hand up. We need capital injection; we need assistance to rebuild and restructure our grazing. If we don't do it, who the hell will?"

What does Clinch want to say to his fellow Australians, particularly city dwellers? "Please seek to understand the value of the Outback" is his plea. "Come out and visit us and ask questions and seek to understand. And once we all understand, let's get out there and do what needs to be done.

"We're passionate about the Outback, and we want to share that passion and take anyone that's willing on that journey of rangeland recovery – the Outback recovery, the grass recovery. We need to bring the Outback up front in our minds. Give it a go!"



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

Rustic ironwork is a feature of Outback architecture. Horseshoes spell out 'Nallan' on the station gate (top left). Windmills and water tanks speak to the centrality of water storage in the Outback (top right). Three generations of the Clinch family: Michael with daughter-in-law Christie-Lee and granddaughter Bonnie (middle right). Rusting farm equipment and cooking utensils decorate an outbuilding wall (middle right). Red sand and corrugated-iron outbuildings characterise many an Outback property (bottom right). A fun-loving steer invites tourists to visit Nallan Station (bottom left).

Cue, which lies south of Clinch's property, is a metaphor for the boom-bust cycle that has dominated life in the Murchison region since white settlement. It's a community that enjoys highs or lows depending on the price of wool and gold. And rain, of course. The annual average is 250 millimetres, but the average rarely happens in the Outback.

The discovery of gold caused the town to 'explode' in the 1890s to the extent that its main street was lined with some of the most grandiose civic buildings in the Outback at that time – built to last from local limestone. It also had a railway line and a handsome two-storey Gentleman's Club, which is now the shire headquarters. A young American mining engineer named Herbert Hoover used to drop in at the goldfields there before he became the 31st president of the United States.

Cue once had a population of 10,000, but the population of the entire shire is now in the low hundreds. Most of those grand civic buildings now stand empty.

Clinch says he's trying to show people how to take the 'bust' part of the cycle out of the region. He's optimistic that rejuvenating the rangelands will be its new boom industry, the new gold, the modern equivalent of wool when it was famously 'a pound for a pound'.

He would love to see Cue return to the vibrancy now only visible in the old black-and-white photos on the walls of the shire headquarters. Then, it was a community with brass bands, race meetings and newspapers – and where the Clinches weren't the only family at Catholic service on a Sunday.

"We can't do all the work that's needed out here. We need people with that pioneering spirit to come out here and help us give it a go," he says. He speculates that maybe the federal government needs to recruit an "Outback Green Army".

With their sweet-tasting foliage, the sandalwood and quandong trees of Nallan Station have taken a particular pounding from livestock. Clinch has fenced four of the sandalwoods off to protect them from further degradation and would like to do the same to others and also the quandongs that remain.

Because of the disappearance of native mammals that once helped propagate the sandalwoods by gathering and burying the nuts, there are few seedlings. Clinch would love to find the time to start gathering seeds and burying them across the station. It's yet another job he likes to think a government-funded green army could take on.

As a younger man, Clinch was a champion bull rider on the rodeo circuit. Were the ups and downs of a bucking bull tougher than life on the land, tougher than the environmental change he's trying to engineer?

"The bull was more predictable," he says. Bull riding also taught him the determination to see his task through to the end. "If you're on the back of a bull and you change your mind, you're in trouble."

Update: Michael Clinch has left his management position with Ashburton Aboriginal Corporation and taken up a senior grazing management role with Anangu Pitjantjatjara Yankunytjatjara (APY) Lands on a 103,000-square-kilometre area in north-west South Australia. As a result, the Clinch family has left its beloved Nallan Station.



In good seasons, native grasses release abundant seeds that fall to the ground to promote regeneration in the future (top). The Clinch family sees a long-term future for sustainable grazing in the Outback (bottom).

Breakout 1 **Monitoring long-term progress**

At a monitoring site on Nallan Station, the original photos from 2003 show a patch of land that is bare and salt-encrusted, almost totally denuded of the hardy perennial grasses that should have been there.

Today, the claypan grass and swamp grass are recolonising it. The salt has retreated.

"The recruitment is just huge," pastoralist Michael Clinch says. "It's exciting, especially that this is happening in the driest and hottest decade since they've been recording temperatures and rainfall around here."

The monitoring site paddock is still grazed, but in a way that Clinch calls "crash grazing". The livestock graze it hard for a short period of time, and then it's given a long rest from grazing pressure to fully recover.

As the grasses spread, they further slow the flow of surface water, moistening and softening the soil. They also form a trap for leaf litter and seeds, promoting the fertilisation and germination of more plants.

"Getting perennial grasses growing back between the shrubs, that's what this country really needs," Clinch says.



Michael Clinch assesses native grass recovery at a permanent monitoring site.



Breakout 2 **Stemming the thirst of a dry land**

As the early pastoralists and gold miners quickly discovered, it's hard country around Cue in mid-west Western Australia.

When the goldfields were first established there in the 1890s, prospectors had to walk 10 miles (16 kilometres) north to Milly Soak pushing a wheelbarrow to get water. What they wheeled back to Cue they would sell for two shillings a gallon, which for many was probably more profitable than digging for gold.

Milly Soak sits on Michael Clinch's Nallan Station, and Clinch values water just as highly as those 19th century prospectors did. "I can't afford to lose a drop of it," he says of the highly variable local rains. Without it, his property can't sustain its normal biodiversity.

One legacy of decades of what Clinch considers to be mismanagement of the land is gully erosion. Water that once travelled across his land in slow-moving, quenching sheets now flows instead into narrow, fast-moving channels. Rather than soaking into his soils, this water rushes away, gouging out ever-deeper channels to make the problem even worse the next time it rains.

The landscape is so flat that even the ruts of a station vehicle track can channel water away from vast sections of his property. Right next to where the hooves of livestock have created impressions in the land, plants are dying of thirst.

The same goes for the highway, the water pipeline, the old railway line and the old Perth-Darwin overland telegraph line, all of which have been built across his land. Another example is the old stock route that passes by Milly Soak, where Clinch is unhappy about the rate of vegetation recovery in some areas.

Of features such as the stock route, Clinch says "they're dehydrating the landscape. It's subtle, but it's enough. They're stealing water from the desert."

Much of Clinch's efforts to rehabilitate his worn-out landscape have been aimed at stopping erosion by slowing and spreading water. 'Whoa boys' (earthen humps put across station tracks) and 'brush packing' (bundles of native vegetation laid across erosion channels) are basic engineering solutions he has used to great effect.

But there is so much more that Clinch would like to do if he had the manpower and money. He's happy to fix the problems caused by his livestock and vehicles but reckons the authorities who put the highway and the railway and the stock route across his land should chip in to help solve the erosion problems they have caused, either with money or labour and equipment.





3.3 Managing threats to protect a Cape York jewel

Tony Cockburn

*Ranger in Charge,
Rinyirru (Lakefield) National Park*

From its lily-covered lagoons to its grassland plains studded with towering termite mounds, Lakefield National Park, on Cape York Peninsula Aboriginal Land in far north Queensland, is a stunning part of the Outback and teeming with biodiversity. It's also a living cultural landscape for the Traditional Owners and a mecca for barramundi fishermen, birders and grey nomads.

The 5,370-square-kilometre park – Queensland's second-biggest national park – is now referred to by its Traditional Owner name of Rinyirru.

It costs about \$750,000 a year to run the park, with about \$100,000 of that spent on pig control.

Pigs are the No. 1 feral animal problem in the park for Ranger in Charge Tony Cockburn. "Pigs are very smart and resilient animals," says Cockburn. "If our program was to fall away, pig numbers would be greater than ever in a matter of years."

The park's pig control program, which targets the animals from the air, concentrates on areas with the highest conservation and cultural values, such as Rinyirru's beautiful Blue Lagoon wetland, brimming with crocodiles and bird life. Two bullets are put into every pig, and there is always a flyback to make sure each animal is dead. "We've got to make sure the kill is clean and humane," Cockburn explains.

After these focussed efforts, made possible by extra funding, he is as close as a ranger can come to feeling satisfied with feral pig numbers in the park.

"I'd go as far as to say that the pigs are now at an acceptable level on the wetlands," he says. "You'll never eradicate them, but you can get them down to an acceptable level. It's very obvious that things have changed. Our wetlands are in much better shape; they aren't all ripped up as much as they used to be anymore.

"Swamps before used to look like a D9 [bulldozer] had been through them. Now they're in much better shape," he adds. "You can drive through the park for hours and not see a pig. Five years ago, you could drive for five minutes and see 30."

Another major cost issue is weeds. One troublesome weed is 'grader grass', which is often spread by earth-moving equipment and thrives where the earth has been disturbed by the metal blades. It was accidentally introduced to Australia in contaminated pasture seed from India in the late 1960s.

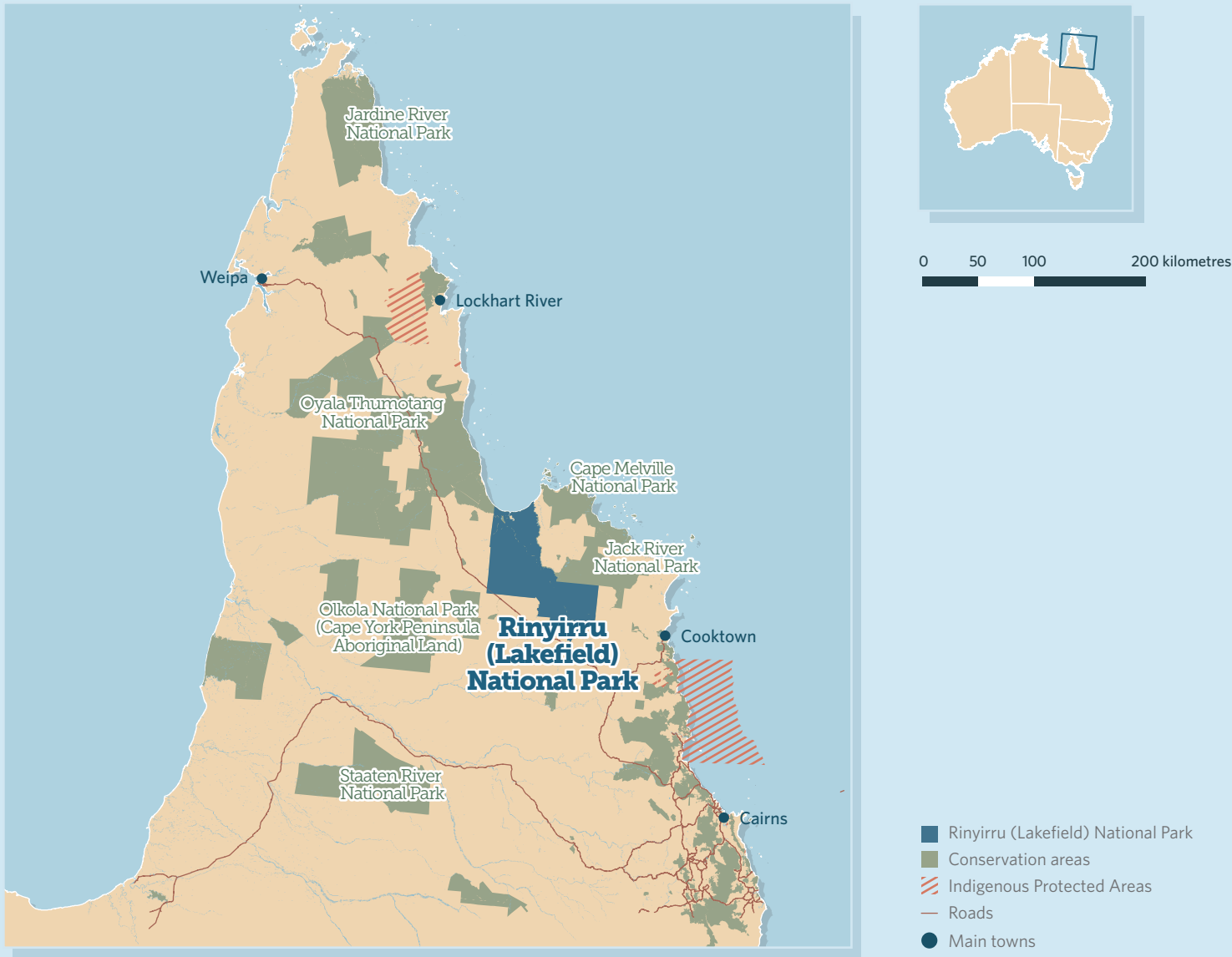
Other vehicles also help spread the grass, and it's now so common along the roads through the park that Cockburn doubts it can be completely eradicated. All graders that come into the park must be hosed down to remove any grass seeds before they can operate. The weed grass not only chokes out all native grasses, but it also changes the fire regime.

"It grows very densely and it burns very, very hot – much more fiercely than native grasses – so it can scorch and change burning patterns," Cockburn explains.



Rinyirru's wide rivers attract both tourists and crocodiles (left). Water-lilies and rushes grow in Rinyirru's shallow wetlands (right).

Figure 8
Location of Rinyirru National Park in North Queensland



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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The weed being treated with even greater urgency is a wetlands plant named olive hymenachne. It's a native of South America that Queensland's Department of Primary Industries encouraged pastoralists to plant as cattle feed as recently as the 1980s. Now declared a Weed of National Significance, it outcompetes native plant species and reduces the habitat available to native wildlife.

An internal Queensland Parks and Wildlife Service report into Rinyirru's olive hymenachne weed problem (QPWS, undated) warns:

"Containment is not a fallback position for this species. There is nothing that can be done to prevent the spread of olive hymenachne once it becomes well established. If this happens the plant will spread to many if not all of the wetlands across the park. It will be impossible to deal with on this scale. The threat posed by this species to the environmental, cultural and social values of the national park should not be underestimated. The initial response to the incursion has been rapid and thorough."

Cockburn believes the weed can be eradicated. If it isn't, the next option would be to try to slow its spread, but this would also involve having to choose which swamps could be saved and sacrificing the rest. Luckily, however, the park's first olive hymenachne infestation was spotted early by an observant ranger at Red Lily Lagoon in 2011.

"We've knocked hymenachne out of several swamps now, and in others it's been reduced to very small patches compared to what it was," he says. "This weed's one you can't go to sleep on; you've got to stay fixed on it. Nothing will stop us getting that weed."

“ There's a lot of helpful overlap between pastoral land management and parks land management.”

– Tony Cockburn

Because of the weed's national significance, the federal government provides funding to tackle olive hymenachne. It is blasted with aerial spraying at the end of each wet season to kill as many plants as possible before they seed in late May and early June (a single seed head can contain 400 seeds). Then the rangers conduct ground-based spraying every six weeks throughout the dry season.

Because olive hymenachne is an aquatic plant, one of the biggest obstacles to controlling it in a place like Lakefield is the presence of crocodiles – the human-eating kind. Rinyirru is home to a greater concentration of the deadly reptiles than any other Queensland park, and some are nearly 5 metres in length.

Cockburn says there is at least one big crocodile living in every one of Rinyirru's permanent waterholes. The rangers emphasise the crocodile threat whenever they speak to tourists. It's a necessary warning, given how often visitors ignore signs warning them not to swim in local waters, fish on the causeways or take their chances in tiny watercraft. A man was killed by a crocodile in the park in 2005 while on his canoe. Another constant is replacing the crocodile warning signs that are repeatedly stolen by visitors to put in their backyard beer gardens.

Cockburn's QPWS shirt can't hide the fact that before he became a ranger 18 years ago, he had a career as a ringer, head stockman and manager on Cape York cattle stations. It's evident in his hat, his boots and the way he talks. He says there's a lot of helpful overlap between pastoral land management and parks land management.

It's a handy pedigree to have when you manage a park that's home to big numbers of cattle – feral and strays – and you have to constantly deal with the owners of eight neighbouring pastoral properties who own a lot of the cattle trespassing in the park. It helps him see things from the cattlemen's perspective. "I can see when they are pulling the wool over my eyes as well," he adds.

Cockburn also previously had his own fencing business – a handy skill when you have a park with fences the length of Rinyirru's. Fencing is a huge part of ranger work on Rinyirru and, thanks to Cockburn's three years as head ranger, the park has a functioning 300-kilometre boundary fence for the first time in its history. It's essential for making the park cattle-free in the near future.

There are also plans to put feral-proof fencing around more of the precious wetlands to protect them from pigs. The fence erected around Red Lily Lagoon in 2003 has been a great success. Internal fencing has also helped with the mustering of cattle from the park.

"It's imperative that we keep the fences up to a high standard," says Cockburn. His team has even developed its own fencing gear to make repairs easier and cheaper.

He believes his cattle industry career gave him the skills to successfully run Rinyirru as a jointly managed park with its Traditional Owners. Rinyirru was handed back into Aboriginal ownership in 2011, through the Rinyirru (Lakefield) Land Trust.

There are eight traditional partners represented on the park's joint management team: the Lama Lama people, Kuku Thaypan people, Bagaarrmugu clan, Mbarimakarranma clan, Muunydyiwarra clan, Magarrmagarrwarra clan, Balnggarrwarra clan and Gunduurwarra clan.



Tony Cockburn inspects grader grass, an invasive species (top). Feral and stray cattle are regularly controlled in Rinyirru National Park (bottom right). Rinyirru’s rivers and waterholes support abundant saltwater crocodiles.



The Indigenous Ranger program provides a wealth of skills and experience for local people, including Patrick Clements (left) and Michael Yeatman.

When Cockburn started working on cattle stations back in the 1970s, many Aboriginal people were employed by the cattle business. It was then that he came to appreciate Aboriginal knowledge of the land and the importance of Traditional Owners being on the land for the survival of their culture.

This experience helps him build rapport with Aboriginal people in his current role. “You’ve only got to mention the stock game to some of the Aboriginal Elders, and their eyes light up, because there are a lot of good memories,” he explains. “They had jobs, and they were able to be out on country.”

Joint management officially started at Rinyirru in 2011, but Cockburn says it was happening in practice long before then. “It’s not a new thing,” he says. “Even before the formal joint management happened, we were doing joint management – it just didn’t have a name.”

The state government provides annual funding through the Land Trust for Cockburn to employ four local Indigenous Rangers on his team. The federal government provides funding for four Indigenous Land and Sea Rangers, meaning he usually has at least eight Indigenous Rangers working with him. At the busiest part of the dry season, the total number of staff members working on the park can grow to 16.

The Land Trust also gets the revenue from all camping fees in the park. One day, Cockburn would like the Trust’s ranger program to be fully self-funded, perhaps by creating more economic opportunities in the local area for Traditional Owners.

He and Rinyirru Land Trust Chairman Les Harrigan usually speak at least once a day about what’s happening in the park. Harrigan has praised the park’s Indigenous Ranger program as a role model for the rest of the Cape. According to Cockburn, it has helped to train dozens of Indigenous locals and is helping to “get kids away from their computers” and back on country, learning about their culture and land.

The cattle stations now employ only a fraction of the workers they once did, and many of the opportunities to be in the bush have disappeared for young Indigenous people. Cockburn says Traditional Owners had a reputation for being brilliant bushmen.

“But there’s a big generation gap now, so the young people need to be shown things. Unfortunately, a lot of the good old bushmen have died, so there’s teaching that’s missing.”

Joint management works well, Cockburn says, as long as there’s shared trust and commitment. “We’ve come a long way in five years,” he says. “Unfortunately, in some other areas it’s not happening to its full potential. To make it work, everyone’s got to work hard at it. It’s not going to happen on its own.

“I’m lucky here, because in the Queensland Parks and Wildlife Service, I’ve got a really good hierarchy in Cairns and beyond. They are very positive and helpful, and the same goes for the Land Trust side. We’ve had a good relationship from day one, and it’s run relatively smoothly.

“You’ve got to earn their trust and respect,” Cockburn says of the Traditional Owners. “You’ve got to have full honesty and good communications between the parks service and the Traditional Owners. If you haven’t got that, you haven’t got a hope in hell.”

Joint management works well, Tony Cockburn says, as long as there’s shared trust and commitment.

In addition to the resources at his immediate disposal, Cockburn can call in specialist teams to help manage fire, ferals and weeds. There’s even a specialist team to deal with troublesome crocs. “We get a lot of support from parks management in Cairns,” he says. “If we need a specialist ranger team, they’ll be here in no time; we’ve got very good backup in our system.”

Water and fire are the two great forces that shape Rinyirru’s environment. The management team can do nothing about the monsoon rains that make its rivers break their banks each wet season, but the dry season fires are a key issue. Too much ‘bad fire’ and not enough ‘good fire’ can have ruinous effects. Extreme wildfire can destroy habitats, overload rivers with sediment and ruin infrastructure.

Each wet season, the rangers and Traditional Owners get together to work out a fire plan for the coming dry season. By dropping incendiaries from choppers, they try to burn 60 per cent of the park each year during the relative cool of winter to create a mosaic of burnt and unburnt areas.

Cockburn says the practice mimics the burning carried out by Traditional Owners before the arrival of Europeans, and it means that when a hot wildfire does break out late in the dry season, “there’s no need to panic”. There will be refuges for wildlife to retreat to, and park assets will be protected.

He says it’s crucial to get the timing of these burns right. Too early and they don’t burn enough to protect the land from fires later in the season; they take out little more than the leaf litter. A burn while there’s still shallow water lying on the land can also ‘steam’ the soil, killing all the seeds and sterilising it for years. If the burn is too late, it can do as much damage as the wildfires.



National park and Indigenous Rangers work together to jointly manage Rinyirru National Park.

Cockburn reckons the biodiversity of the park is in good shape, because management is getting its burning regime right and the native vegetation and wildlife are thriving. Not everything is perfect, though. The once-common northern nail-tail wallaby is now a rare sight. Swordfish are rarely found in the waterways any more, and a golden-shouldered parrot has not been seen for years.

The rangers gather at 7 each morning to discuss the day ahead. On this morning's agenda, there's rubbish to be picked up and a toilet block to be painted and cleaned. Cockburn stresses to his team the importance of presenting the park, and themselves, in the best possible light. He encourages his rangers to be well dressed, friendly to visitors and ready to share their knowledge. "Stop and have a chat," he tells them. "The tourists love that."

He is passionate about giving the visitors a special Outback experience. Rinyirru gets about 15,000 visitors a year, though there are only two places in the entire park with toilets and only one with (cold) showers. There are just 113 campsites, and he is thinking of adding 25 more to cope with growing visitor numbers.

There are also plans for a new amenities block at the main campsite, and an official bird-watching trail for the increasing number of birders. Having good signage is another of Cockburn's priorities, and his workshop has a new sign-making machine.

Cockburn loves his life and work at Rinyirru, including the months each year when the wet season isolates him almost entirely from the rest of the world. He received a 2015 Australia Day award that acknowledged 'his invaluable contribution to operational joint management of national parks on Cape York Peninsula'.

Much of his contentment stems from a conviction that Rinyirru is a model for a workable Outback future. This is a special place where a well-resourced team of people manages a landscape using the best of modern science combined with the knowledge of Traditional Owners. This joint effort maintains the park's environmental splendour so it can continue to be enjoyed by thousands of visitors every year.

Breakout 1 **A richly inhabited, water-soaked land**

It is a glorious sight to watch the sun set behind the paperbarks on the edge of Red Lily Lagoon. The mass of pink lotus lilies fluttering in the breeze is among more than 700 plant species found within Rinyirru National Park. The lagoon is part of a vast network of freshwater and saltwater wetlands, all throbbing with life.

Rinyirru lies in the Laura Basin, which features a web of rivers flowing north to Prince Charlotte Bay and the Great Barrier Reef.

With the coming of the wet season each year, the Hann, Kennedy, Bizant, Normanby, Deighton and Morehead rivers break their banks and flood vast areas, watering an array of ecosystems. During the dry season the water retreats, leaving behind a host of permanent wetlands as well as grasslands, woodlands, vine forests, mangroves, salt pans, salt marshes, samphire herb lands, and forests of palms, paperbarks and eucalypts.

One tree species that reaches its greatest numbers and range in Rinyirru is the cabbage tree or corypha palm. While the palm is

often found in tropical woodlands, in Rinyirru it forms woodlands where it is the only canopy species. This is one of the unique features of the national park. Ranger in Charge Tony Cockburn says the palm grows slowly but to a great height and flowers just once in its lifetime, at maturity, which could take more than half a century.

The areas of the park that hold water all year round are particularly rich in biodiversity. They support crocodiles, catfish, turtles, shrimp, barramundi and bull sharks. Abundant birdlife includes honey eaters, orioles, cockatoos, lorikeets, bush turkeys, tawny frogmouths, radjah shelducks, cormorants, brahminy kites, spoonbills, magpie geese, white cranes, broilgas, sarus cranes, jabirus, fig parrots, scrub turkeys, nankeen night herons and sea eagles. Sand monitors and agile wallabies also make regular appearances.



Rinyirru's wild rivers flow unimpeded into Princess Charlotte Bay.

Breakout 2 **A bovine legacy**



The long history of cattle grazing at Rinyirru is on display at the heritage-listed Old Laura Homestead.

When purchased by Queensland National Parks in 1978, Lakefield was one of the Cape's biggest cattle operations, running about 20,000 head. Thousands of cattle have been removed from the park, but because fence management was neglected for many years, the park still contains several thousand head. Rinyirru's landscape is in good shape even though the land was used for cattle grazing for a century.

However, cattle continue to have a significant negative impact on the environment, and head ranger Tony Cockburn says it's

time for them to leave. If all goes according to plan, the park will witness its last big cattle musters in 2016, and further controls will be implemented in 2017. It's been a long battle to get to this point – years of intense negotiations and heated meetings. Cockburn says there are plenty of people in the industry who are yet to be convinced that the cattle should be cleared out of the park. But, he adds, many people can now see that the park's future lies with tourism, not cattle, and the cattle have to go for the park to thrive.

Breakout 3 **Burning up a storm**

Tony Cockburn is a master of ‘storm burning’. It’s an art needed to control one of Rinyirru’s biggest environmental challenges: melaleuca sucker growth.

“Savanna grasslands are being lost to invading native woodland species at an alarming rate, not only at Rinyirru, but throughout the tropical savanna of northern Australia and in particular the Cape York Peninsula,” warns an internal Queensland Parks and Wildlife Service report (QPWS, unpublished). “Fire has either been too early and cool or too infrequent with the cool fires promoting germination of ti-trees.”

It is a consequence of the absence of traditional Aboriginal burning. In a book about their country, Lama Lama elders Paddy Bassani and Albert Lakefield (2006) write:

“The cattlemen they burn too, but too many suckers come up after that. They don’t burn the Aboriginal way. You gotta know right time to do the burn. You gotta know how strong to make the fire. Hot enough to kill them sucker, but not too hot. You might burn up the whole country. You gotta know when to burn the country. The best time is after first storm. You only burn a little patch. You don’t make a big fire. You burn them dry grass and rubbish. In the old day the Old People kept the country clean and open. Now, too much ti-tree and suckers coming up. Our country is closing up now. Come wild. That’s no good. You gotta use fire to keep country open like the Old People did.”

Storm burns are hotter than the cool burns of the early dry season but not as intensely destructive as wildfires. A storm burn is done at the end of the dry season, but after some of the first storms of the wet season have dumped enough moisture into the soil and vegetation to limit the heat and intensity. The windows of opportunity are small, and the key to successful storm burning is to have the right resources available at the right time to do the job, Cockburn says.

Lakefield was the first national park in Queensland to develop a fire management plan (in the 1980s) and was one of the first locations where the concept of prescribed burning became an integral part of parks management.

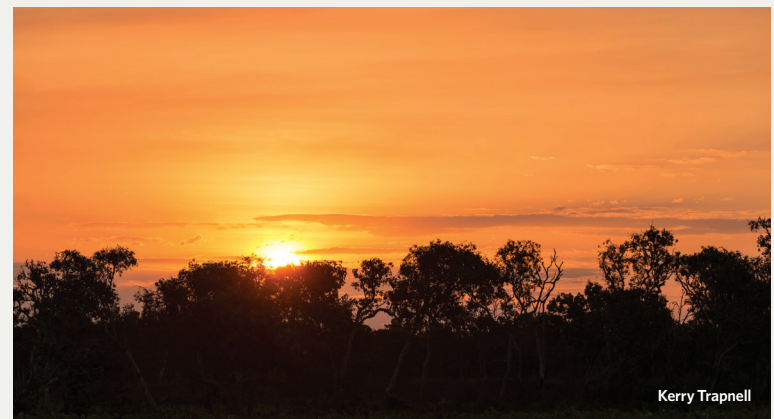
The aim is to avoid a single, intense wildfire in a large proportion of the park or any particular habitat. The best way to prevent this is by conducting a mosaic pattern of cool burns.

Queensland Parks and Wildlife Service’s *Planned Burn Guidelines* (QPWS, unpublished) state:

“The protected area network throughout Cape York Peninsula provides the cornerstone of biodiversity conservation for this unique part of our state. Fire ... provides us with the single most valuable tool to assist in managing these natural assets. A well-planned and implemented fire program will afford managers the ability at the landscape level to influence diversity in ecosystem age, class and structure.

“As the increased resourcing of fire management has enabled the ongoing funding of successive peninsula-wide aerial ignition programs, we have successfully commenced a return to more pre-European regimes which promoted greater ‘patchiness’ across the landscape.

“Throughout the peninsula, this return has effectively resulted in a shift away from the more recent patterns of destructive and large-scale late dry season wildfires. The benefit is three-fold. Firstly we fulfil our obligations as custodians of nature, secondly we fulfil our commitment to be good neighbours and we reduce the greenhouse gas emissions from the protected area estate by shifting toward a generally lower-intensity fire regime.”



Smoke from controlled fires intensifies the sunset’s fiery colours.



A photograph of a dry, bushy landscape with a yellow road sign in the foreground. The sign is partially visible on the left side, showing a black border and a yellow background. The background consists of dry, brownish branches and green grass.

3.4 Bringing Outback wildlife back to the future

Felicity L'Hotellier

*South East Field Ecologist, Scotia Sanctuary,
Australian Wildlife Conservancy*

On one level, it's just another Outback fence. A bit more sophisticated than your average four-strand barbed job but still wire and posts driven into the red dirt to divide one bit of scrub in far western New South Wales from another.

On another level, it's the most marvellous time machine. The feral-proof fence that encloses 8000 hectares of Scotia Wildlife Sanctuary is just as powerful as anything dreamed up by science fiction novelists or the Hollywood creatives behind the time-racing DeLorean in the movie *Back to the Future*.

As field ecologist Felicity L'Hotellier says, when you step through that fence, you are instantly transported back centuries to an Outback that's still alive with the animals that populated it before the arrival of Europeans. There are no sheep or cattle, rabbits or goats, cats or foxes.

Instead, there are small mammals that have otherwise disappeared from vast tracts of the Australian landscape: burrowing bettongs, brush-tailed bettongs, bilbies, numbats and bridled nail-tail wallabies.

Altogether, six threatened mammal species have been reintroduced inside the feral-proof fence at Scotia. The results are astonishing.

"Time travel is possible," L'Hotellier tells those who visit her beloved sanctuary. "As soon as you walk through that gate, you're effectively walking back 200 years in time. This is what the landscape looked like before cats and foxes wrecked things."

L'Hotellier works for Australian Wildlife Conservancy (AWC), a not-for-profit organisation that owns and manages 25 properties, encompassing more than 3 million hectares across Australia. This represents the nation's largest non-government conservation estate.

AWC protects some of the largest remaining populations of threatened native species, including almost 25 per cent of the numbat population, 15 per cent of the bilby population and over 90 per cent of the bridled nail-tail wallaby population.

Six threatened mammal species have been reintroduced inside the feral-proof fence at Scotia. The results are astonishing.

AWC purchased Scotia, a 65,000-hectare former pastoral property, in 2002. It now contains the largest feral-free fenced-in island on the Australian mainland. Free from the pressure of feral herbivores and predators, it has proved successful in safeguarding populations of some of Australia's most threatened mammals.

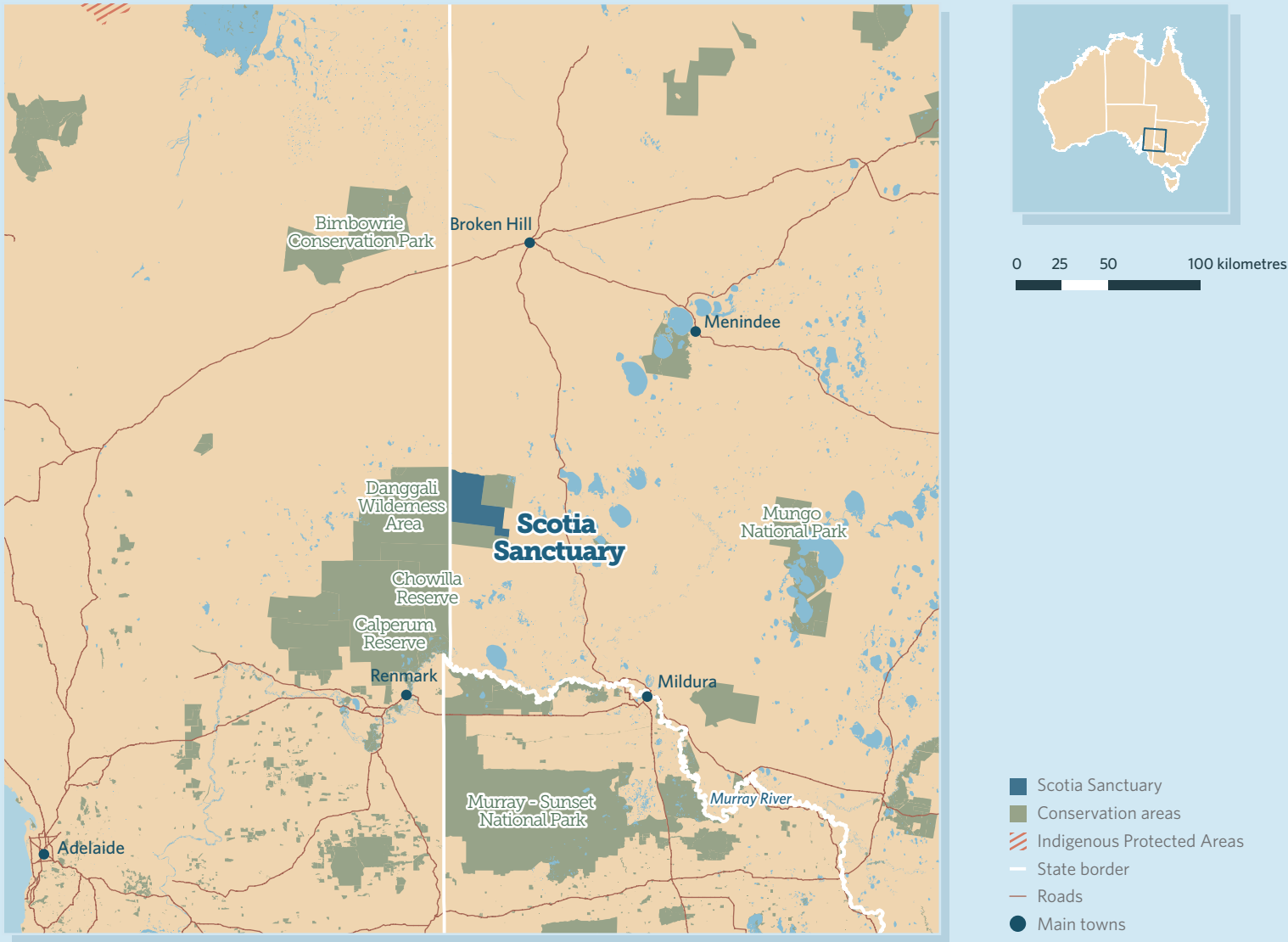
L'Hotellier says the feral-proof enclosures have a critical role to play, although she hopes they don't prove to be the answer to Australia's mammal extinction crisis in the long term. At the moment, however, they are crucial, because numbers of native animals continue to plummet outside the fences but are increasing inside.

Numbers of brush-tailed bettongs, for example, have fallen from more than 200,000 in the wild to about 15,000 in just 15 years. Scotia is home to more than 400 individuals. Inside the fence, the property is also home to self-sustaining populations of about 240 numbats, 870 burrowing bettongs, nearly 1200 bilbies and 2200 bridled nail-tail wallabies.



Mala, which are now extinct in the wild, breed at Scotia Wildlife Sanctuary (top). Predator-proof fences protect Scotia's endangered mammals from feral cats and foxes (bottom).

Figure 9
Location of Scotia Sanctuary in Western New South Wales



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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Scotia was part of the last pastoral lease ever taken up in far western New South Wales in the 1920s. It still has healthy native vegetation because of its relatively short grazing history and very little clearing. It features majestic old-growth mallee woodlands, stunning red sand dunes, spinifex and a cryptogamic soil crust that has not been destroyed by hard-hooved animals.

Scotia's pastoral days ended in 1994 when it was purchased by Earth Sanctuaries – a business owned by the colourful John Wamsley, whose feral-proof fences and striking hat made from a feral cat skin briefly made him the most well-known environmental figure in Australia. Wamsley originally used the property as an ecotourism venture, which explains the on-site accommodation and a commercial kitchen used by the many visiting volunteers on whom AWC relies heavily these days.

After purchasing Scotia, AWC upgraded the original feral-proof fence and doubled the area enclosed, so there are now two 4000-hectare exclosures protected by a fence that's 1.8 metres high and buzzing with 9000 volts of electricity.

It's not only the threatened wildlife inside the fence that makes the sanctuary special. Scotia's 11 ecosystems (two of them threatened) are home to 35 mammal species, 171 bird species, 59 reptile species, two frog species and at least 331 different plants. There are at least nine threatened plant species and 40 species of threatened wildlife.

Outside the fence, Scotia still has populations of small mammals such as dunnarts, ningau and Bolam's mouse, plus malleefowl, other ground nesting birds and rare reptiles such as the western blue tongue, but all these animals do much better living inside the wire.

AWC knows this because it rigorously monitors the wildlife and native vegetation across the property's four different management zones. Stages 1 and 2 are the 4000-hectare blocks within the conservation fence, Stage 3 is an area of about 18,000 hectares with (temporarily) no feral animal management and the rest of the property is Stage 4, where there is no fence but ferals are intensely managed.

Not only are feral predators targeted, but feral herbivores such as goats are controlled by mustering and closing off water points, while rabbits' burrows are 'ripped' – dug up and destroyed.

"We do intensive monitoring across those four treatment areas," explains L'Hotellier. "So we're looking at how our management is affecting our reptiles, our small mammals, our birds, our vegetation and all aspects of the ecosystem."

"It's land management driven by good science. For us, it's not good enough to implement land management practices and just assume

they're the right thing to do," she adds. "We're trying to measure what the outcome is and make sure what we're doing is the right thing. We monitor everything very closely."



Felicity L'Hotellier and team regularly monitor Scotia's reptiles and mammals, like this echidna.



Mallee woodlands at Scotia are habitat for 171 bird species, including mallee fowl (left). Mallee fowl bury their eggs in large nesting mounds (center). Volunteers help Felicity L'Hotellier monitor the health of endangered burrowing bettongs (right).

"When we do our biodiversity surveys and we've got separate teams working inside and outside the fence, it's always the people surveying inside the fence who come back of an evening raving about all the animals they've seen. The guys on the outside feel like they're missing out."

Small mammals and reptiles are surveyed each year using pitfall and funnel traps that are open for three days and three nights and checked each morning and afternoon at 48 permanent monitoring sites. Spotlight surveys are used for monitoring bilbies and wallabies, and bird surveys are conducted using sight and song.

"We're always looking to see if populations are going up, down or are stable and how our management might be affecting that," says L'Hotellier.

Extensive fire and weed control to keep habitats healthy is also central to the Scotia success story. But it's the fence that's the key. "The conservation fencing is really critical at this point in time," says L'Hotellier, referring to Australia's position of having the worst mammal extinction rate in the world. "Australia has a really poor report card when it comes to recent extinctions, so if we don't act now, we're going to lose everything.

"We're creating these feral-free islands on the mainland to protect what we have left," she adds. "The endgame will be to get these populations established back outside conservation fenced areas." When will this happen? L'Hotellier would like to think AWC will be able to re-establish some species outside the fence within the next decade, although for other species it will take much longer.

We're creating these feral-free islands on the mainland to protect what we have left.

The AWC business model is heavily reliant on generous supporters, and Scotia hosts several weekends a year, when supporters visit to see how their money is being spent. The property is usually home to at least half a dozen AWC staff members engaged in scientific study, land management and feral animal control.

"I've been fortunate enough to not only work here, but to also live here and get to know the landscape quite intimately," says L'Hotellier. "In the early years, we didn't have the abundance of animals we have now, and seeing the growing numbers and knowing what we're doing is working is a really good feeling.

"Our model is very effective at protecting native fauna," she says. "We've got governments looking at our model and saying, 'Hey, that's working; let's implement that on our land.' It's really exciting." Last year AWC entered a historic partnership with the New South Wales Government to establish feral predator-free areas at two national parks.

L'Hotellier believes a key to AWC's success is that 80 per cent of its staff is based on the properties. "You have to have people out there knowing the country and working on the ground. I can't understand why more people wouldn't want to live out here. You can fall in love with it," she says.

The 30-year-old has spent seven years at Scotia, first as a land management officer and now as an ecologist. “Working with AWC feels like being part of a big family,” she says. “My job is my life and my life is my job. I can’t imagine leaving this place or AWC.

“I’ve been really fortunate. Some people would give anything to be doing this. I originally came on a nine-month contract and now I’m an Australian Wildlife Conservancy junky. I even spend my holiday leave visiting other AWC properties!”

On Scotia, the sound of humans huffing and puffing in the dark scrub at night can mean only one thing: bettong survey time. Twice a year, with the help of volunteers, the sanctuary conducts trapping surveys of the local burrowing bettongs and brush-tailed bettong species. The blowing is used to encourage the burrowing bettongs to move from the metal cages into sacks so they can be examined and processed before being released.

“Sometimes you feel like the Big Bad Wolf – you’re huffing and puffing and they’re just not moving,” L’Hotellier says. “Sometimes at three or four o’clock in the morning, when you’re blowing and blowing and they don’t move, *you* can be moved to tears.”

In the Stage 1 enclosure, there are 114 trapping sites spaced 500 metres apart, each with three traps so that personnel can check on the size and health of the burrowing bettong population. For four days in a row, a few hours before sunset, the traps are baited with balls made of oats and peanut butter. At 10.30 pm, the four survey teams head out, rugged up against the cold, to check every trap.



L’Hotellier spreads supplementary food to keep Scotia’s endangered mala fit and healthy for breeding.

There are about 870 burrowing bettongs in Stage 1, and in a single night a team might process 70 animals. Bettongs are curious, social and nocturnal animals, and they seem to be everywhere come sunset. The numbers go up and down, but L’Hotellier says “that’s what you expect; they’re a boom-bust species. In the good seasons, numbers will build up, and in the poor seasons, numbers die off. They’re a self-sustaining wild population”.

The back of L’Hotellier’s ute, covered in hessian sacking, is her mobile field station. The weight and sex of each trapped bettong is determined. If it’s a male, its testicles are measured; if it’s a female, its pouch and teats are checked. Foot length is measured to determine age.

The animals store their fat reserves in their tails, so tail circumference is another important measurement. A bettong with a short foot and a fat tail is most likely young and in good health. If the animals haven’t been trapped before, they are microchipped, and a piece of skin is punched from an ear for DNA testing.

Burrowing bettongs are such charming animals and now so threatened. They are completely absent from mainland Australia outside fenced feral predator-free areas, such as Scotia. The species is listed as officially extinct in the wild in New South Wales, the Northern Territory and Western Australia and as endangered in South Australia. Across its properties, AWC now protects around a third of the entire national population.

It’s hard to believe the species once had the one of the largest geographical ranges of any Australian mammal. There used to be a bounty on their heads because they were deemed a threat to agriculture.

The beauty of the burrowing bettong, L’Hotellier says, is that “once you remove feral predators and herbivores, these guys respond immediately”.

Inside Scotia’s main electrified conservation fence there’s a 100-hectare area cordoned off by a second fence, every bit as feral-proof as the main one. It’s there to protect the sanctuary’s most precious possession: its mala population.

“Little balls of fluff with tiny T-rex type arms” is how L’Hotellier describes these hopping marsupials, which are also known as rufous hare-wallabies. Although the animals look like cute cartoon characters, the plight of the mala is deadly serious. They exist on the mainland only inside protective feral-free fencing like that found at Scotia and a few other sanctuaries.

They are not native to western New South Wales, but a ‘security population’ of mala has been established at the sanctuary in case something catastrophic were to happen to any of the few other tiny fenced-in populations. Scotia’s population of about 60 is like a modern-day ‘mala ark’.

“We want them to be as reproductively healthy as possible,” L’Hotellier says, explaining why the mala are fed every second night: a mixture of guinea pig feed, cracked corn and sunflower seeds. The animals are also trapped, examined and documented once a year to help ensure their survival. To prevent ‘capture myopathy’ – a potentially fatal build-up of lactic acid in their muscles during the trapping process – vitamin E is added to their feed in the weeks leading up to the trapping.

Not everything tried on Scotia has been a success, however. A population of greater stick-nest rats was also reintroduced inside the conservation fence, but there has been no confirmed evidence of them for several years. All that definitely remains is one of the distinctive stick nests they built inside a hollow log.

Across all its properties, AWC has carried out over 60 translocations of more than 3600 animals, more than any other non-government organisation. “We’re still writing the textbook when it comes to reintroductions of threatened species, and you learn more every time you do something,” L’Hotellier says. “The process evolves, and we’re getting better and better at it.”

Across its properties, AWC now protects around a third of the burrowing bettong’s national population.

L’Hotellier reckons that the bridled nail-tail wallaby is Scotia’s greatest success: “We now protect 90 per cent of the population of an animal that was thought to be extinct until 1973, so that’s pretty cool.” Scotia staff tried establishing a community of the wallabies outside the conservation fence several years ago when fox numbers were at all-time lows, but seasonal events resulted in a swelling of the fox numbers, and the wallabies outside the fence were wiped out.

Inside the conservation fence, the land looks as cratered as the moon, as if an army of miniature opal miners has toiled for centuries to dig the shafts and mound the mullock heaps. It’s estimated that each bilby and burrowing bettong can turn over 20–30 tonnes of soil a year, mixing and aerating the soil as it forages for roots, fungi, insects and seeds and creates its burrow.

The digging power of the small mammals in the enclosed areas of Scotia adds up to around 525,000 wheelbarrows of earth being turned over each year across 8000 hectares.

These are the busy gardeners of the Outback, tilling the soil and improving its overall capacity to support plant and animal life. Elsewhere, attempts

have been made to mechanically replicate the diggings of bettongs and bilbies, but it hasn’t worked.

“There’s so much going on here because of this digging,” says L’Hotellier. “You’ve got water and leaf litter accumulating in these holes and creating little compost pits, and that’s helping produce seedlings, because the seeds get trapped in the holes as well, and they’re in the perfect conditions for germination.

“Just think about what it means to no longer have that constant digging happening in the landscape,” L’Hotellier says. “You remove that role and it’s got to have massive repercussions.

“People ask, ‘Why do we need to save these animals?’ It’s not just about saving these animals; it’s about saving the whole environment, because they’re all connected. Everything has evolved so intricately,” she says.

For L’Hotellier, the magic of Scotia most hits her when she leaves it – when she’s in a landscape devoid of bilbies and bettongs and their massed diggings. “The landscape is empty of these animals and the ground almost feels harder under foot,” she explains.

L’Hotellier will have achieved her goal the day her beloved time machine becomes redundant – the day she can open the gate in the feral-proof fence and leave it open. She believes she will experience this *Back to the Future* moment in her lifetime: a time when bilbies and the bettongs once again roam every corner of Scotia.

It will be a time when so much more of the ground is alive with native biodiversity and feels soft beneath her feet.



Bilbies and bettongs are important ‘ecosystem engineers’ that turn over large quantities of soil.

Breakout 1 **Macca—taking management down to the wire**



Josh 'Macca' McAllister maintains Scotia's predator-proof fences.

He's a long way from the green paddocks of Victoria's Western District, where he started his career in merino sheep and cropping, but Scotia Wildlife Sanctuary Manager Josh 'Macca' McAllister still identifies himself as a farmer, which is a great asset for getting on with the neighbouring pastoralists.

"A lot of the things are still exactly the same," he says when comparing his job at Scotia with traditional farming. "You've got to keep the water up, and the power. You've got to maintain your fences. Now I call myself a bilby and spinifex farmer."

Nowadays, Macca farms for biodiversity, not dollars. Ferals, fire and conservation fences are his priorities, not fleeces, fat lambs and fertiliser.

Macca fell for his partner, Scotia's field ecologist, Felicity L'Hotellier, at another mainstay of rural Australia: a bachelors' and spinsters' (B&S) ball. When the eight-hour drive to see her after a 12-hour day behind the wheel of a harvester got too much, he took a land management job at Scotia.

He originally told L'Hotellier he would stay for two years and then head back to farming, but, like his partner, he has fallen in love with the Outback and holds Scotia in the same affection he would his own farm. Macca's been there more than four years and became the manager after two years.

He usually has about seven permanent staff members at the sanctuary, plus an intern or two. One employee is dedicated to feral animal control. When volunteers visit the sanctuary to do survey work or supporters pay a visit, Scotia's population can swell into the dozens, making it easily the busiest place for miles around.

One of Macca's job priorities is maintaining Scotia's most imposing and vital edifice: the 56-kilometre feral-proof conservation fence. The original Earth Sanctuaries fence was considered state-of-the-art at the time but was only waist high, and feral animals learned to get over it.

The new fence installed by AWC is almost 2 metres high and has a floppy, overhanging top that requires an animal to hang upside down in order to climb over it. At the bottom, the fence uses very small gauge wire mesh to stop even rabbit kittens from getting through, though rabbits sometimes do get in – possibly dropped by birds.

At ground level, the mesh also extends out a distance from the fence on both sides to stop animals from digging under it. The coup de grace is three wire strands, each carrying 9000 volts of electricity – enough to throw an animal away from the fence and discourage it from coming near again. To keep it functioning, Macca also has to make sure Scotia's solar panels,

Continued on next page.

batteries and diesel generators are doing their job. He needs to be everything from bush electrician to bush mechanic.

The fence's entire length is checked every second day. The biggest risk to its integrity is big kangaroos on either side fighting and tearing holes in it. Herbicide is sprayed along the fence line to stop plant growth that could fuel destructive fires. Mosaic pattern hazard reduction burns are also conducted during winter to protect the fence and its enclosed lands from summer wildfires.

"Fire can completely decimate habitat," Macca says, and AWC research has also shown that fires favour feral cats. They will travel long distances to hunt in and around recently burnt areas, which provide easier access to vulnerable native animals.

The area inside the fence is also constantly monitored for ferals using methods such as 'dusting', in which old four-wheel drive tyres are dragged along the roads to rake them smooth so that any telltale footprints can easily be observed.

Since the big fence was built, there has been only one feral incursion, of a fox that entered when a gate was inadvertently left ajar in late 2013. "Christmas plans got cancelled in a big hurry," Macca recalls of the fevered hunt.

He shot the fox on the sixth night after its presence was discovered, luring it in with water amid the summer heat. "One fox in 4000 hectares and it took six nights to get him, I'd say that wasn't a bad effort," Macca says.

The conservation fences can cost more than \$50,000 a kilometre, depending on the location and terrain, but they will last decades if properly maintained. According to Macca, they more than pay for themselves in terms of effectiveness in protecting native mammals, and compared with the alternative cost of paying people to be constantly tracking, trapping, baiting and shooting ferals.

"And at the end of the day, it's pretty hard to put a price on the survival of endangered animals," he adds.



The tall predator-proof fences at Scotia are 56 kilometres long.





3.5 A passion for living in Australia's heartland

Ann Ballinger

*Stockholm Station,
Western Queensland*

Ann Ballinger is a rebel with causes. She defied the expectations of many when she chose to keep running 11,000-hectare Stockholm Station in western Queensland by herself after the sudden death of her husband, Bill, in 2000.

Her causes have included everything from the local sheep show to mental health and the environment. But above all, she's always been an evangelist for life in the Outback. It has been her beloved home for most of her life, and she hates to see it depicted as hellish instead of heavenly.

Ballinger yearns for an Outback where there are many more people enjoying its charms, as she does, in order to make it more environmentally, socially and economically sustainable. She believes the best solution for safeguarding the environmental health of the Outback is to have more people living in it and managing it appropriately.

"The greatest asset we have is people, and when my generation goes, there'll be a new breed of young people coming through and with them will come enthusiasm and confidence," she says. "And that's what the Outback needs: an injection of confidence and enthusiasm."

Ann Ballinger yearns for an Outback where there are many more people enjoying its charms, as she does, in order to make it more environmentally, socially and economically sustainable.

She has a firm belief that the next generation of pastoralists who manage vast swathes of the Outback will do an even better job of sustaining it as one of the planet's last great natural places. She believes their more enlightened approaches to living on and caring for the land will help make remote Australia a more attractive place to live, because it will be a place of education, innovation and prosperity, not ignorance, conservatism and hardship.

Ballinger is intensely passionate about the kind of lifestyle that Outback living can offer to anyone who is prepared to give it a try. "I really, really believe in this life," she says. "I don't want to see it portrayed the way it always seems to be portrayed. It's a fantastic place to live in and to bring up families in. I know what a great life it offers and how lucky we are to live here. And sadly, so much of the rest of Australia doesn't recognise it. They see all the negative things like snakes and dying of thirst and the isolation."

Just as Ballinger has a son who has gone to the 'big smoke' and loves it, she believes there are plenty of city kids who would fall in love with the Outback if they experienced it.

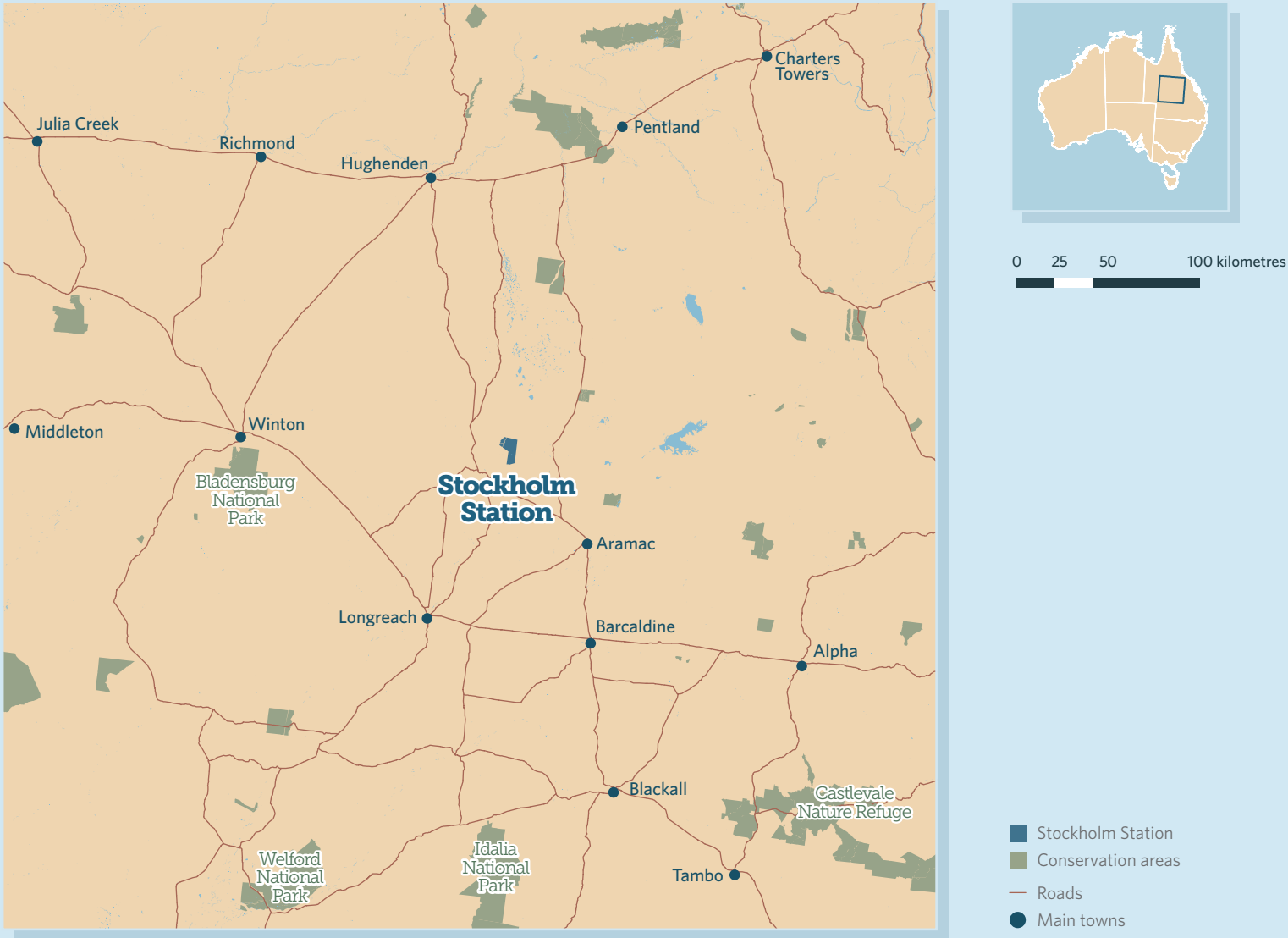
"A good example of that is when teachers come to these parts," she explains. "When they find out they have been posted to Aramac or Longreach or somewhere remote like that, they spend the rest of their summer holidays in tears. But when they get here, they have the most wonderful time, because everyone's so friendly. One of my main goals is to get across to people that it's a good life here in the Outback. We don't tell people enough about it."

She believes that if enough people resided in the Outback, all would be good. "People create industry. Get the people here and the rest will look after itself." But those people never come, Ballinger says, because the Outback is "sending the wrong message - we send a shocking message that it's always bad, that it never rains, that it's never good, that it's hard to educate our kids". But balancing these messages with the many good stories could change all that.



Ann Ballinger spreads poison to kill invasive prickly acacia, a weed of national significance (top), and maintains fences and gates at Stockholm Station (bottom).

Figure 10
Location of Stockholm Station in Western Queensland



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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She hopes more Outback residents will share their stories on social media and help overcome the negative perceptions that urban people hold toward remote Australia. She would also love to see a fair dinkum, high-quality TV miniseries – something way better than *McLeod's Daughters* – about Outback life. “I think people would love to look into our lives more,” she explains.

If a camera were to peer into Ballinger's life, it would show her tackling Stockholm's biggest threat, prickly acacia, in the cool of the early morning, spreading pellets and spraying from her four-wheel bike to kill off the invasive weed. It wouldn't show her covered in dust and sweat straining a fence in the baking heat of the afternoon, though. That's when she takes her daily siesta in the air-conditioned comfort of her homestead.

The camera would find her in her office doing important work on the phone or the computer for farming and natural resource management support groups such as AgForce and Desert Channels. At sunset it would show her sitting beneath the deep eaves of her verandah, nursing an ice-cold can of beer as she gazes over a breathtakingly vast paddock of golden Mitchell grass and kangaroos drinking from a pond.

This end of the house was once the post office in nearby Muttaborra but was hauled out to Stockholm to become the homestead in 1936. In the ‘big smoke’, a flash designer would charge thousands of dollars to re-create the home's funky rustic charm. Its pastel colours, high ceilings, rural curios, corrugated iron, art, nooks and crannies, peeling paint, farm furniture and knick-knacks all come together beautifully in what could best be described as ‘bohemian RM Williams’.

The view from the verandah also includes the tennis court; flowering bougainvillea, frangipani and poinciana; fruit trees; tall gums; and a patch of green grass. In this environment of extremes, Ballinger is particularly proud of the many trees she has planted and nurtured to maturity.

Indeed, Stockholm Station feels every bit as charming and sophisticated as its Scandinavian namesake. It's also as neat and tidy, which certainly can't be said about many Outback stations, where generations of junk tends to accumulate in ugly piles.

This tidiness wasn't evident when her husband was alive. “It's what happens when a woman gets in charge,” Ballinger confirms. She believes tidiness and image aren't just there to make one feel good – they are key factors in running a successful business and in making the Outback a beautiful place to live.

She can't understand why Outback Queensland can't win people back by once again embracing some of its former industries. She also sees a fantastic future in new industries such as alternative energy. A massive \$70 million, 80,000-panel solar farm is already planned for Barcaldine.

But the most important requirement for building a vibrant Outback, she believes, is cutting-edge internet and telecommunications technology that will enable people to reside there while making a living through connecting with the world. “We don't have to stick solely to these industries,” Ballinger says of wool and beef.

Add to that education and best-practice resource management and you have Ballinger's recipe for maintaining an economically and environmentally sustainable landscape in this part of the continent.

Right now though, things are pretty bleak in the Muttaborra district. Drought has hit hard – some say it's the worst anyone can remember. By late 2015, more than 80 per cent of Queensland has become drought declared – the biggest area of the state ever covered by this official proclamation of rural hardship.

Struggling farmers who qualify can get tens of thousands of dollars in drought assistance to keep going. There are drought fundraisers going on in the cities, and a rural debt and drought task force is touring Outback centres trying to come up with solutions. The Rotary Club is putting on an outdoor cinema night near Muttaborra to get people off their properties and lift their spirits.

The most important requirement for building a vibrant Outback, Ann Ballinger believes, is cutting-edge internet and telecommunications technology that will enable people to reside there while making a living through connecting with the world.

Stockholm Station is looking better than most in the district, but even here you'll find all the stereotypical features of yet another Outback drought: dust, dung, patches of bare earth, baking heat, shimmering mirages, empty dams, dry creek beds, flies, gaunt livestock, barbed wire, emaciated kangaroo carcasses. A headline in *The Courier-Mail* newspaper declares: ‘Queensland drought crisis: families suffer Third World-like malnutrition.’

The story reports comments from residents, doctors and charity workers about the ‘brutal reality’ of ‘a catastrophic drought now swallowing up over 86 per cent of the state’. It refers to the desperation, isolation and worsening poverty being experienced by many families; the early signs of malnutrition among children whose parents can't afford fresh fruit and vegetables; the dramatic drop in business income and employment in some Outback towns; and the ‘immense stress’ being experienced by the state's rural population.



Workers muster agisted cattle (top). Kangaroos drink at the homestead dam at Stockholm Station (bottom right). Ballinger checks the solar panels (bottom left).

This is the kind of media report that causes Ballinger so much angst. She despairs that such images are constantly shown to metropolitan Australia as being synonymous with Outback life: images that make the Outback look like a place populated by battlers for whom life is a constant, joyless struggle, where people rely on the charity of others to get by, where the climate is relentlessly brutal.

Ballinger wants people to also hear about the fun times, like the night out at the Muttaborra pub for a neighbour's birthday. Outback people know how to party, even when times are tough. She would also love urban people to experience all the fun at Muttaborra's biggest event, the Landsborough Flock Ewe Show, with its livestock competitions, fashion parade and entertainment. "The main reason for holding the show is for people to get together," she says. "It does everyone a lot of good to have a nice day out."

But even retaining residents who are born to the Outback life is proving to be a huge challenge. Despite Ballinger's passion for the country life and what she says were idyllic lives growing up on Stockholm Station, only one of her three adult children still lives in the Muttaborra district. A sign outside the only pub says Muttaborra once boasted six hotels, but that was back in 1890. Today it's a village of about 60 souls.

Ballinger says life has been lonely at times, and it has been hard managing Stockholm by herself. She has had to do some things she had never done before, such as kill and butcher livestock. "It's a man's world that I live in," she says. Her work includes driving trucks and tractors, fixing fences, pumps and pipes, distributing blocks of lick to the cattle and cleaning out stock troughs.



Stockholm Station and its surroundings were severely affected by drought conditions in 2015.



"It's a man's world that I live in," says Ballinger (top). Ballinger cleans the stock water troughs (middle) and musters cattle by motorbike (bottom).

And it wasn't all smooth sailing when her husband was alive, either. When the local creeks are up, connecting with the outside world from Stockholm can involve a 5-kilometre boat ride. There was the devastating crash in the wool price in the early 1990s and then her husband's depression. Overall though, she has relished the challenge of running an Outback station on her own. "I've always felt quite confident," she explains. "It's been interesting and enjoyable. I wouldn't have stayed here if it wasn't."

On Stockholm, Ballinger controls feral pigs and wild dogs, but prickly acacia takes up much more of her time. "It's a fantastic stock feed," she says – full of protein – but it eventually forms an impenetrable, thorny scrub that outcompetes all native plants. Imported into Australia as a shade and fodder tree in the 1960s, prickly acacia is now considered one of the worst invasive weeds in Australia. It has been declared a Weed of National Significance and is classified as a Class 2 pest plant in Queensland.

Prickly acacia is also a major focus of Desert Channels, a natural resource management organisation of which Ballinger is a board member.

Desert Channels works with landholders to resolve land management problems and issues such as weeds and feral animals. It's always on the lookout for innovative ways to address the common threats facing Outback land managers. It has its own expert team that attacks prickly acacia on thousands of hectares each year in the south-west third of Queensland that drains toward the Lake Eyre basin. The team has even enlisted the help of a drone helicopter to intensify its war on the weed.

Ann Ballinger believes it's crucial that governments subsidise the running of education programs, because it's a small investment that will prevent billions of dollars' worth of land degradation and welfare support over the longer term.

Ballinger is particularly full of praise for the mapping and control work that Desert Channels does to respond to threats from weeds and feral animals. The organisation monitors and targets feral pigs over vast areas of the Outback, is helping to protect the recently discovered population of the mysterious night parrot, conducts studies on climate change and runs public awareness campaigns to encourage pastoral activity that is good for the land and also good for the wallet.

Ballinger is looking forward to seeing the new generation of young land managers develop and employ innovative practices that overcome the destructive cycle that often affects Outback farming enterprises. She's

referring to the high debt that leads to overstocking and a reluctance to destock when drought hits, leading to huge damage to the landscape and the inability of vegetation to recover when the rains return, leading to even more debt.

Ballinger is a big fan of providing education for pastoralists, such as the Grazing for Profit School, that stresses the link between economic and environmental sustainability: the need to destock before doing long-term damage to your land.

“They’re simple things, but we make it seem so difficult,” she says of some traditional approaches to pastoralism. “We’re grass merchants, and without the grass we can’t do anything – our whole livelihood depends on having enough grass. We’ve got to look after that first. We’ve got to take the simple steps that Grazing for Profit teaches us to take.”

Ballinger says the pattern that has been established during a hundred years of mostly unsustainable pastoralism has to be broken by putting the environment first; then the other things will look after themselves.

The top 20 per cent of farmers – those who are always doing well financially – are testament to this philosophy, she says. That’s why she believes it’s crucial that governments subsidise the running of education programs, because it’s a small investment that will prevent billions of dollars’ worth of land degradation and welfare support over the longer term.

Ballinger also dreams of a day when that same grass she nurtures can deliver her another income stream: cash for the huge amounts of carbon stored in the deep root systems of her perennial grasses.



“Our whole livelihood depends on having enough grass. We’ve got to look after that first,” says Ballinger.

She reckons one of the biggest improvements to the Outback environment in recent years is the way people have embraced rotational grazing, in which livestock graze a small area for a short time before being moved on, allowing that land to recover before being grazed again. The grass is treated as the most precious commodity, not the livestock. “It’s very obvious that it’s certainly the way to go,” she says.

Ballinger says a big part of the Outback’s environmental problem is that “we’re the most conservative people, but we’re the biggest gamblers in the world. Our whole life depends on the weather. It’s a total gamble”.

Another of her projects is aimed at ending the game of chance that is Outback grazing. She’s on a task force set up by the Queensland farmers’ body, AgForce, that is working on solutions to help pastoralists in places like the Murrumbidgee district to drought-proof their properties.

She believes people are getting smarter, and the Outback environment is becoming healthier as a result. “People are grazing their land in a more sustainable way. They’re more likely to sell stock when things get dry, to protect their grass,” she explains.

One of Ballinger’s great fears for the sustainability of the Outback way of life is the perennial issue of having reliable access to water. Stockholm and all the Murrumbidgee district stations are highly reliant on underground water from the Great Artesian Basin, and she worries that extensive drilling and fracking for coal seam gas could eventually cause the “poisoning” of that water source.

Standing beside her bore, Ballinger describes it as “the lifeblood of Stockholm”, providing water for her stock and also for the bounding kangaroos and dancing brolgas.

Like many other stations in the region, Stockholm made the transition from grazing sheep to cattle a few years ago. But even the cattle that graze on Stockholm these days aren’t Ballinger’s.

As part of her transition to eventually retiring and moving off the property, she has sold all her stock and now earns her income through agistment – the money other graziers pay for having their cattle graze on her land. She photographs the cattle with her iPad and emails the images to their owners so they can see how they’re doing.

While agistment is not as lucrative as having her own livestock, it means Ballinger doesn’t have to worry about mustering and marketing anymore. It gives her more time to enjoy life and manage other income streams.

Ballinger says earning off-farm income is also a key to making a success of life in the Outback. Her off-farm portfolio includes investment properties plus a part share in the Murrumbidgee Motel, of which she says, “There’s not much in it financially, but it’s been a fantastic thing for the community.” One

of her investment properties is on the Sunshine Coast, which will one day become her home when she retires from Stockholm and leaves the Murrumbidgee district. Like so many others, Ballinger will eventually gravitate to the urbanised coast. She’s sad at the prospect but appreciates the importance of being close to health services and other support in her retirement.

Regardless of where she ends up living in years to come, Ballinger says her heart will always be in the Outback. She’ll never stop singing its praises in the hope that many others will eventually lose their hearts to it, too.



Noisy galahs drink from a dam (top). Ballinger releases ground water from the bore at Stockholm Station (bottom).

Breakout 1 **Falling off the sheep's back**



Kerry Trapnell

Mobs of thirsty kangaroos drink at Stockholm's dam, and also its cattle troughs.

Near a picnic ground in Muttaborra there's a stunning sculpture made from rusty old bits of farm machinery. It immortalises a shearer at work and harks back to the area's once-booming wool industry.

Ann Ballinger of Stockholm Station really misses the big flock of merinos that grazed her property's vast paddocks when she moved to Stockholm in 1988.

Continued on next page.

She misses the simple pleasure of thrusting her hands into the thick fleece to admire the density, micron, staple length and crimping of the white wool. She misses the flurry of activity and fresh faces that shearing time would bring each year – the buzz of the hand pieces, the bleating of the sheep, the barking of the dogs working in the yards, the smells coming from the cook’s kitchen.

And she misses seeing her kids playing among the pile of pressed bales, and the whole lanolin-coated grandeur of the six-stand shearing shed made from corrugated iron and twisted timber, resembling a frenetic, yet noble, scene from a Tom Roberts painting.

Ballinger also misses the team of big, hard-working Maori shearers, with boom boxes blasting out music, who would descend on Stockholm Station annually to shear its flock. Back in the late 1980s and early 1990s, Ballinger recalls, Muttaborra was a thriving colony of Kiwi shearers – that was when the district still rode high on the sheep’s back. Muttaborra’s Maori-rich rugby union team was feared throughout western Queensland.

But that’s all changed now. It has been several years since the last shearing on Stockholm, because all the sheep have gone, and the same is true for many of the other stations north of Longreach. Low wool prices, combined with the pressure from wild dogs and kangaroos, have caused many people to switch to beef cattle.

All those Kiwi shearers have moved on, and the town is a shadow of its former self. Wool is massively labour-intensive compared with cattle, so this corner of the Outback is a greatly depopulated place. Ballinger’s husband, Bill, who died of a heart attack in 2000, is buried in the Muttaborra cemetery – the only place in the district that still has a growing population.

Ballinger is hopeful wool will make a comeback and help return some vibrancy to the area. “I absolutely love sheep,” she declares. “I’d love to go back to sheep.” She and her neighbours are looking at putting up a fence around their properties that will enable them to address their dog and kangaroo issues.

The dog problem has been particularly bad, Ballinger says, and “it just breaks your heart seeing your precious ewes with their tummies hanging out after a dog attack.”

She estimates that Stockholm has around 10,000 kangaroos, which results in a massive amount of extra grazing pressure. Their numbers can become artificially high on pastoral properties such as hers, because the stock troughs always contain water in an environment that often has little water naturally.



NGADJU



3.6 Carving out a future for their woodlands

Les Schultz and David Graham

*Ngadju Conservation Coordinators,
Western Australia*

While property prices in Sydney and Melbourne were hogging all the headlines in late 2014, one of Australia's more amazing real estate transactions occurred in the town of Norseman in the Western Australian Outback.

Overnight, the Ngadju people went from fringe dwellers on their traditional lands to legal owners of 10 million hectares of country. That's an area bigger than Tasmania or Switzerland. The journey from being dispossessed Traditional Owners to becoming some of Australia's biggest landowners involved an epic legal battle lasting almost 20 years.

One of the Ngadju claimants, James Schultz, who gave evidence about his people's history and identity as part of the native title campaign, recalls the feeling of ecstasy and numbness at winning his land back but also the burden of this "really big responsibility".

The Ngadju people's greatest challenge, however, is still in front of them. They must now manage their vast estate, which includes a huge chunk of one of the Outback's most significant jewels: the Great Western Woodlands (GWW) that stretch from the wheat belt to the Nullarbor Plain.

It's a challenge that Schultz's brother, Ngadju Conservation Coordinator Les Schultz, is tackling head on at the helm of the organisation he pioneered. Les established Ngadju Conservation because he felt a deep need to help his people and the woodlands, well before the native title victory became a reality.

"The worst enemy is hot wildfire, out-of-control fire," Les Schultz says. "My people, Ngadju, used fire to manage our landscapes. There is bad fire and good fire.

"The first Europeans to visit our coasts in 1627 saw fire and smoke," he explains. "This was Ngadju keeping our country healthy with good fire. Fire management creates access by cleaning out thick scrub, it attracts animals and birds to hunting grounds by promoting green-pick, and it stimulates flowering and germination.

"The worst enemy is hot wildfire, out-of-control fire," Les Schultz says. "My people, Ngadju, used fire to manage our landscapes. There is bad fire and good fire."

"It helps keep the excess fuel loads down and brings fresh vegetation through. The animals, birds, reptiles and plant life thrive. The kangaroos would come for the fresh shoots after our fires to have a feed, then we would have a feed."

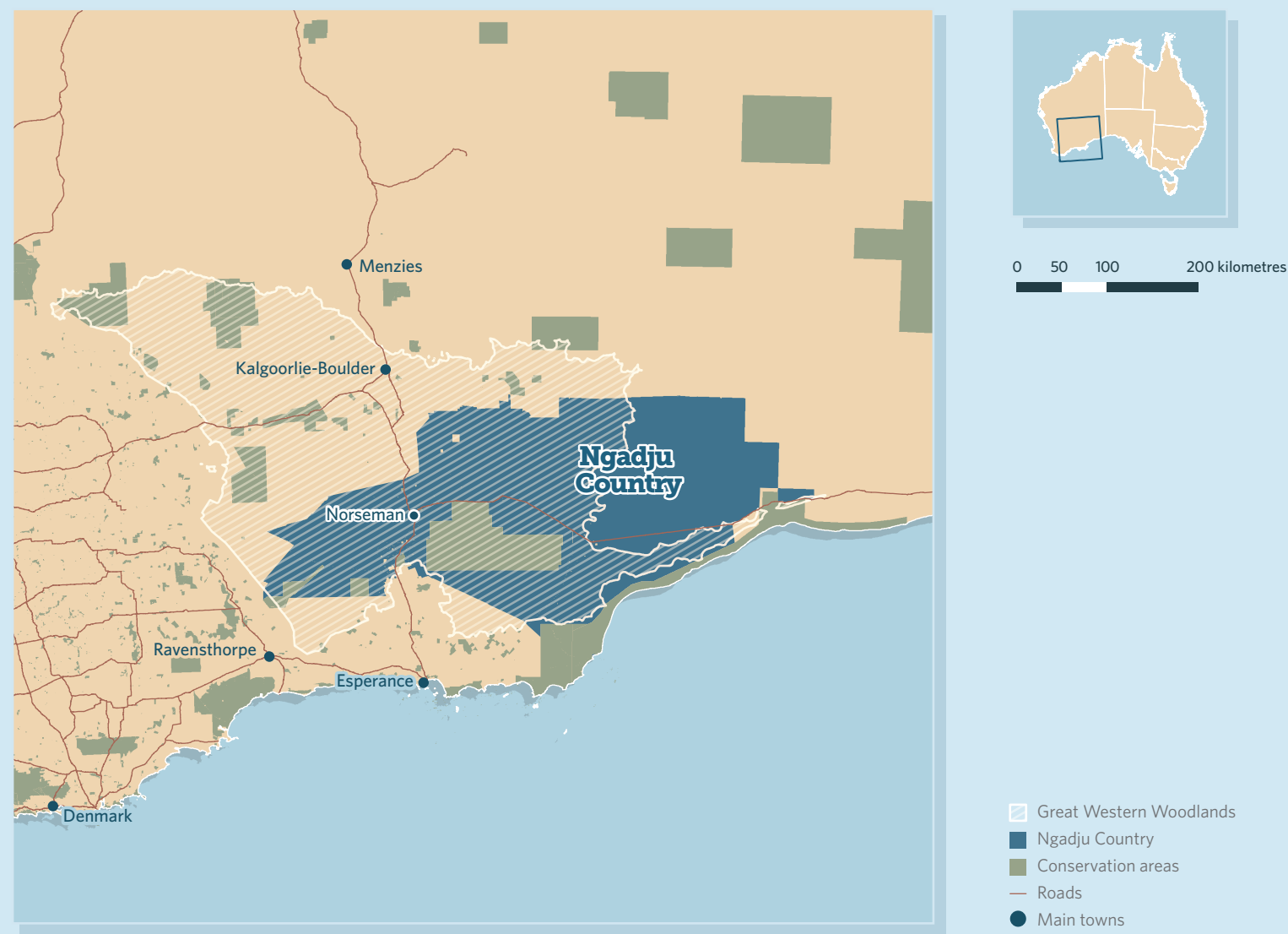
It was when Schultz saw a raging wildfire that "absolutely destroyed our country" that he knew there was a job for the Ngadju to do.

"What we want is to see the Great Western Woodlands managed properly," he says. "And we want to be resourced to do that role. We will always be around, and it ticks all the boxes of everything good in terms of outcomes for Ngadju people, the environment and the general community."



An aerial (top) and up-close (bottom) view of the vast Great Western Woodlands—the largest intact, temperate woodlands in the world.

Figure 11
Location of Ngadju Native Title Area and Great Western Woodlands
in South-West Australia



Sources: National Native Title Tribunal, Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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Schultz dreams of an Outback where Indigenous people use traditional knowledge and modern science to safeguard their country and give themselves meaningful, skilled and economically sustainable jobs. After all, he says, “skills pay the bills.” But it’s a dream that needs outside help.

Schultz says the region’s goldfields have been an “engine room” of the Australian economy, producing immense wealth from the rocks on Ngadju land for more than a century. But, he adds, few Ngadju have ever become miners or benefited from that wealth. “We need urban Australia to invest in the Outback and the Ngadju as land managers,” he says. “We need Ngadju Rangers with boots on the ground.

“It’s now time to correct that wrong from the past,” he says. “It’s time Ngadju was supported to get back on country and resource us to do what we do best, which is being the land managers of the Great Western Woodlands.

“We aren’t miners, we aren’t pastoralists, we aren’t bureaucrats – we are land managers, Ngadju people. We want our future generations to be skilled in land management and traditional knowledge about the animals, birds, plants, reptiles, small creatures and their stories. Please help us manage this country.”

Schultz stresses that Ngadju Conservation is not anti-mining; instead it is “a firm believer in partnerships”. He believes there are lots of opportunities for Ngadju rangers to work with the mining industry, the pastoral industry and government agencies.

For example, the rangers can provide land management services such as weed and feral animal control, waste management, fire management and rehabilitation on a fee-for-service basis. “We need the mining industry and others to be more accountable for their social responsibility to Ngadju Nation,” he adds.

He also believes it’s high time that Indigenous Australians fully appreciated the “common ground and shared values” they have with the conservation sector. “We often don’t see that in the Indigenous sector; we get tied up in the social side of things, or wait for governments to do things for us in health and education,” Schultz says. “We rarely see that the land we’re so close to in spirit is where our future lies and that it has powerful holistic healing.

“It’s time to rise up above, like an eagle; it’s not about waiting for government or waiting for mining. The dependency habits we’ve built up over the years have tied us down, and we keep waiting and waiting. But if you look beyond the horizon, you see the vast landscape of this common ground that we share with the conservation sector.”

Schultz’s beloved woodlands make up the world’s biggest remaining tract of intact temperate woodland – 16 million hectares in total – and the Ngadju now have exclusive possession of vast areas of it (about 5 million hectares). Size alone is not what makes it special. The woodlands are a botanical hotspot: a mosaic of eucalypt woodland, mallee, heathland, saltbush shrub lands, coastal scrub, spinifex, creek lines, granite outcrops, greenstone and banded ironstone hills, quartzite hills, salt lakes and claypans, and the Nullarbor limestone ecosystems.

They support at least 3,300 flowering plants (more than 4,200 taxa are on record), which represent over 20 per cent of Australia’s estimated total flowering plant species and more than twice the number that occur in all of the United Kingdom. It’s also around the same number of flowering plant species found across all of Canada – a country 60 times larger than the GWW.

Les Schultz’s beloved woodlands make up the world’s biggest remaining tract of intact temperate woodland – 16 million hectares in total – and the Ngadju now have exclusive possession of vast areas of it.

The woodlands are also a significant heartland for Australian eucalypts. In fact, the GWW is second to none in the diversity and endemism of eucalypt species.. More than 300 taxa account for about a third of the eucalypt varieties in Australia, and many of those can be found nowhere else.

From the pink glow of salmon gums to the burnished copper of gimlet gums, the area has the timeless beauty and complex diversity of woodlands that have been 250 million years in the making. This ecological provenance is largely due to the region’s unique geological stability.

There are also 49 native mammal species still hanging on, though many of the small wallabies and bush rats are not as abundant as they once were. Some other species have become extinct since Europeans came to Australia and introduced pest animals such as foxes and cats. The 138 reptile, 14 frog and 215 bird species have fared better than the mammals – Ngadju country is among the last of Australia’s woodlands to have intact assemblages of these species.

The Ngadju Native Title area also boasts the fourth-longest beach on Earth, with cliffs bordering the Great Australian Bight capping off the white beaches.



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

Ngadju Traditional Owners David Graham (at left) and James Schultz inspect a mallee fowl mound (top). More than 20 per cent of Australia's flowering plant species grow in the Great Western Woodlands and Ngadju Native Title area (bottom right). Ngadju people have collected water from gnamma rock holes for millennia (bottom left).



Kerry Trapnell



Kerry Trapnell

Beautiful salt lakes are scattered across the Great Western Woodlands and Ngadju country (top). Large wildfires have become more frequent in the Great Western Woodlands, preventing the development of big old trees (bottom).

And, of course, there's the cultural heritage of the Ngadju people that can be seen in *gnamma* rock holes, water trees, rock art and artefacts. "Important cultural places like these keep us connected to country; keep our traditional knowledge healthy for future generations," says Schultz.

Despite an intimate connection with the woodlands going back at least 22,000 years, caring for this country is a daunting task for a people already burdened by the effects of generations of marginalisation.

But in their native title win and the environmental challenge ahead, the Ngadju see a path to redemption – a path to an Outback where they once again care for their country in a way that is environmentally, economically and culturally enriching.

Standing on the summit of Beacon Hill, the highest point near Norseman, David Graham proudly declares: "As far as the eye can see, it's Ngadju country in every direction!"

Graham is Ngadju Conservation's on-country coordinator, and he's the embodiment of what this new Indigenous conservation opportunity represents for his people. He loves *bunna yalinya* – the "good country" of his people – and dreams that Ngadju Conservation will "grow into a business for our people, something they can have pride in". He hopes it will give Ngadju people much-needed training and employment, and opportunities to reconnect with their traditional land.

Graham's a one-eyed devotee of Norseman but readily acknowledges things aren't good for his community there. He loves his footy and used to play rover for the Norseman Vikings, but a few years ago, at the age of 38, he had a triple bypass heart operation because of the damage he had done to his body from smoking, drinking and junk food. Any Aboriginal man in Norseman who lives beyond 50, Graham says, "is on a good wicket".

He hopes that by getting Ngadju people back out on country, getting to know and manage their land again, things can get better. "I drank, I got locked up, but I always had time for country," he says. "That's what's helped me get out of trouble. Hopefully this Ngadju Conservation work is going to be a big help to our young people, because the way we're going at the moment, we'll end up with nothing for them. We've got to leave something for them."

The vast landscape he gestures to from Beacon Hill contains a lot of glorious mature woodlands and natural salt lakes but also areas affected by fire, the mining industry, weeds, litter, erosion, feral animals and vandalism.

In partnership with Gondwana Link – a non-government organisation committed to nurturing a 1000-kilometre corridor of ecological

connectivity linking the biodiversity of the GWW with the coastal forests across southern Western Australia – the Ngadju have drawn up a conservation action plan to tackle these issues.

"We're only taking baby steps at the moment," Graham says, but they have big plans for managing a big land.

One of the marvels of the GWW is how anything, from towering gums to delicate orchids, exists at all in such a parched landscape. Parts of the region receive as little as 250 millimetres of average annual rainfall. Nowhere else on Earth do tall woodlands like this grow where it is this dry.

That same dryness means fire is the woodlands' greatest threat, the key 'regime changer'. It takes 200 to 400 years for the woodlands to reach maturity and full biodiversity with big, well-spaced trees full of breeding hollows for animals. However, nearly 40 per cent of the woodlands has been burnt in the past 80 years as the extent and frequency of fires have increased.

Graham believes this is due to climate change and the way management of the woodlands has been neglected since the reduction in traditional fire management practices.

The new conservation plan gives the Ngadju a big role to play in fire control through firefighting, removing weeds that threaten to change the fire regime and conducting traditional small-scale burning.

The new conservation plan gives the Ngadju a big role to play in fire control through firefighting, removing weeds that threaten to change the fire regime and conducting traditional small-scale burning. They have formed their own bushfire brigade to support rapid response, aiming to put out the small fires before they become big ones.

Just north of Norseman is a big area of woodlands that was burnt by a wildfire about 15 years ago. The grey trunks of thousands of big dead trees tower above the carpet of saplings that have sprung up beneath them – so thick it's almost impossible to walk through them. Members of today's Ngadju community will not live to see this area return to healthy, mature woodlands.

And if it were to burn again in the near future "it might turn into the Nullarbor," Graham says, referring to the vast, treeless plain to the east. "Hopefully, with our new crew we can nip the fires in the bud before it gets to that stage. Burnt woodlands take such a long time to get back to their glory days."

In the future, there could be potential income from carbon credits earned through stopping the woodlands burning, but in the meantime the Ngadju team needs funding for a proper fire truck and firefighting equipment. One of its next tasks is establishing a valid methodology for measuring the carbon stored in the woodland.

This will enable the Ngadju to trade carbon credits for the additional funds needed to manage fire in their country. It's a task that requires a strong combination of Ngadju knowledge and western science, and the support of partners.

While it abounds in natural treasures, the Ngadju's land also bears more than its fair share of man-made scars. In 1894, a man checked his lame

horse and discovered a lump of gold-bearing quartz stuck in its hoof. The horse's name was Hardy Norseman, and thus Norseman has been the name of this busy gold mining centre ever since.

Graham says it's "the prettiest country around", but it also bears sterile open-cut pits, shafts, drill holes, mullock heaps, and old tailings dams redolent of toxic chemicals. These remnants cause erosion and kill wildlife. The miners also felled much of the big timber to run their steam engines, prop their drives and build their railway lines.

"This is what they left us with," says Graham, standing at the edge of a yawning open-cut pit in the woodlands. "There are hundreds of them. There are more holes in my country than there are craters on the moon."



Abandoned mining operations, such as this open-cut mine pit, are dotted across the woodlands.



Les Schultz (at left) and Ashley Simpson inspect a traditional Ngadju water tree.

While fixing the damage already done is something the Ngadju can only dream of at the moment, their native title win at least guarantees them a seat at the decision-making table with mining companies operating on their land from now on. They are determined to demand more environmental responsibility from the miners and hope to earn income for Ngadju Conservation by conducting sustainable land management on behalf of mining companies.

"We're always going to have mining in our area," says James Schultz. "It will still go ahead as long as they revegetate and don't leave a mess that can't be repaired. We've got to coexist with mining companies and work together. We need to go in a new direction."

Ngadju Conservation also wants to be a voice at the table when it comes to dealing with government issues such as the proposed vast barrier fence to keep feral animals away from neighbouring agricultural land that would effectively pen them on Ngadju land.

The Ngadju are keen to do feral animal control so they can reduce the number of wild camels, donkeys, horses, rabbits and goats that take water from the rock holes at the expense of native wildlife and sometimes fall

into *gnammas* and drown, fouling the waters. "Those bloody camels, they are real hard to fish out of your rock holes," says Graham.

Another goal is for fully trained and resourced Ngadju Conservation rangers to once again simply be a presence on country, managing it and policing it. They will report illegal firewood collection, monitor what's happening with wildlife, sound the alarm on bushfires, remind campers not to light fires in summer, remove roadside weeds and stop the mindless graffiti that has already destroyed their forebears' hand stencils that adorned Dundas Rocks near Norseman.

"We don't mind if they go out and enjoy the bush, but look – *this* is how they 'enjoy' the bush," says David with sadness as he surveys spray painting on the mighty granite boulders. "Nothing's sacred no more. We're caretakers; that's what our role is now."

The GWW survived being cleared for agriculture because of the dryness and lack of potable water. The lakes are salty, as is the underground water supply. This meant the earlier Ngadju inhabitants had to find innovative ways to access fresh water. On the granite outcrops they had their *gnamma* rock holes, which allowed them to camp near reliable drinking water.

To cross long distances between the granite outcrops, they used water trees – mature gum trees with deep depressions where the main branches stem. The depressions fill with water that trickles down the branches. Sometimes Ngadju would break a stem or wedge a rock into a young gum to manipulate its growth into a water tree. They would also line the depressions with clay to make them more watertight if necessary. Ngadju are the only people known to employ this practice for catching water.

Ngadju Conservation has started plotting the location of water trees, photographing them and cleaning out hollows. When they become clogged with bark, leaves, sediment and dead animals, native animals that also rely on the water trees find it difficult to get a drink.

“Water trees are like a walk line that our Ngadju ancestors relied on to travel,” Les Schultz explains. “They’re of major importance to our country and need protecting and cleaning. We’ve got to look after them so we can keep our culture alive and teach our children about them. This is important for continuing our culture and important for wildlife.”

By knowing where these special trees are, the Ngadju can also make sure they are not destroyed by mining or fires. The Ngadju are intent on saving water trees and the ancient pathways of their people.

This is what an early white settler wrote of Aboriginal water trees (cited in O’Connor and Prober 2010):

“Let those in need of water, while travelling through a forest, keep a lookout for trees with three or more large branches springing from one butt; should there be a dead stick protruding from the fork, pull it out, and nine times out of 10 water will be found within; to reach it, roll a thin piece of bark into a tube and suck the water through it. The aborigines are adepts in the art, and in their natural state carry a hollow bone stuck through the nose for the purpose. After drinking replace the stick, not only to keep away dogs, emus, etc., but to prevent impurities from accumulating in the receptacle. I have found numbers of trees containing from 10 to 15 gallons, though more frequently only a few pints.”

“Water trees are like a walk line that our Ngadju ancestors relied on to travel. They’re of major importance to our country and need protecting and cleaning.”

– Les Schultz

“All Ngadju country is important to us, and we value all the animals, plants, places and stories that connect us to them,” says Schultz. “Ngadju

Conservation respects partners and supporters who respect our culture and our country.”

One of the most valued and respected animals of the woodlands is the malleefowl, which is under threat because of clearing for mining and excessive burning. The bird’s survival is severely affected by fire, because it requires an abundance of leaf litter to build the large mounds – around 3–5 metres across and 1 metre high – it uses to incubate its eggs. The bird prefers woodlands that have been fire-free for at least 40–50 years to be able to nest. Its breeding patterns decline significantly in burnt areas and can take at least 30 years to return to normal.

The Ngadju have been surveying malleefowl nesting mounds in the woodlands. The resulting information is helping them to focus their firefighting activities and prevent mining activity that could harm the birds.

Malleefowl will sometimes leave a nesting mound, only to return after many years to rejuvenate the nest and get it functioning properly again. They serve as a powerful metaphor for the Ngadju and their beloved woodlands.



A traditional Ngadju water tree.

Breakout 1 **Fire (*kala*) and water (*mijal*)**



Fire is culture for the Ngadju people. Robert Graham lights a fire in the Great Western Woodlands.

“European occupation brought an end to Aboriginal supervision of the forest and wherever it was absent infernos were endemic. Whatever else we think of when we think of the bush, underneath it is always the land violated, the indigenous people too.” (Watson, 2014)

After water, known as *mijal*, fire is the most important element of Ngadju life. The people use it to communicate, celebrate, keep warm, manufacture, engineer, farm, cook, hunt, negotiate, cleanse, prevent wildfires and ward off evil spirits.

“Fire calms the spirits and cleanses you of your bad luck and sickness,” Ngadju Conservation’s on-country coordinator, David Graham, says of smoking ceremonies. “The bad spirits can’t pass through the smoke.”

In short, fire is culture for the Ngadju people. They call it *kala*.

The Ngadju even used fire to maintain their water supply in this dry landscape. They enlarged and deepened the natural, water-bearing rock holes on granite outcrops, known as *gnamma* holes, by lighting fires on the granite, then dousing it with water. The rapid temperature extremes made the granite easier to flake away.

Their reliance on these rock holes made the granite outcrops important campsites and food gathering places. Expanding the rock holes in this way also meant there would be water available about a day’s walk apart along all of the Ngadju’s important travel routes. When a group left a granite outcrop, it would burn part of the area to make sure there was plenty of green pick for animals to feed on. The burnt areas also helped reduce fuel loads to protect these water sources from hotter bushfires.

The Ngadju never used fire to burn the woodlands on a massive scale, because they loved and valued them and knew what damage such intense fires would do. Instead, they always did small, cool burns in the early mornings, when there was still dew on the vegetation to keep the flames low. The burns were never carried out in summer; they were lit selectively and did not harm the mature trees. The Ngadju also used small fires to create protective firebreaks around their water trees.

Soon the Ngadju will return to their traditional patterns of burning to protect their precious granite outcrops, *gnammas* and water trees.





3.7 Mining's legacy: Restoring the land when the miners have gone

Matt Lord

*Superintendent Closure,
MMG Limited*

Matt Lord didn't apply for a job with MMG Limited because he wanted to help run one of the world's biggest open-cut zinc mining operations. Instead, he wanted the job of closing it down.

He wanted to rehabilitate the 3000 hectares of Outback Queensland that the Century Mine has disturbed. He wanted to show Australians and the mining industry the way mine closure should be done, and set an example that others could seek to emulate. Judging whether he has been successful will take decades.

For Lord, Century is a once-in-a-generation opportunity to execute his passion for effective mine closure and rehabilitation. It's the first time in Australia in more than a decade that a base metals mine of this size has reached the end of its economic life and begun the process of closing down operations. Lord's grand mission is making sure it becomes a shining example of the mining industry cleaning up properly after it has finished digging.

"Challenges don't come much bigger than closing down Century Mine," says Lord, 52. "Our work will likely take decades. This site will need to be managed to some degree for many long years."

What made Century such an attractive project for Lord is the commitment of its Chinese-owned parent company, MMG Limited (formerly known as Minerals and Metals Group), to do a thorough rehabilitation job, coupled with the vast scale of the mine.

Matt Lord wants to show Australians and the mining industry the way mine closure should be done.

Located 200 kilometres inland from the Gulf of Carpentaria in north-western Queensland, Century is Australia's largest open-cut zinc mine. It supplied about 5 per cent of the world's zinc over its 16 years of operation and is a place where everything seems to be on steroids – where dollars and tonnes are measured in millions.

The pit is 340 metres deep, 3 kilometres long and 2 kilometres wide, surrounded by piles of waste rock and a vast tailings dam. A descent down the pit's massive benches feels like a journey to the centre of the Earth. Since mine operations began in 1999, more than 800 million tonnes of rock have been dug from this pit, including some 80 million tonnes of zinc and lead ore.

In the first half of 2015, when the mine was coming to the end of its life, Century still had revenue of US\$390 million and operating expenses of

\$225 million. The Komatsu 830E trucks rumbling around weigh about 200 tonnes empty and can haul a payload of twice that. Their V16 engines consume 2500 litres of diesel a day, and each tyre costs \$80,000.

On paper and in person, Lord is not the classic mining management employee you would expect to find in such an operation. Growing up on acreage surrounded by bushland on Sydney's northern outskirts gave him "a passion for native plants". That led to an associate diploma in horticulture. He went on to manage a big native plant nursery before becoming a horticulturalist/greenkeeper/environmental manager at tourist resorts in Thredbo, Dunk Island, Uluru and Broome.

Then came work in the mining industry in the Pilbara, on Groote Eylandt and in the Bowen Basin. Lord also has a postgraduate degree in mine rehabilitation. "I'm not really a closet greenie; I'm an 'out-there' greenie," he explains with a grin. "Not everyone in mining just likes digging things up. People here genuinely want a good environmental outcome."

He still sees himself as a humble gardener. "What I'm doing now is really just gardening with big toys. You're just using a D11 [bulldozer] where once you would have used a wheelbarrow."

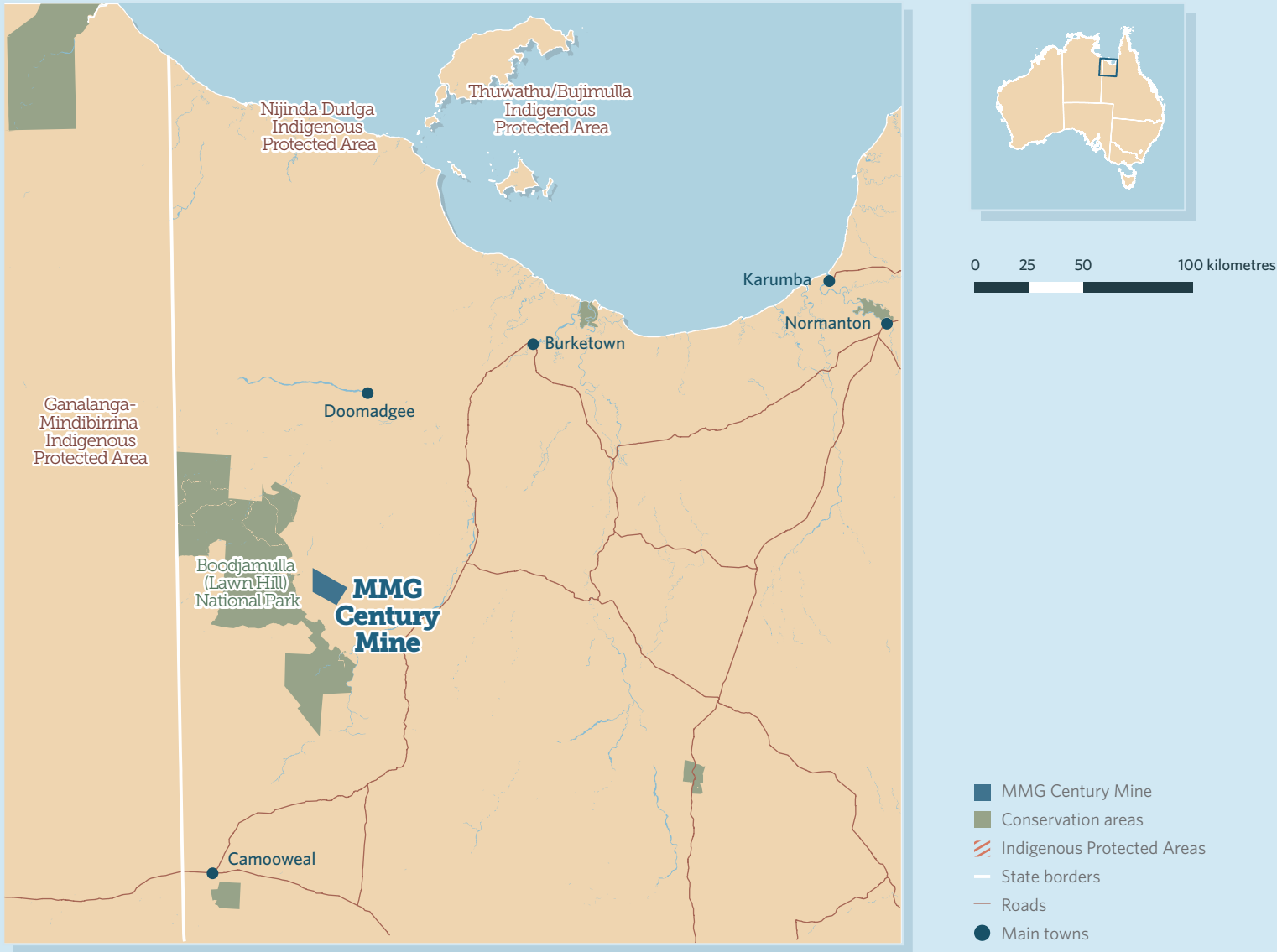
Century was operated by four different mining companies before being bought by MMG in 2009, 10 years after it began open-pit production. At its peak, the mine employed around 1,200 people, about one quarter of whom were Indigenous people connected with the Gulf region. During 2016, the number of on-site workers will drop to less than 40.

The mine's final ore was mined in August 2015, with processing and shipping completed in January 2016. The next phase of super-sized earthworks is underway in earnest as part of an initial period of 'active closure', after which there will be a 25–30-year 'passive closure' period. The goal over that extended time frame is to turn the mine site into a safe, stable, resilient and self-sustaining system that requires minimal ongoing human management.

The rehabilitated area will be revegetated, the waste dumps will be designed to provide fauna habitat, and the more lightly disturbed areas may be able to support cattle grazing. The pit void will not be completely backfilled, and an artificial lake will remain. The void will be barricaded to prevent access by humans, native animals and cattle.

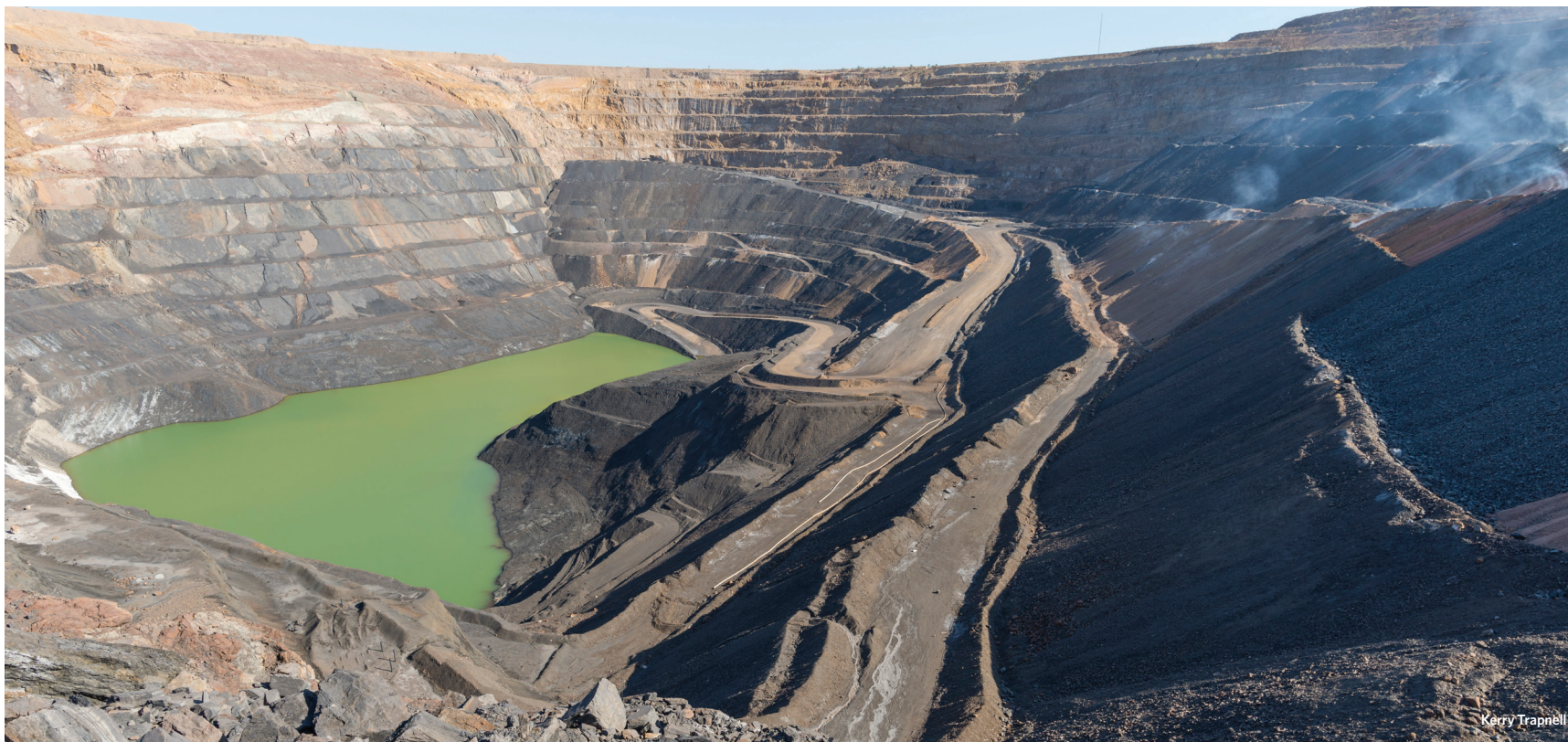
The Queensland Government will monitor the process to make sure rehabilitation has been effective by about 2046, when the company hopes to relinquish the 23,500-hectare mining lease. Governments have been 'burnt' before. Lord has "seen the good, the bad and the ugly of mine closure" in Australia and overseas.

Figure 12
Location of MMG Limited's Century Mine in Northern Queensland



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.

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At 3 kilometres long and 340 metres deep, Century Mine is Australia's largest open-cut zinc mine (top). Large trucks transport ore from the mine (bottom).

He says the bad and ugly examples significantly outnumber the good ones, particularly older operations that were established and subsequently closed before environmental legislation and guidelines were developed. And the number of accomplished mine closure practitioners around the world is tiny.

Century's closure will be a long saga that will come at a cost. It will not involve using those huge trucks to haul mountains of waste rock back into the pit. That, Lord says, would cost unaffordable billions of dollars and still leave a highly disturbed landscape.

Century's rehabilitation issues are far more complex than simply filling a hole in the ground and planting trees on top. The crux of the issue is acid mine drainage. That's why the No. 1 aim of rehabilitation at Century is to turn its waste rock dump landscapes into a "mineralised waste encapsulation system" – a safe armoury for the waste rock and water created by mining.

Lord explains that when ancient rock is exposed to the elements for the first time in millions of years, there's a chemical reaction that can create sulphuric acid. The great environmental challenge at Century, therefore, is to keep water away from the mineralised waste in its massive dumps and capture any acid mine runoff created if the waste does come in contact with water. That requires an innovative capping and drainage system.

Century's rehabilitation issues are far more complex than simply filling a hole in the ground and planting trees on top. The crux of the issue is acid mine drainage.

On the top of each massive waste dump there will be a 1.5-2-metre 'sponge' layer of broken, weathered limestone over a 30-centimetre layer of rock that has been compacted by heavy truck movements to the point where it's like concrete. The sponge will host native vegetation as part of a 'store and release' system that stops water from soaking down into the waste rock to create acid mine runoff.

Because evaporation usually greatly exceeds precipitation at the mine site, during the dry season the vegetation 'pumps' into the atmosphere all the rain that falls into the limestone sponge during the wet season. It's deemed the best solution, given the local semiarid climate.

"The purpose of the sponge we're building on our dumps is to hold up the wet season rain and keep it there, and then the vegetation will transpire that back into the atmosphere over the dry season so the water doesn't penetrate down through the compaction layer," Lord says. "The non-



Mine workers stand in the shade cast by a large mine truck (top). An employee washes down a vehicle (middle). Matt Lord displays a 20-year rehabilitation plan for Century Mine (bottom).

shedding covers mean that we intend to keep nearly all the rainfall up on that dump surface to be recycled back into the atmosphere by the vegetation cover.”

The outer slopes of each dump are also clad in limestone so that any rainwater that does flow through them doesn’t come into contact with reactive mineralised waste rock. The alkaline nature of limestone, which has also been used as a foundation for constructing the dumps, has the effect of neutralising the acidity generated when the mineralised waste oxidises.

Lord says Century’s previous operators did some good things and some not-so-good things when it came to preparing the mine for eventual closure and rehabilitation. On the good side, more than 10 million cubic metres of weathered limestone was set aside and is now available for encapsulating the waste dumps. “We’re very lucky that we’ve got an abundant supply of limestone,” he says. “It was put aside in the early days, so some good mine planning went on very early in the piece.”

But when times were economically tough, bad decisions were also made. One example is the short haul dump that surrounds Magazine Hill – a place of cultural significance to the Waanyi people.

Magazine Hill stands as an untouched island in the heart of the Century operation. However, to save a few cents per cubic metre when the zinc price was low, a previous mine owner decided to short-haul waste rock and dump it around the hill.

According to Lord, it wasn’t built “in accordance with leading practice encapsulation methodology”, and the dump obliterated the Magazine Hill vista. There was no compacted layer to stop water seeping into the waste rock, and the sponge layer of limestone on the surface was 10 metres thick, meaning tree roots couldn’t reach the water and trees couldn’t transpire it back into the atmosphere. As a consequence, Lord decided to dig up the entire dump and shift it – all 5.7 million cubic metres.

“The trick for mining of this nature is to have a walkaway solution where you don’t have a reliance on what I call the five Ps: people, pumps, power and pipes in perpetuity,” he explains. “And there are some mines that do rely on the five Ps, because they didn’t understand the issue of acid mine drainage or they didn’t accommodate it in their designs. We’re very fortunate here that in addition to the limestone, we’ve got gravity on our side, so we can direct that seepage into the pit without the need for pumping once construction of the drainage system has been completed.” Drainage works have also been undertaken to direct clean overland flow away from mineralised waste landforms.



One of the many native plants grown from local seed at Century Mine (top). Road signs warn drivers to look out for echidnas (bottom).

All the waste dumps will be angled so that any runoff flows into cleverly designed limestone drains, then into the pit. Surface water, groundwater and wastewater produced during the mine's operation will be directed into the pit, which will gradually fill over the next century until it reaches a point of equilibrium where evaporation exceeds inflow.

MMG is undertaking pit lake modelling to confidently predict water quality and ascertain a stable and non-harmful final landform even during the most intense rain events. The course of a creek that naturally flows into the pit may need to be altered to ensure this, but such action would be taken only after discussions with local stakeholders.

Century has done climate modelling for the next 600 years that suggests there will be more intense rain events, but generally the climate will become hotter and dryer, leading to greater evaporation. If the water quality cannot be confirmed as safe, the artificial lake will be fenced off for many years.

How much is it going to cost to close and rehabilitate Century over the next 30 years? MMG won't say exactly, but it's likely to be in the hundreds of millions of dollars. The Queensland Government has a bank guarantee of that scale from the Bank of China to pay for rehabilitation, should MMG ever abandon the project.

Lord says about \$100 million or more worth of earthworks alone will need to be done – a significant commitment in the MMG financial planning. The company report for the first six months of 2015 noted that an additional mine rehabilitation provision of US\$146 million had been made for Century, which contributed to the company taking a US\$48 million loss for the same period.

Lord says a key lesson of mine closure and rehabilitation is that the process should be built into the initial mine design and integrated into the mine's operating plan. The better the planning and integration, the lower the ultimate closure cost.

Mine closure needs to be considered in critical decisions that a mining company makes about designing, commissioning and operating a mine, because closing a mine down is just as complex and often requires a longer time frame than developing an operation.

As a starting point, mining companies need to work with stakeholders, such as Traditional Owners, to agree on the final post-mining land use and landform. "Make sure people don't lose focus on what the endgame is – ask what longer-term outcomes we're looking for," Lord explains.

Unfortunately, it's common to think short term instead of long term. And that happened at Century over its previous life span of five different owners. Mountains of waste rock were sometimes dumped in the wrong

places in the wrong way in an apparent reaction to tough times and cost-cutting.

Lord reckons that the closure bill at Century could have been cut by at least a quarter if closure planning had been fully integrated into the mine's operational plans from the outset, before MMG bought it. He says mining companies should be looking many decades ahead and thinking about mine closures to ensure that they happen properly. "You should have someone responsible for planning the closure before you even turn a spade of dirt," he says.

Lord started working at Century as the closure superintendent in December 2010. Spending five years there before open pit mining had been completed was crucial to achieving a better closure outcome, he says. "You've got to have boots on the ground, being in the right meeting at the right times saying, 'Hang on, if you do that, have you thought about this?'"

He says the role of the closure team includes adding value and developing more cost-effective and innovative closure options and solutions. "Some people within the industry may view closure planning as a negative, but with the right planning, it can assist in extracting maximum value from the resource while minimising long-term liability," he explains.

How much is it going to cost to close and rehabilitate Century over the next 30 years? MMG won't say exactly, but it's likely to be in the hundreds of millions of dollars.

Century's footprint is a relatively small wound in the vastness of the Outback; about 89 percent of the lease area remains undisturbed by mining. The disturbance is an area that has been sacrificed to bring Australia great wealth. The mine has helped bring vast improvements in income, employment and training opportunities to the isolated Gulf country, particularly for local Indigenous people.

Lord says a big part of his job has been educating the workers so they can make the transition from miners to rehabilitators. Mining, for example, loves bulldozer drivers to do neat, straight lines, but that doesn't work for rehabilitation, "because nature doesn't do straight lines". Lord tells them they are now "landscape sculptors", creating what will hopefully be a rehabilitation masterpiece that mimics the curves of nature.

As part of its Caring for Country program, MMG has been contracting with Traditional Owners to collect native seed for the revegetation process. The company intends to continue employing Traditional Owners to undertake

fire, weed and feral animal management of the mine site as it goes through its decades of rehabilitation.

On the summit of Century's south waste rock dump, where rehabilitation work is the most advanced, Lord likes what he sees. The sponge surface of weathered limestone was aerially seeded just before the wet seasons in 2009-10 and 2010-11, and today it's studded with a healthy covering of small eucalypts and acacias, their roots already tapping down and spreading across the compacted layer buried below. "They've had a couple of years of drought and they're still doing fine," Lord says. "It's already an operating store-and-release cover."

In the more barren patches, pockets of topsoil have been added to give regrowth a kick-start. The intent is to inoculate the weathered limestone surface with beneficial micro-organisms and introduce additional nutrients and organic matter.

Weeds have been poisoned and native grasses and spinifex have started to naturally recolonise the area. There's leaf litter accumulating that will put nitrogen back into the earth. There are ants ... and wallaby scats. Some big

boulders have been piled into high points to create extra habitat for reptiles and provide perch points for raptors.

Data from five solar-powered monitoring stations, in operation since 2012, indicate that the south dump sponge system is working, that it's stopping the deep percolation of water into the waste rock stored below, where it would become acidic.

However, according to Century's on-site environmental engineer and senior closure engineer, Pascal Defferrard, the first two wet seasons since the monitoring stations were installed were poor, producing little rain. So the system has yet to be fully tested by the elements.

To be certain that the cover system can stay robust in the long term, Defferrard says, data need to be gathered for many years and during extreme events such as epic wet seasons, cyclonic winds and wildfires. Ideally, a trial would have been established when the mine started operating, and there would already be nearly two decades' worth of information gathered through such extremes.



Solar-powered stations monitor sub-surface water levels (left). Rocks and soil in rehabilitation areas are sculpted to mimic the curves of nature (right).



The tailings dam at Century Mine covers 376 hectares (top). MMG Limited hopes to extract zinc from sediments before rehabilitating the dam (bottom). A rehabilitation plan is currently being developed.

"That's the Catch-22 of the industry," Defferrard says. "Because they aren't planning for closure, they typically don't gather the data necessary to enable a quality closure." Mineralised waste encapsulation systems have not achieved the intended outcome at other mines, so he can understand why government regulators want long-term data to confirm that rehabilitation measures have worked before letting mining companies walk away from sites.

So Lord and Defferrard need Mother Nature to apply some pressure to prove that MMG's rehabilitation approach will work over the decades to come. To work in mine closure, Defferrard says, it helps to have a personality that can cope with "long-term delayed gratification".

Mining might have stopped at Century, but it's still home to one of the world's most significant zinc ore deposits. That ore no longer sits in the ground; it's in Century's vast tailings dam, a silver-grey lake of sediment covering 376 hectares that is nearly 20 metres deep in some places.

MMG has pledged not only to make sure that Century is closed and rehabilitated properly but also that it happens transparently and publicly.

Century's processing mill usually extracted only 75 to 80 per cent of the zinc in the ore that it processed, generating more than 60 million tonnes of tailings that contain plenty of metal. They are potentially an asset worth many millions of dollars but also a legacy that requires an expensive clean-up.

Small trial sites have been established to test different methods of capping the tailings dam. The trials alone cost \$2.5 million to build. Rather than covering it in rock, the company will use 'hydraulic recovery' – scouring out the tailings with high-pressure water – before pumping the tailings back. The preference will be to extract the zinc before pumping the tailings residue into the main pit void, where it will be stored for eternity. Once free of tailings, the former dam area will be remediated, including aerial seeding to encourage revegetation.

Once the best capping method has been established and the economics have been worked out, it's also possible the tailings could be reprocessed to extract the zinc before they go into the pit. Decisions are yet to be made, but even if the work started tomorrow, Lord says, it would probably take at least 10 years to remove all the tailings, then rip and seed the area.

Once the decision is made, it won't be kept secret. MMG has pledged to make sure not only that Century is closed and rehabilitated properly

but also that it happens transparently and publicly. For Lord, that means presenting hard data at conferences, hosting media and stakeholders on mine site tours and updating information on the company website.

There's still a long way to go with rehabilitation on the west and north dumps, where a bare plateau of compacted rock remains. To get the compaction needed for a water-resistant layer, the rock needs to be driven over at least 100 times by a fully laden haul truck weighing more than 400 tonnes.

Lord plans to stay on the project as long as he feels the company values him and his role. "I'd like to see it out, because it's such an enormous challenge," he says. "I didn't take this job for the money; I'm doing it because it's an opportunity to do something properly that hasn't been done well very often in the past."

Lord hopes he'll be leading Century's rehabilitation long enough to see eucalypts growing strong and tall on the west and north dumps – trees that will stand as a symbol for mine rehabilitation that has been taken seriously.



Lord assesses acacias planted in the revegetation area, which have flowered and set seed.

Breakout 1 **Bring in the drones**

When he decided to become a surveyor, Paul Cresswell didn't know he would need to become a pilot as well.

But just as drone technology has revolutionised Cresswell's surveying job, it will revolutionise the monitoring of the rehabilitation at Century Mine, where he works. Cresswell has trained to become a licenced drone pilot and is using his Questav Q200 Survey-Pro to generate stunning data from the vast mining operation relatively cheaply.

Weighing 4.5 kilograms and able to cover about 60 kilometres in 30 minutes using its battery-powered propeller, the drone takes images every three seconds as it flies at an altitude of 110 metres.

By clipping different pods to the drone, Cresswell can capture a variety of data. Clever software can stitch together photographs to produce amazingly detailed three-dimensional images of the waste dumps. There are also techniques for generating colour-coded vegetation regrowth mapping.

Thermal imagery can be used to identify hot spots within the rocks or cool spots where water is flowing. Detailed three-dimensional contour maps can be produced to show exactly where runoff will

flow over the landscape or where land is slumping or bulging, requiring additional remediation work.

MMG also hopes that images can be used to support the annual weed management plan by identifying isolated weed outbreaks within emerging native vegetation. This would save time and money when the site is surveyed for weeds that need eradicating.

The technology has already established a link between hot spots and bulging in the waste dumps. It can also show where vegetation will struggle to re-establish itself because of excessive heat held in the earth.

MMG has spent about \$100,000 to buy the drone, the various pods and computer software and to train Cresswell in their use. However, it's far more cost-effective than hiring an aeroplane, and the drone can be flown every day of the year if necessary.

The plan is for the drone to fly over the rehabilitation areas several times a year to collect data. "The amount of data you get out of it is amazing," says Cresswell, who started his surveying career when it was still all about theodolites and chains, and drones were little more than science fiction writers' fantasies.

Breakout 2 **Changing lives through work**

What does Ernie Cheetham, an Aboriginal man, like best about his 10-year career at the Century Mine as an operator of massive shovels, bulldozers and trucks? “That’s easy: money. And the roster.”

It’s a job that has enabled Cheetham, his partner and their six children, age 4 to 12, to live in Townsville, which he says offers not just a good climate and lower cost of living, but better education and medical facilities for his children and job opportunities once they grow up.

The roster of eight days on and six days off has improved the 32-year-old miner’s quality of life, including the flexibility to spend plenty of time with his family or visit his people on Mornington Island when he’s feeling homesick.

Century Mine, the Queensland Government and four groups of Traditional Owners signed a landmark native title agreement in 1997, prior to the start of mining. The Gulf Communities Agreement had lofty goals to provide opportunities and a higher quality of life for Aboriginal people. Over the years, some Indigenous leaders have been critical of the mine for what they see as a failure to deliver on some aspects of that agreement.

Cheetham says what Century did deliver for local Aboriginal people is simple: “It helped a lot of people do what they wanted to do. It’s kept people out of trouble because they’ve had a job.” More than 1000 Aboriginal people have been trained and employed through Century Mine, and at times nearly a quarter of its workforce was Indigenous. For some, it was the first time they had an income that wasn’t welfare.

Cheetham says the opportunity to work at Century delivered him from a life in Mount Isa, where he was doing nothing more than drinking and “hanging around with the wrong crew”. It gave him purpose and a hefty pay packet and literally turned his life around.

When he is eventually made redundant at the mine, he plans to keep living in Townsville and probably complete the carpentry apprenticeship he started many years ago.

“This place here changes a lot of people,” Cheetham declares as he prepares to put in another big day behind the wheel of a massive Komatsu truck as part of Century’s rehabilitation team.

Breakout 3 **A better neighbour than some**

Lawn Hill and Riversleigh Station

Over the life of the mining operation, Century Mine's operators have paid more than \$30 million to local Aboriginal organisations.

During the mine's development, two neighbouring cattle grazing properties were purchased: Lawn Hill (where the 23,500-hectare mining lease is located) and Riversleigh Station. These became a single entity – the Lawn Hill Riversleigh Pastoral Holdings Company Ltd, which is now 51 per cent owned by the local Waanyi people and 49 per cent owned by MMG. The long-term plan is to make a transition to 100 per cent Waanyi ownership.

Lux Lethbridge, who until late 2015 was the station's manager, oversaw 30,000 head of cattle and about 30 workers, ranging from stockmen to cooks. Like everyone who manages the landscape in this savanna country, one of Lethbridge's chief preoccupations was controlling destructive wildfires.

As station manager, he met with mine representatives, pastoral and tourism neighbours and the Queensland Parks and Wildlife Service to discuss what fire management looks like as Century makes the transition to closure.

For many years, the mine has played a big role in helping to deal with the regular fires that threatened its land or that of neighbouring national parks, cattle stations and tourism enterprises. With its workforce dwindling over the coming months, the same level of specialised emergency response will no longer be available to the community. The question on everyone's minds now is: 'How are we going to replace them?'

Lethbridge said the mine "has been a very valuable asset to have around to get you out of trouble". If a fridge, a hydraulic hose or flat tyre needed fixing, someone from the mine would usually help out. The same principle applied if local kids needed a return flight to boarding school or if someone required medical help.

"But we all knew this day was coming," he said of the mine's closure. "Before the mine was there, people managed without it, and we will learn to manage without it again."

Adels Grove

Chosen by the Queensland Government in the 1920s as a site to experiment with growing tropical fruits irrigated by the creek, today Adels Grove Camping Park is a popular tourism destination that can host hundreds of guests a night and employ up to 30 staff members at its busiest times.

Its popularity is due to its idyllic location on the banks of Lawn Hill Creek – a stunning spring-fed body of crystal clear water. It's an Outback magnet for those who want to swim, fish for barramundi, travel up Lawn Hill Gorge on the camping park's solar-powered boat and visit Boodjamulla (Lawn Hill) National Park and the famous Riversleigh fossil site.

Michelle Low Mow and her husband, Rod, have owned Adels Grove for as long as the mine has been operating downstream from their tourism operation.

Being able to use the mine's airstrip and medical facilities has been particularly beneficial over the years, and Low Mow is full of praise for Century's commitment to local Indigenous people. "They have done a lot of good things for the Traditional Owners," she says.

Low Mow says she has confidence in MMG's rehabilitation plan, which is a major vote of confidence, given that many residents believe a serious leak from the mine's containment structures could ruin the health of the creek and her business.

Although there have been times when aspects of the mine's operations haven't impressed its neighbours, she believes that, overall, it has been a well-managed benefit to local communities and Adels Grove.





3.8 Preserving a geological paradise

Marg and Doug Sprigg

*Owner-Managers,
Arkaroola Wilderness Sanctuary,
South Australia*

At Nooldoonooldoona Waterhole, where Arkaroola Creek kinks deep through the ancient rocks of the Flinders Ranges, a group of artists is intensely studying the landscape.

Armed with sketchbooks and easels, pencils and paints, they're joined in a struggle to do justice to its incredible colours, shapes, spirit and antiquity. They're deep within a 'postcard Outback', complete with gnarled river red gums, spiky spinifex, cypress pines, mulga, emus, wedge-tail eagles, kangaroos, carpet pythons and a mountainous geology like nowhere else on Earth.

Big, bold blobs of vivid red, purple, orange, green, yellow and blue are slapped onto a canvas.

"I think I've captured some of the energy of the place," says one smiling artist as he steps back to examine his work. "To catch the wildness, you have to put it on rough."

Another artist declares that a painting trip to Arkaroola is just like fishing: "At the end of the day, if I don't go home with a good painting, I don't care. It's art therapy."

The artists have come to Arkaroola Wilderness Sanctuary from far and wide for a seven-day *plein air* painting retreat, paying good money for the experience – \$2500 each. They're loving their creative Outback experience.

Most importantly, there are the hands-on owners ... a dynamic and very hospitable duo in their early 60s who make the magic happen at Arkaroola and keep their late father Reg Sprigg's dream alive.

Birds sing, a cool breeze blows and clouds skittle across the big blue sky as they discuss palettes, techniques, light and perspective while they depict the incredible crumpled landscape of arid mountains climbing to over 900 metres above sea level. A booking has already been made to come back in 12 months.

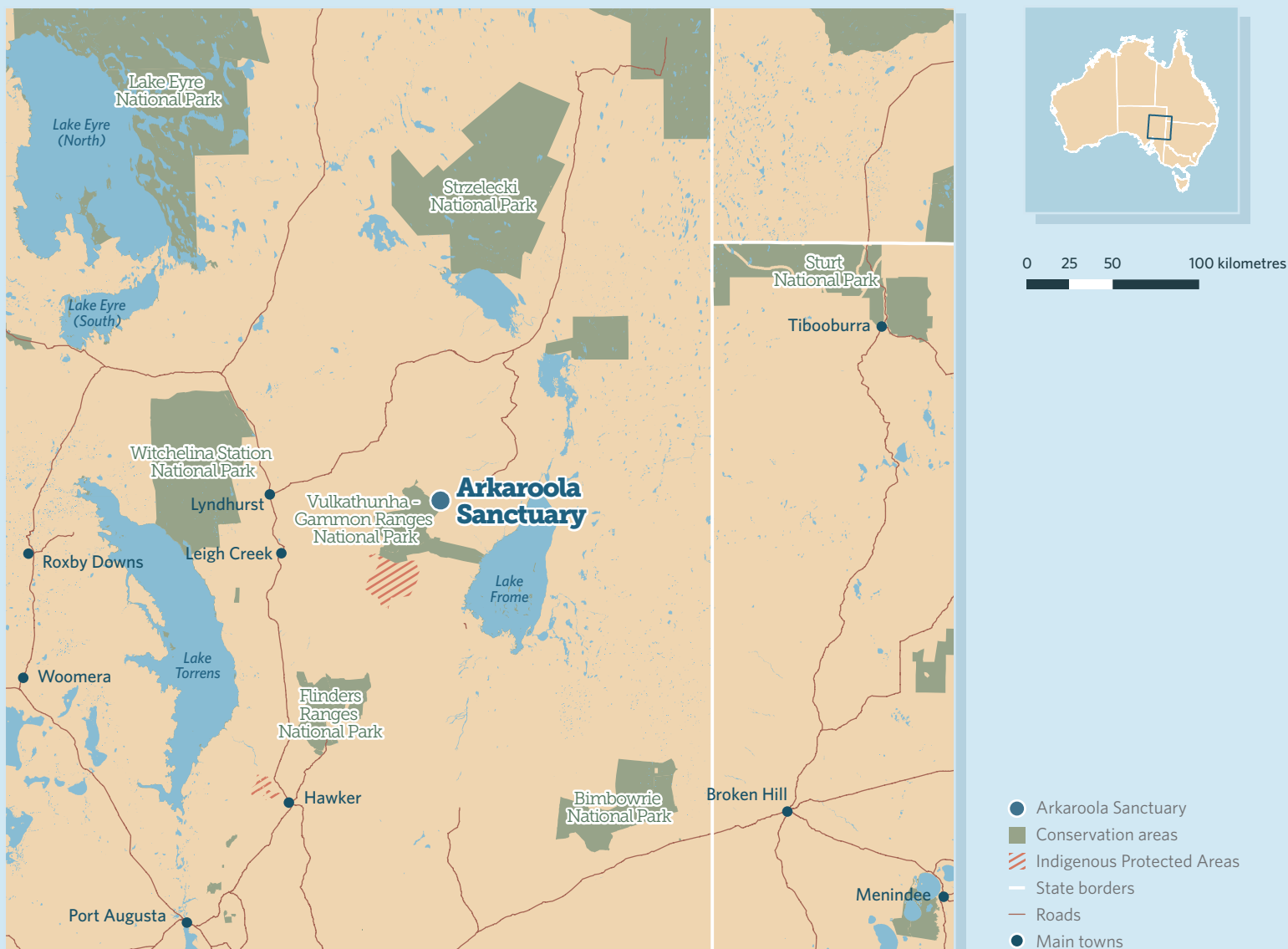
What these artists are painting is the perfect picture of Outback ecotourism. The experience they are paying for helps to protect the very landscape they are enjoying.

They're also painting a picture of what the future Outback could look like – a place that's beautiful and biodiverse; a place of research and education; a place that's environmentally, economically and culturally sustainable.



Artists make a pilgrimage to paint Arkaroola's imposing landscape (top). Steep rocky ridges encircle the Arkaroola tourist village (bottom).

Figure 13
Location of Arkaroola Wilderness Sanctuary in South Australia



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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Arkaroola is a sprawling, 610-square-kilometre former sheep station in South Australia, 600 kilometres north of Adelaide, that for nearly 50 years has been a privately owned pioneer of Outback ecotourism.

The sanctuary's modest tourist village has 50 neat motel rooms with hot showers, as well as powered van sites and backpacker accommodation. There's a little general store and a service station, the Native Pine Restaurant for ordering tasty kangaroo kebabs, and the Pick & Shovel Bar for a cold beer. There's even a spacious studio for the artists to use after they have finished their outdoor work or if the weather turns foul. Some visitors are shocked to find there's no mobile phone service, but there is wi-fi as well as three public pay phones.

Arkaroola has something for everyone: students pursuing a career in science, grey nomads on their bucket list holiday, four-wheel drivers, campers, bushwalkers, mountain bikers, geologists, botanists, birdwatchers, astronomers, photographers and seekers of solitude.

There are stunning ridge tops and gorges to explore using a network of walking tracks and dirt roads. There are two observatories for exploring the heavens; scenic flights; and guided tours looking at the local wildlife, waterholes and geology. No wonder visitors stay an average of three days.

Most importantly, there are the hands-on owners, siblings Marg and Doug Sprigg – a dynamic and very hospitable duo in their early 60s who make the magic happen at Arkaroola and keep their late father, Reg Sprigg's dream alive.

Sprigg and his wife, Griselda, bought Arkaroola in 1967 after the years he spent urging politicians to turn it into a national park came to nothing. An acclaimed geologist and conservationist, he had first gone there in 1937 as a student of Sir Douglas Mawson, who, in addition to being a famous polar explorer, was a professor of geology and mineralogy at the University of Adelaide.

Mawson first visited Arkaroola in 1906 and declared it "a geologist's paradise ... one great open air museum", and an ideal laboratory for his students. Sprigg never forgot his mentor's plea: "If you can do anything to protect Arkaroola for posterity, then do it."

Sprigg quickly set about managing Arkaroola for wildlife preservation and conservation and re-establishing native flora and fauna. It was formally declared a private sanctuary in 1969 (sheep were removed from the property in 1970), but the then-state government revoked that status two years later. The property was reinstated as a sanctuary in 1996.

Arkaroola's hot springs are a natural feature that makes geologists salivate. The sanctuary has the world's only known hot springs created by rainwater that is warmed as it passes down a fault line through radioactively heated

rocks. And that has NASA interested, because bacteria manage to live in this incredibly hostile environment.

"This is a window into the earliest life on Earth and perhaps elsewhere in the solar system," says a South Australian Government information guide about Arkaroola's geology. It describes the hot springs as a "natural laboratory" for study that could help in the development of geothermal energy sources.



The oldest rocks at Arkaroola date back 1.6 billion years (top). The wilderness sanctuary has two observatories where visitors can explore the heavens (bottom).

In fact, Arkaroola's geological wonders are so unusual that it is considered to be possibly the closest landscape on Earth to that of Mars. It's been identified as Mars Society Australia's (MSA) prime site for Mars analogue field research because of the diversity of its geology and landforms, and the range of potential habitats of astrobiological interest.

Arkaroola features an incredible 122 mineral types across four main groups: precious, ore, radioactive and rock-forming minerals. There are igneous rocks, metamorphic rocks, sedimentary rocks, breccia rocks. It has rocks from the Permian, Cretaceous and Tertiary periods. The oldest rocks date back 1.6 billion years, which means Arkaroola houses geology that covers 40 per cent of the Earth's history.

Reg Sprigg and his wife, Griselda, bought Arkaroola in 1967 after the years he spent urging politicians to turn it into a national park came to nothing.

Twenty-one types of uranium have been found at Arkaroola – more than anywhere else in Australia – and one of them is called Spriggite. In 1944, when the race was on to build the atomic bomb, Sprigg began work at the Geological Survey of South Australia to reactivate a nearby uranium mine and map the region's uranium resources.

"It is a globally important region of concentrated and diverse geological, geomorphic and geo-historical phenomena of national heritage significance," the government guide says.

"Like no other precinct in Australia, this three-dimensional exposure of the Earth's crust reveals phenomena of vital interest for research in the mineral and energy industries, for research into ancient life and for practical geological education of students of crystalline rocks, economic minerals, hydrothermal and sedimentary processes, structural geology, geomorphology, planetary exploration and geological links with arid-land ecology."

This extraordinary geodiversity in turn underpins a rich flora and fauna including endemic, threatened and relic species, and species at the end of their range. The weird-looking endemic spidery wattle and slender bell fruit are two rare plant species that the Spriggs monitor on Arkaroola for scientific purposes. The precious yellow-footed rock wallaby, jewelled gecko and Flinders Ranges short-tailed grasswren are also part of the sanctuary's native menagerie.

When it comes to the sanctuary's human inhabitants, Doug Sprigg can be described as an Outback renaissance man – a bloke as comfortable fixing a cracked diff with a welder as he is guiding gobsmacked guests through the jewels of the night sky with a telescope.

He uses Latin as fluently as an ancient Roman to give the native plants and animals their scientific names, and makes rocks come to life in a vivid geological saga he tells with breathless wonderment.

From the moment he picks guests up in the bus to transport them to his Cessna for a scenic flight, Sprigg – who's also an experienced pilot – enthusiastically holds forth first about geology, then about plants, animals, history, weather, the neighbours and anything else on his mind.

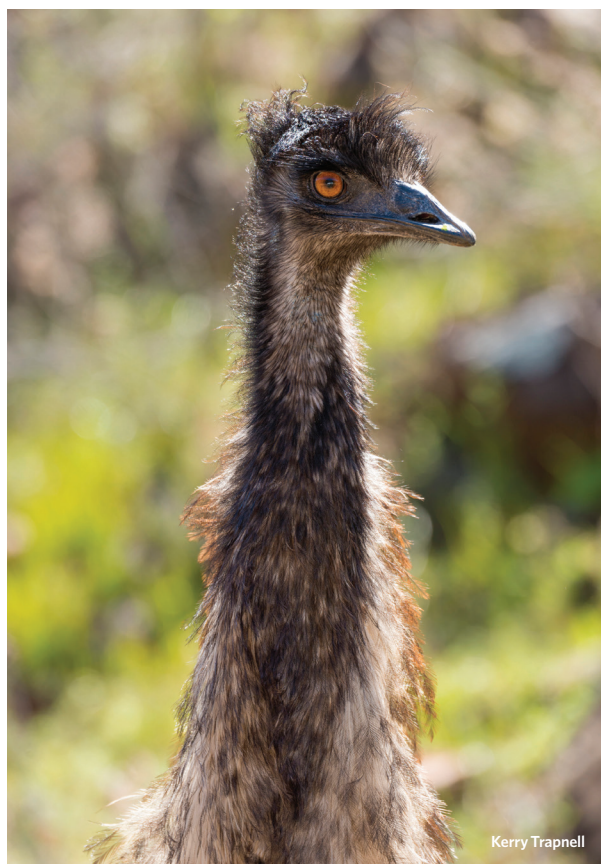
He points out fault lines, tilted seabeds, landmasses crashing together and being torn apart. There's curly mallee (*Eucalyptus gillii*), a tree that entrepreneurs in Israel have made a fortune from in the European floral arrangement industry. There's emu bush, which was eaten by pregnant Aboriginal women during times of drought because it contains a toxin that made them miscarry.

He points out Lake Frome, a vast body of glaring white salt and water used to calibrate satellite imagery equipment. And the dog fence – at somewhere between 5400 and 5600 kilometres (sources vary), the longest man-made barrier in the world.

He notes the Beverley uranium mine, producing 900 tonnes of yellow cake a year. Those big river red gums (*Eucalyptus camaldulensis*) can transpire 1000 litres of water a day. Sprigg's commentary is as rich and stimulating as the landscape he is flying over.

The flight also goes over a neighbouring pastoral property, Wooltana. At 253,000 hectares, Wooltana is more than four times the size of Arkaroola. Fifty years ago, it ran vast flocks of sheep and employed 25 full-time workers. Today, just a husband and wife live there running a few thousand cattle while the wife also holds down a full-time job with the national parks service.

In contrast, Arkaroola employs about 30 full-time workers during its peak period in spring, when it can host several hundred guests a day. Even in the low period during summer, it employs six full-time workers. More than half the staff members are transient foreign backpackers, and Marg Sprigg says Arkaroola never has any trouble attracting workers, often by word of mouth.



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

The sanctuary is home to a rich flora and fauna, with colourful wildflowers and beautiful wildlife, including emus (top left), Sturt's desert pea (top right), euros (bottom right) and purple *Solanum* species (bottom left).

For over 45 years, the Spriggs also have had a policy of employing local Aboriginal people, and one of Marg Sprigg's great hopes is that Aboriginal people will play a much bigger part in Outback ecotourism in the future.

Arkaroola has been showered with tourism awards over the years and spends very little on marketing. About 90 per cent of its business is from word of mouth or repeat customers.

Sprigg recalls crying when her father first told her about buying Arkaroola. It wasn't because she didn't want to go there; it was because she didn't want to have to share it with tourists. But over the years, she has warmed to the property's ecotourism role and is now a consummate host.

"It's a good life," she says. "You meet people; they're on holiday and they're generally happy – unless they've had six flat tyres on the way here."

For over 45 years, the Spriggs have had a policy of employing local Aboriginal people, and one of Marg Sprigg's great hopes is that Aboriginal people will play a much bigger part in Outback ecotourism in the future.

"We don't get the riffraff you get when you're at the end of a bitumen road," she adds. "People make friendships here that last a long time."

Sprigg is acutely aware of the constant balancing act between letting people have the freedom to get around the property and do as much as they can so that they stay as long as possible, versus the risk that such access poses to the fragile Outback environment.

"The biggest challenge for Arkaroola is the fact you're trying to encourage people to come here, but the minute you have people in the equation, you're having an impact," she explains. "Managing those impacts is really the crux of the matter – you want them to enjoy but not damage."

Sprigg is also passionate about keeping alive her father's vision of Arkaroola as a place of conservation, education and research. She loves the visits from celebrated academics as well as school kids who are getting their first exposure to practical science. "We get kids who were going to drop out of school and instead have gone on to have careers in science after a visit to Arkaroola," she says with pride.

Sustaining Reg Sprigg's vision is also a constant battle. Keeping the property accessible and safe for tourists requires constant maintenance, and the war against weeds and feral animals is never ending.



Doug Sprigg readies his plane to fly tourists (top), who enjoy views of the rocky ranges and gleaming salt lakes (bottom).

Arkaroola has dozens of kilometres of hiking tracks that can keep bushwalkers busy for days and require ongoing care. Perhaps the most stunning is the 5.8-kilometre Acacia Ridge Track. It offers views and many insights into Arkaroola's triumphs since the Spriggs took over, as well as the family's continuing land management challenges.

On the hillsides near the old station homestead, where sheep grazing was the heaviest during the pastoral days, no mulga seedlings stood a chance anywhere in South Australia for decades. But the Spriggs destocked when they took over. Then came the exceptionally wet years of 1971-74, and there was mulga regeneration the likes of which hadn't been seen for decades.

Young mallees are now everywhere, but they are slow growing so are still generally much shorter than the ghostly grey skeletons of thousands of mature mallees that were ringbarked years earlier by marauding feral goats.

Because Arkaroola was a sheep station for only 30 years – it was land so rugged that nobody much liked it, including the sheep – its native vegetation was not as badly degraded as on many other Outback properties. Reg Sprigg also had the foresight to limit the majority of tourism and vehicular access to only a portion of the property.

"The minute you get people in cars, you get weeds," Marg Sprigg says. Any vehicles about to venture into Arkaroola's most pristine places must first be put up on a hoist and blasted with a high-pressure air hose to get rid of any stowaway seeds.

Despite being a ferociously hot place for much of the year, Arkaroola educates visitors not to swim in its beautiful waterholes. One big, cooling splash into a waterhole by a tourist is all it takes to destroy that drinking source.

Arkaroola's weed and feral animal control measures, coupled with strict controls over the impact of tourism, allow its native vegetation to flourish to the extent that it's now regarded as the most intact in the Flinders Ranges.

A new management plan for Arkaroola formalises Reg Sprigg's intention to keep all but bushwalkers out of the sanctuary's wildest area, the mountainous Mawson Plateau, which is a wilderness of national significance and probably supports endemic species as yet unknown to science.

From the Acacia Ridge summit, the beauty of the panorama is interrupted by half a dozen black feral goats standing out starkly against the red rocks of a nearby outcrop. Miners introduced domestic goats to the Flinders

Ranges for meat and milk in the 1850s. Some goats quickly ran wild and have been destroying native vegetation, fouling waterholes, compacting the soils with their hard hooves and outcompeting native animals for food, water and shelter ever since. It's a familiar story that continues to be played out across almost a third of the continent – Australia's feral goat population is estimated to be at least 2.6 million.

The same record wet years that helped the mulga explode back into life propelled goat numbers on Arkaroola as well. Sprigg declared war on the goats, and since then nearly 100,000 have been dispatched from the property. But boundary fences don't stop goats, so Arkaroola also became a pioneering advocate of the need for regional goat control, which has helped bring their numbers under control.

The Spriggs now rate feral animal control as one of their triumphs, but constant vigilance is required to stay on top of things. The ongoing war against rabbits, goats, cats and foxes employs traps, baits and shooting. The government offers some help with the baiting program and aerial goat culling.

Arkaroola keeps a meticulous record of its feral animal control in handwritten logbooks. The toll for the first eight months of 2015 was 14 goats, 36 cats, seven foxes and 380 rabbits. Marg Sprigg says cats are now Arkaroola's main feral threat. She would love to see the small native mammals that once lived on Arkaroola – like bilbies, quolls and bettongs – reintroduced, but first they will have to conquer the cats.

Farther along the Acacia Ridge Track, there's evidence of some recent maintenance work. The Spriggs built the property's original walking track network and have skilfully maintained it for many years with volunteers from South Australia's Walking Trails Support Group. But track maintenance is hard work. The group's members are now in their 70s and 80s, and unless some younger, stronger blood arrives soon, they may no longer be a volunteer labour force Arkaroola can rely on.

Nearing the bottom of the descent from the ridge top, visitors encounter the bone-dry Mount Elva Dam. It was built in the 1980s to hold 20 megalitres and help Arkaroola cope with its constant water supply issues, but as the sanctuary's bushwalking pamphlet points out, "seasons are capricious", and the dam has filled only a few times.

Arkaroola relies on rainwater captured from rooftops and 'fossil water' from underground for its operations, but even the underground supply is poor, needing rare flood events to get recharged. Every bathroom in the tourist village bears a notice begging people to be water-wise, because many years of below-average rainfall mean supplies are under pressure. Climate change could render water an even bigger issue in the years ahead.

Despite being a ferociously hot place for much of the year, Arkaroola educates visitors not to swim in its beautiful waterholes. They are mostly salty water that comes from underground. But on top of the saltwater sits a thin layer of fresh water that native wildlife relies on. One big, cooling splash into a waterhole by a tourist is all it takes to destroy that drinking source, so the Spriggs encourage everyone to use the village's swimming pool instead.

As the walking track flattens out on its final leg back to the village, an ugly example of Arkaroola's weed problem can be spied: a cactus of North American origin called jumping cholla (*Cylindropuntia fulgida*). Marg Sprigg says this cactus and the Mexican poppy (*Argemone mexicana* and *A. ochroleuca*) are Arkaroola's two biggest environmental threats.

Government grant money is available to help pay for removing the cholla, as well as hands-on assistance from the Arkaroola Landcare Group. Arkaroola also relies heavily on a small core of reliable volunteers to do other weeding work. Some speculate that wallabies and euros could be unwittingly helping to spread the cactus in their fur and on their feet. Marg Sprigg hopes that one day, drones may be used to help spot patches of cholla and aid in its control.

Back in the village's Native Pine Restaurant, young backpackers with exotic accents wear tops that scream, 'Ark Up! No mine in Arkaroola. We did it!' They hark back to Arkaroola's overcoming probably its greatest threat: being dug up.

The mining company Marathon Resources illegally dumped radioactive waste near Arkaroola's Mount Gee while exploring the area for uranium in 2008, and a big fight ensued to head off Marathon's bid to establish a uranium mine inside the sanctuary. It ended with the South Australian Government passing special legislation, the Arkaroola Protection Act 2012, safeguarding the property from any mining in the future.

It was a victory made possible by a noisy coalition that included the Spriggs, The Wilderness Society, grassroots Arkaroola devotees, members of the local Indigenous community, and eminent scientists from around the world. That's how Arkaroola became the state's first legally protected wilderness sanctuary.

The Spriggs are by no means anti-mining – when he was South Australia's state geologist, Reg Sprigg led widespread mining surveys throughout the state and was instrumental in setting up the oil and gas company Santos Ltd. But, as Marg Sprigg says: "Some places are too important to mine, and Arkaroola is one of them."

The legislation that protects Arkaroola from mining also comes with obligations for its owners. The Spriggs are obliged to keep doing what they



Sanctuary staff members control cats and other feral animals (top). Grass trees grow across the ranges; their fragrant white flowers are followed by dark seed spikes (bottom).

have always done: manage the property to foster conservation, research, tourism and education. And that all costs money.

It's \$50,000 a year to get a contractor in to grade the roads. Another \$50,000 is spent on environmental protection and monitoring, and at least that much goes into supporting its role as a centre for scientific research and education.

The Spriggs would love to manage their land in an even more environmentally friendly manner if they had more resources. Examples include using solar panels and batteries or geothermal energy from hot rocks instead of burning diesel to generate electricity; installing a system to recycle wastewater and effluent instead of using evaporation ponds; and turning green waste into biofuels instead of burning and burying it.

To make sure there's money for that to happen, no matter who might own Arkaroola down the track, no matter what fluctuations occur in the tourism industry and what happens to government grants, the Spriggs have established the Arkaroola Education and Research Foundation. It has an independent board of high-profile people and aims to raise and allocate funds in line with the Spriggs' philosophy, regardless of what the future may bring.

Arkaroola's most iconic resident is the yellow-footed rock wallaby – delicate and nimble, with beautifully coloured fur. Reg Sprigg loved rocks, but he loved yellow-footed rock wallabies too. They were a symbol of precious biodiversity to him.

Marg and Doug Sprigg remember their father expressing how angry he was when a group of miners shot an entire colony of wallabies for sport as they were packing up to leave the radium workings on Arkaroola in 1946. It was an incident that galvanised his determination to buy the sheep station and turn it into a wildlife sanctuary.

The wallabies are barometers of the sanctuary's health. Across their normal range in the dry, rocky hills of inland Australia, their numbers have fallen dangerously low, and the species is listed as vulnerable. In the bad old days, they weren't hunted only for sport; they had a bounty on their heads because they competed with sheep for feed, and their coveted pelts were sold to England for the fashion industry. On top of that came extra predation from cats and foxes, competition for food from rabbits and competition with goats for shelter.

Wallaby numbers were low on Arkaroola when the Spriggs took over in the late 1960s, but today the animals are a common sight, thanks to decades of hard work. Numbers rise and fall with the seasons and are estimated to have doubled in recent years. "They're in really good numbers," Doug Sprigg says. "They're a good indicator that the ecosystem is working."

After Reg Sprigg's death in 1994, his ashes were scattered over his favourite Arkaroola peak, Mount Painter. With the property's geological wonders now internationally recognised and protected from mining forever, his children are happily and successfully continuing the ecotourism business he established.



Arkaroola was the first wilderness sanctuary to be legally protected in South Australia.



The yellow-footed rock wallaby is one of Arkaroola's most threatened native animals.

Breakout 1 **An ecotourism pioneer**

Tourism first came to Arkaroola in 1923 when Dr Charles Fenton set up a primitive 'health spa' at the Paralana Hot Springs, now known to be radioactive.

Isolation, harsh conditions and poor access meant it was doomed to fail, and, mercifully, the spa had only one group of customers. Since Reg Sprigg bought the property almost 50 years ago and established the Arkaroola Wilderness Sanctuary, visitors have been enjoying much healthier activities. There are now 11 experiences with Advanced Ecotourism accreditation, one of the most popular being the memorable Ridgetop four-wheel drive tour.

The 42-kilometre journey takes visitors on a track locked off to all other 4WDs to help keep weeds out of the wilderness that constitutes much of the property. To say the experience is epic is to sell it short. The mountainous scenery takes the breath away. And rugged? One guest's pedometer recorded 36,000 steps in the five hours he was bouncing about in the back of the Toyota Land Cruiser as it clawed its way up and down incredibly steep tracks.

Along the way, the driver delivers a rich flow of information about the amazing geology of the landscape and the rich prospecting and mining history inspired by those rocks. "This is where I have to hand out bibs to the geologists to stop them drooling all over their clothes," he quips.

The sanctuary won South Australia's top ecotourism awards three years running from 2005-07 and has also picked up the top sustainable tourism and best major attraction awards over the years. It was inducted into South Australia's Tourism Hall of Fame in 2007.

The same ruggedness and isolation that made that first tourism venture and the subsequent pastoral enterprise fail on Arkaroola

are part of what makes it so special today. They also continue to present challenges. As Reg Sprigg's son Doug says, "The tyranny of distance is both the Outback's blessing and curse."

Arkaroola is a (very) full day's drive north of Adelaide, at the tip of the Flinders Ranges. It relies on the small settlement of Leigh Creek, more than 100 kilometres away, for supplies and services. However, the Leigh Creek coal mine, which the town relied on, closed down in late 2015. This means the sanctuary could soon feel more remote and isolated than it already is. What will the mine closure mean for access to food supplies, mail, medical care and police?

Marg Sprigg would love to see more money spent on Outback roads such as the Strzelecki Track, which would make getting to Arkaroola as part of an Outback safari easier. Doug Sprigg would love to see the state government subsidise and promote a cheap bus service that makes it easier for travellers without vehicles to get to Outback places, including Arkaroola.

The Spriggs are lucky enough to have freehold title over their tourism village inside the Arkaroola pastoral lease. Marg Sprigg says it would definitely help others develop their ecotourism ventures on pastoral land if the leases were more flexible and offered great security of tenure. She cautions people with pastoral properties who want to get into ecotourism to think carefully before making the leap, because it will have an impact on their land and must be managed carefully.

A monument to their late father, along the Ridgetop Track, remembers him as "Geologist, biologist, oceanographer, conservationist and a man of vision ... Thirty years ahead of his time, he practised ecotourism long before the word was invented".

Breakout 2 **If only the rocks could talk**

The Arkaroola Wilderness Sanctuary retains a long, unbroken geological record that showcases the legacy of some of the Earth's most dramatic swings in climate.

Its quartzites were once clean, white sands laid down in ancient seas 900 million years ago, when the land was part of the super-continent Rodinia. When this giant landmass was torn apart, Arkaroola was beachside eastern seaboard, according to a recent report on the region (Worboys and Hore 2013).

On the other side of the rift were portions of what are now South China and Canada, which slowly migrated to their current positions. In the trench that formed between them, molten basalt lavas flowed onto the sea floor, and their remains are found today at Arkaroola.

This period was followed by the greatest ice age the Earth has ever experienced – when the planet nearly froze – over 700 million years ago. Arkaroola was then sitting at the equator, at what should have been one of the warmest places on Earth, and yet it was covered in glaciers.

The world's thickest sequence of known ice-rafted material (boulders, pebbles and muds) is found here. It's thought that changing water chemistry caused by the freezing and thawing,

plus the dumping of billions of tonnes of nutrient-rich rock into the sea by icebergs, probably resulted in the acceleration of the evolution of life.

A short time later, the soft-bodied animals of the Ediacaran Period (640–510 million years ago) appeared. Coincidentally, the first Ediacaran fossils ever found were discovered in 1940 by eminent geologist Reg Sprigg, who later founded Arkaroola.

The great 'icehouse' glaciation was followed by a warmer 'greenhouse' period, during which a 'barrier reef' formed off Arkaroola's ancient shores. As coral had not yet evolved, the reefs and atolls, which are now fossilised, were composed of stromatolites, tiny ancient sponges and other as-yet-undescribed small curiosities.

Whereas Australia's famous Great Barrier Reef off the coast of Queensland is about 100 metres thick, the ancient Arkaroola Reef grew upwards as seas deepened and became 1000 metres thick as the planet thawed and sea levels rose. The offshore side of the reef bears calcite veins where it's thought other micro-life evolved 4 kilometres below the Earth's surface later during the Ediacaran period.





3.9 Returning to country: Managing a vast ancestral estate

Michael Ross and
the Olkola people

*Cape York Peninsula,
Queensland*

It was an irresistible story that made its way from a remote corner of Cape York Peninsula to the newsrooms of metropolitan Australia in 2015.

Good news for science – bad news for arachnophobia, was how one report put it. “As if Australia didn’t have enough spiders – 13 new species found in Queensland,” was the headline on another. Remarkably, the discoveries were made in just one 10-day research ‘blitz’ on the traditional lands of the Olkola people, proving once again how little is known about what exists in the vast Australian Outback.

Rare fish and orchids were also discovered during the survey, which was conducted by the Olkola people and the Bush Blitz program – a joint research partnership among the Australian Government, BHP Billiton and Earthwatch Australia – that brought scientists from all over the country to work with the Olkola to study the biodiversity of their land.

There were experts on plants, fish, reptiles, amphibians and, of course, spiders. They even had a helicopter fly them to the most remote points of Olkola country, which straddles the northern tip of the Great Dividing Range in far north Queensland.

In 2014, ownership of five big Cape York cattle stations, totalling 766,272 hectares, was handed back to their Traditional Owners, the Olkola. Together with the cattle leasehold country they also manage, the Olkola – who call themselves the ‘Freshwater People’ – are now custodians of more than 800,000 hectares of the tropical Outback.

The Olkola estate is a mix of joint-managed national park, nature refuge, regional park, leasehold and Aboriginal freehold. It includes the old Strathmay, Crosbie, Dixie, Wulpan, Mulkay, Glen Garland and Killarney cattle stations, and the Kimba Plateau – the birthplace of many of the cape’s rivers and a wild treasury of rare geology, flora and fauna.

The Olkola – who call themselves the ‘Freshwater People’ – are now custodians of more than 800,000 hectares of the tropical Outback.

Nine threatened regional ecosystems are spread across this land, which is part of the largest unbroken tropical savanna in the world. There are unusual mound springs as well as wetlands, tall forests, remnant rainforests and savanna woodlands. And there’s the extremely rare golden-shouldered parrot – an Olkola totem. Cultural sites abound.

Most of this area has never been surveyed by western scientific methods. It’s something Olkola Aboriginal Corporation Chairman Michael Ross

would dearly like to see happen so his people can better manage their vast inheritance by combining science with traditional knowledge.

Ross wants to see a research and education centre on Olkola land with visiting scientists stationed there all the time, studying the wonders of Olkola country – wonders that may well include an eventual cure for cancer. Maybe it’s to be found in the venom of one of those newly discovered spiders?

“It’s not just about cattle,” Ross says of Olkola land and its future. “We need those people here. We’re finding new things every day, every time we go out.”

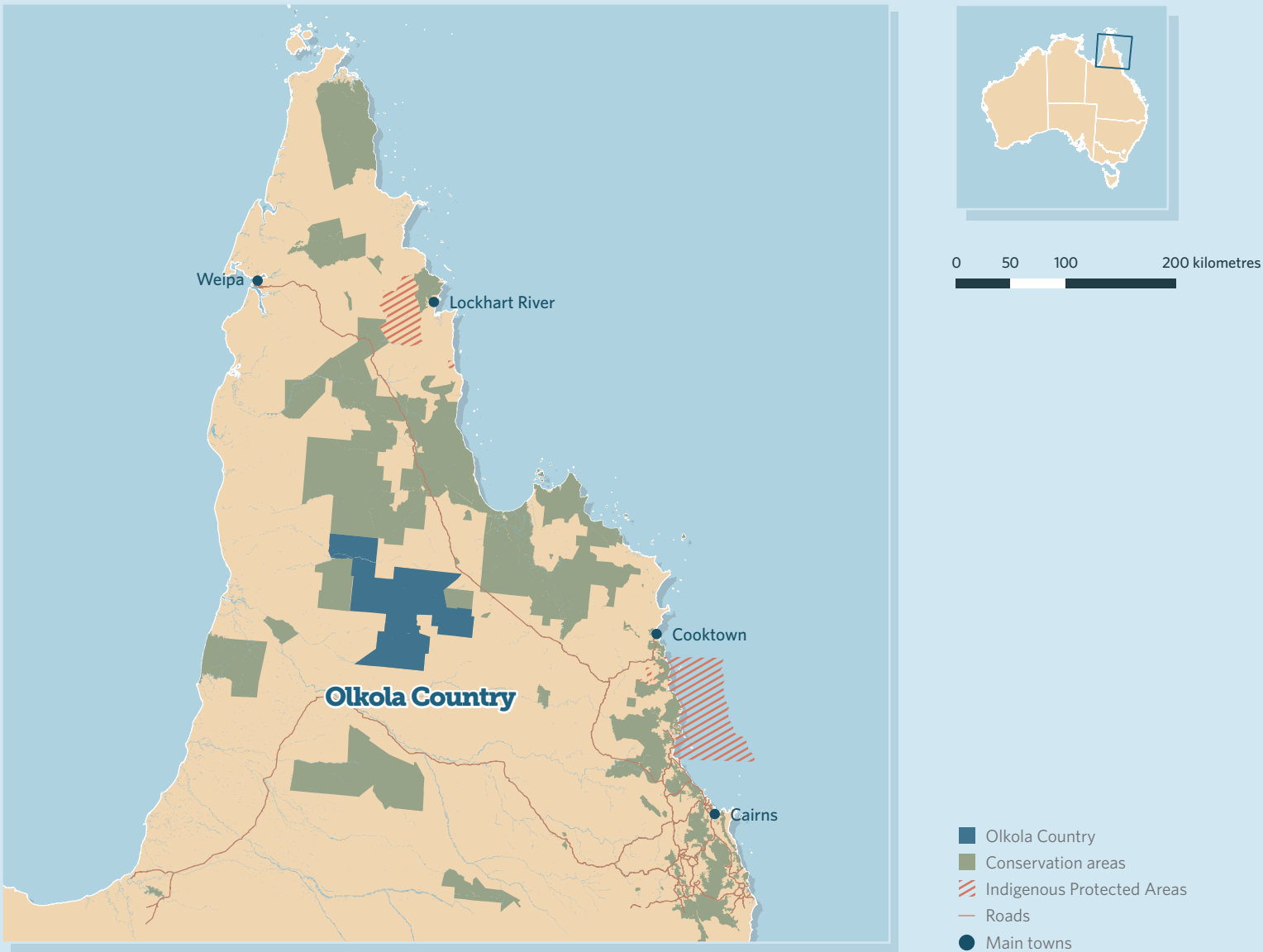
A few months after the excitement of the Bush Blitz, in a corrugated iron shed beside a dirt airstrip bordered by termite mounds, the Olkola have gathered on the former Killarney Station to make a plan. It’s an Olkola Healthy Country Plan, and it needs to be a good one, because the Olkola have a lot of country to keep healthy.

They also need to work out how to make the land pay its way so it can be sustainably managed and Olkola people can return to live there, work in real jobs and reconnect with their country and culture.



The vast Olkola estate includes nine threatened regional ecosystems.

Figure 14
Location of Olkola Country in Cape York Peninsula, Queensland



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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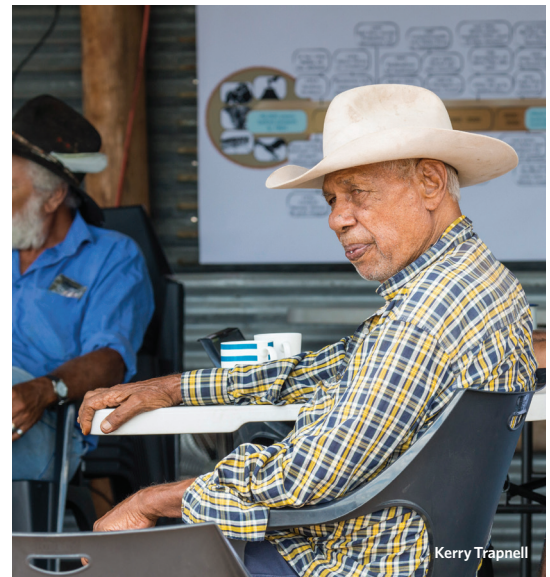
Kerry Trapnell



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

Traditional Owners discuss their Healthy Country Plan at a community meeting, while a child (bottom middle) plays outside.

Finalising the plan is just the latest step in a frenetic journey since the Olkola again became masters of this massive domain. They have already been involved in surveying the golden-shouldered parrot, mustering cattle out of a newly created national park, establishing a joint ecotourism venture, building, fencing, signing a carbon credits deal and setting up a base for the Olkola ranger group.

The community meeting coincides with an 'On Country Camp' during the school holidays, designed to encourage Olkola people to visit their traditional lands (some for the first time) and participate in the Healthy Country Plan discussions.

A timeline on the corrugated iron wall at Killarney maps out the history of the Olkola since the arrival of Europeans. In the second half of the 19th century, the arrival of gold prospectors and pastoralists resulted in violence, deaths and then removals. By the early 20th century, many Olkola no longer lived on their traditional lands.

Nowadays, the vast majority of the some 400 remaining members of the Olkola community live hundreds of kilometres away in Kowanyama, Cairns, Cooktown, Coen, Mossman, Laura and other places across Cape York and Australia. A key to managing their estate properly is to have people living on country, but the Olkola lands lack infrastructure, and there are few job opportunities to encourage people to move back there.

Another poster on the corrugated iron wall paints a picture of what the Olkola lands will look like in the future: healthy people living on country and enjoying a rich culture and landscape.

There will be revenue from carbon credits earned through fire management activities; cultural and ecotourism ventures; sustainable cattle grazing and forestry; healthy woodlands, savanna, mound springs, rivers and high country; and a thriving golden-shouldered parrot population.

But achieving the dream will be difficult, and the people attending the meeting debate how they should prioritise and articulate the targets and threats in their Healthy Country Plan. It's a document they hope will help them achieve desperately needed outside funding.

Targets include safeguarding cultural sites, story places, traditional knowledge and customs; achieving strong self-governance and economic development; acquiring the necessary infrastructure and equipment; and protecting animal totems and their environments.

The biggest threats include climate change, invasive species, limited appropriate infrastructure and equipment, limited capacity and resources, not having people on country, unregulated and illegal land uses, and wildfires.

Ross tells the group that strong self-governance is critical. After more than a century of dispossession, the Olkola are determined to make their own decisions. He also wants to prioritise a language program.

He says having better roads is also vital in a corner of the Outback where the wet season still brings isolation. Inaccessibility – "that's what kills most of the Cape", he says. To make money from cattle and tourism, the Olkola need better access.

For example, land managers can spend all day just driving to and from a single job. It might be better to spread rangers out over Olkola land instead of basing them in the one location, but for that to happen, they need more vehicles and more ranger bases. And where will that money come from?

The meeting hears that, because it's so hard to earn money on the Cape, maybe the Olkola need to think about off-country investments to fund their on-country dreams. Do they need to buy some roadhouses or an office block in Cairns? But where will the investment money come from? Although they own a lot of land, most of it is Aboriginal land, so it can't be sold and no bank will lend against it.

The Olkola have the potential to earn a regular income through carbon abatement and the sale of carbon credits if they can control wildfires and stop the release of 65,000 tonnes of carbon a year. That means doing widespread cool mosaic burns at the start of the dry season, putting in firebreaks, working with neighbours and suppressing fires when they do break out. But their fire management resources are modest, and one bad wildfire could wipe that income out for a year.

The Olkola Aboriginal Corporation receives some funding from the Queensland Parks and Wildlife Service to undertake joint management of the national parks. But income is precarious; it ebbs and flows.

The organisation's staff numbers fluctuate with its income. It employs a CEO and other part-time staff. It needs guaranteed funding to turn its rangers into a full-time workforce.

A key to progress so far has been astute partnerships with groups such as Bush Heritage and the Australian Conservation Foundation (ACF). Bush Heritage, a non-government environmental group, has been helping the Olkola study and implement a recovery plan for the golden-shouldered parrot to aid in its survival.

Another partner, The Centre for Appropriate Technology, is an Aboriginal organisation that provides technical assistance to Traditional Owners who want to live on country. It teamed up with the Olkola to assess the infrastructure on their land, then prepared a maintenance program and sustainability plan.

Fishers for Conservation, a non-profit recreational fishing organisation, has helped the Olkola survey their waterways for fish species.

In a pilot project, the Olkola are working with CSIRO researchers and the Tropical Indigenous Ethnobotany Centre to explore how to get Traditional Owners to contribute to and use the online *Atlas of Living Australia* to record, share and apply long-held knowledge about caring for country.

The Olkola have the potential to earn a regular income through carbon abatement and the sale of carbon credits if they can control wildfires and stop the release of 65,000 tonnes of carbon a year.

The ACF partnership has given the Olkola a politically savvy friend that can lobby governments for support, attract media attention, deliver advocacy and respond to legislative changes.

The ACF has also introduced the Olkola to another partner, Intrepid Travel, which has led to a fledgling ecotourism joint venture. The three parties hope it will be another initiative that ultimately lets more Olkola people live on and manage their country while also earning a living. Ross hopes that by 2020, there will be 50 Olkola people living on country, mostly employed by the Olkola Aboriginal Corporation.

In 2015, 60 ACF members put their hands up for just 12 spots on Olkola's pilot ecotourism trip in partnership with adventure company Intrepid. The lucky dozen came from all over Australia. They learned about bush tucker and medicine. They visited an initiation ground, rock art sites, Jungle Creek

on the wild plateau country where the rivers rise, a lookout that allows people to grasp the vastness of the Olkola estate, and the breeding sites of the golden-shouldered parrot. They went to the 'dancing ground', a place where the watertable is so high that if you jump up and down, the land will literally dance around you.

Four trips are already booked for the 2016 dry season. Although it's important to get people back working and living on country, says Andrew Malcolm, a caretaker of one of Olkola's homesteads, it's just as important to encourage Olkola people to come back and visit whenever they can so they maintain the connection with their land. "There's not enough employment here to get all Olkola people back on country," he explains. "The most important thing is that they know we're looking after the land and not abusing it; that we're using it right."

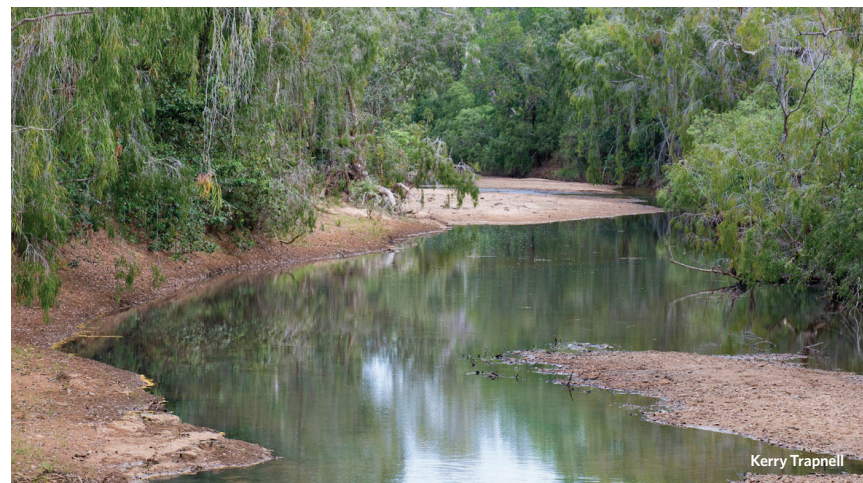
Ross – widely known as the 'barefoot chairman' because of his preference to go shoeless – is 64. He was born and grew up in Coen, one of 12 children, and worked on Cape York cattle stations for much of his life. He was a veteran of Aboriginal politics on the Cape when he took on the battle to win back his people's land.

Ross is also still deadly accurate with one of the favourite bush weapons of his childhood. A simple stick becomes a powerful *woomera* (spear-throwing device) when it's wedged into the peg-like nut of the beefwood tree and used by an expert. With an effortless flick of the wrist, the *woomera* turns the heavy nut into a high-speed projectile that's just the thing for knocking down ducks or goannas, he explains.

This is just one bit of bush knowledge that Ross shares with national park rangers as they stroll along the planned line of a boundary fence for the new Olkola National Park, which is jointly managed by the Olkola and the Queensland Parks and Wildlife Service (QPWS).



Pristine rivers flow through paperbarks to the coast.



A 12-metre-wide break has to be cleared for the fence, and QPWS wants to show Ross some of the big old trees that will be pushed over before the work proceeds. He inspects every tree and gives the work his blessing, and the rangers agree to pile up all the straight ironbarks, stringybarks and bloodwoods that are felled so the Olkola can use them for construction projects and fencing.

Along the walk, Ross also points out what he calls the “bellyache tree” – unpleasant to eat, but the leaves will fix an upset tummy. There’s also the soap tree, whose leaves can be crushed with water to create an antiseptic lather. He explains how the core of termite mounds burns slowly and produces a smoke that’s great for keeping mosquitoes away. He identifies animal tracks, edible fruits and bird feathers. He’s the keeper of vast knowledge that he desperately wants to pass on to younger Olkola.

It’s another reason he’s passionate about the Olkola Indigenous Land Managers: The ranger service is one of the vehicles for getting Olkola people back living and working on country, where the knowledge of the elders can be passed on to the next generations.

Ross hopes that one day all the rangers managing the national park will be Olkola and that his people will eventually take on full responsibility for running the park.

In the meantime, he says, the joint management system is going through its teething stages. It’s not yet perfect, but he’s happy with the general direction it’s taking. The Olkola are committed to building a good relationship with local parks service rangers, he says.

The important thing, Ross adds, is that each joint management plan has to be flexible and genuinely accommodating of Indigenous points of view. “They’ve got to realise that every joint management plan needs

to be individual; special for that particular landscape and the Traditional Owners,” he says. “It can’t be just a one-size-fits-all template issued from head office in Brisbane.”

Keeping the land safe and making it pay its way will be a tricky balancing act for the Olkola, but Ross rejects potential money-making ventures such as intensive agriculture. The federal government envisions northern Australia becoming the ‘food bowl of Asia’, but Ross says of growing crops on Olkola land: “It would be senseless to even attempt it.”

The soil is too infertile, he says, and would simply wash away during the first wet season if it was cleared. And what of the effect on the rivers of all the chemicals that would have to be used to control pests and weeds and improve soil fertility? Cattle, he says, have done little environmental damage, and he can’t see the Olkola switching from them.

Ross can cope with a few small gravel quarries supporting road maintenance on his land but isn’t interested in hearing from anybody planning to mine its gold and uranium. “I don’t want them here. I don’t want things that can damage this country,” he declares. One old gold mine is already a problem area in his country, and he wants the Queensland Government to rehabilitate it.

Even though the Olkola have their land back, they can’t stop mining on it, because the Queensland Government still owns everything below ground level and the air space above. The Olkola officially own only what’s on the surface.

And there lies Ross’s next battle. He believes the Olkola’s native title extends down to the centre of the Earth and up to the heavens. “Our totems fly in that airspace; our old people are buried in the ground,” he says. “That’s going to be the next thing I fight for.”



Scenic wetlands are one of many ecotourism attractions at Olkola (left). Numerous tree trunks are covered with the red mud of termite nests (right).

Breakout 1 **A golden, threatened legacy**

To the Olkola, it's the *Alwal* – one of their totem animals and the emblem of one of their land management teams.

To the rest of Australia, it's the golden-shouldered parrot – one of Australia's most threatened bird species, which nests on Olkola traditional land and only one other place. Changing land management practices and wildfires have destroyed much of the parrot's habitat. It's estimated that about 1500 *Alwal* remain on Olkola land.

The Olkola Indigenous Land Managers are leading an alliance with Bush Heritage Australia and the Queensland Parks and Wildlife Service that's working to ensure the species survives.

The birds nest each May and June in their favourite country: open savanna woodland dotted with mature trees and plenty of grasses that provide the seeds they live on. Their nests are located at the ends of tunnels dug into the side of termite mounds.

They also share a relationship with a moth that lives inside their nesting holes and eats the parrots' droppings, helping to keep the nest chamber clean. The birds usually lay about half a dozen eggs, and both parents help care for the eggs and chicks, though they will readily abandon the nest if predators threaten or a nearby water supply is exhausted.

The land managers use probes to look inside parrot tunnels and see whether eggs have been laid. In 2015, during the first monitoring season, they found three nests with eggs and set up motion-activated cameras outside to monitor activity. Land managers also record the nearby vegetation types, level of canopy cover and height of the nest above the ground.

The monitoring will hopefully reveal what most threatens the birds. Possibilities include intense wildfires, cats, goannas, snakes, butcherbirds and weeds. The cameras also record what times of the day the parents return to the nest, how often they return and whether this is influenced by temperature.

For land manager Glen Kulka, the scientific monitoring of *Alwal* during their nesting season has been a highlight of his career.

Kulka has the laborious job of spending hours going over the footage captured by the cameras and analysing it. He would like to set up cameras at nearby waterholes to see what they show of *Alwal* behaviour during the nesting season.

For the 2016 breeding season, 20 cameras will be available for use if the land managers can find enough nests with eggs. It will mean a lot more time staring at his laptop screen, but Kulka says he's looking forward to building the years of data needed to protect this sacred Olkola totem.



Tall termite mounds provide nesting sites for endangered golden-shouldered parrots.

Breakout 2 **Robert Burns and Louise Price: Cattle in the blood**



Traditional elder Robert Burns and granddaughter Louise Price share a commitment to managing Olkola country.

The one thing that did keep some Olkola living on country during the decades of dispossession was the cattle industry.

Olkola elder Robert Burns, born in 1933 perhaps, is an old cattleman who's lived on country all his life. "I was walking about here with my grandfather and grandmother," he recalls during the

Olkola 2015 On Country Camp.

He never went to school, can't read or write, started working as a stockman as soon as he was old enough. There were no wages, just rations – corned beef, flour for damper, some syrup – "maybe a blanket".

Continued on next page.

He has long forgotten much of the Olkola's traditional language. "They wouldn't let us talk in language, because they thought we were talking the white fellas down," he explains.

Burns possesses an immense pool of knowledge about Olkola country and culture and is happy his people have their land back. But he warns that it will be worthless unless they manage it properly, and that means getting people out there making a living on country. The Olkola now possess some decent cattle country, but Burns says that to make it pay, it needs to be worked by people who know how to manage cattle. "It's no good taking the place back if you can't work it," he says.

Louise Price, Robert's granddaughter, is every inch a Cape York cattlemaster. Her family lives on the Olkola's Strathmay Station and with her sister's family operates a busy contract fencing and mustering business. Their family has worked for various owners at Strathmay for generations. It's their traditional land, and they are intent on living and working there.

"You can't have unmanaged property, and that's what I fear for the Olkola land," Price says. "I don't want the land to be neglected. I don't want people to say there's no money so we're not going to live there."

The 27-year-old grew up on Olkola country on a cattle station and was schooled by distance education. However, it wasn't until after the vast Olkola estate was handed back in 2014 that Price got to see the full extent of her people's land.

Now she also does fire, cattle and weed management work for the Olkola. She cites weeds and sucker regrowth as the key

environmental threats, and believes getting fire regimes right is a key to fixing those problems.

Price describes the challenge facing the Olkola in managing their land: To get the money to pay for this important environmental work and to have people living on country providing the manpower, the corporation must make money from cattle. But to do that, it needs the money to invest in fences, livestock, yards and road access, because the infrastructure on the land is old and run-down.

Just like the landscape, cattle won't manage themselves. They need people who are dedicated to grazing them through the fun times and the dull ones. Price worries that the Olkola will invest a lot of money into cattle and then turn their back on them, because managing them is such a tough job.

"The cattle business isn't that exciting, because fencing isn't that exciting, de-ticking isn't that exciting. Chasing cattle is exciting, but you sure don't do that every day of the year," she says. "So you've got to have a passion for them, beyond the money they earn you."

One day the Olkola will be looking to people like Price to become their leaders. She says she knows about land management but has a lot to learn about culture. She's worried that she has forgotten things her grandfather told her, that she has taken it for granted he'll always be around.

So, in a classic display of new technology aligning perfectly with traditional knowledge, Louise gets her iPhone out and starts recording her grandfather's wisdom.

Breakout 3 **Glen Kulka: Discovering his culture and country**



Indigenous Ranger Glen Kulka checks a nest site of the golden-shouldered parrot.

Glen Kulka, 25, is a ranger with the Olkola Indigenous Land Managers and is “loving it”.

He grew up in Cooktown, didn’t access his traditional country and culture, and instead worked in construction. “I’m getting to know the country better, getting the knowledge of these old fellas – the elders – getting to know our country better,” Kulka says. “There’s always something new to look at. There’s much more out there to explore.”

He says what takes up most of the rangers’ time is travelling the vast distances across Olkola land, and he reckons they need more and better vehicles. At the moment they have only two, so if one is being serviced, the rangers have no choice but to all go to the same place, when it would be better to have them working in different places. It also makes it hard to control wildfires. A proper fire truck also would be nice. And a bulldozer to put in firebreaks.

Work includes everything from fire management and showing around visiting scientists to maintaining water, power and rubbish

services. Kulka has qualifications in chemicals, chainsaws, quad bikes, 4WD, conservation land management, first aid, agriculture and horticulture.

He says that before the land was handed back and he became a land manager, “I didn’t know the country. I’d heard stories about it, but I didn’t know the country. I didn’t know what the land looked like.

“It’s good to be out here and see it for yourself,” Kulka says. “I’m enjoying it, and I’m not going anywhere. My mates always say, ‘I wish I had your job.’ There’s plenty to do out here. You’re just sitting around bored back in town.”

It’s a six-hour drive back to Cooktown each weekend to catch up with family and friends, but by the end of the weekend, he’s always eager to get back home – to his own country.





3.10 Managing a dry land across the generations

Jess and David Bell

*Dulkaninna Station,
Birdsville Track, South Australia*

"Central Australia. A vast, flat wilderness as large as Europe and a thousand miles from anywhere. In all the great emptiness, a lonely track joining Marree in South Australia to Birdsville in Queensland; 330 miles (530 kms) across shifting sandhills, stony plains and the flat dry beds of ancient streams.

A lane through the burning centre of Australia – the Birdsville Track. A bare, dry rut disappearing into the mirage over the edge of the world – the Birdsville Track ... they call it the Never Never Country, the Back of Beyond ..."

It's the haunting voice-over to a classic Australian film. *The Back of Beyond* is a 1954 documentary that made famous Tom Kruse, the mailman of the Birdsville Track.

It's part of the rich fabric of mystique that has made the Birdsville Track one of Australia's ultimate Outback icons and a 'must-do' for any serious Outback traveller with an equally serious 4WD vehicle.

The documentary seared into the Australian psyche the legendary toughness of Kruse and the people he delivered to on the track's vast, lonely stations. One of those stations is Dulkaninna, home to generations of the Bell family. The family traces its connection to when Dulkaninna was first established in the 1890s, and the Bells continue to thrive there, despite its extremes, using modern innovation and wisdom passed down through the generations.

To make enough money to sustain a growing family requires a vast amount of knowledge about how to care for that country.

Today, the historic station is in the hands of David Bell, 33, and his wife, Jess, 32. They share its splendid isolation with their three children – Cody, 4, Lara, 2, newborn Daniel – and David's parents, Daryl, 69, and Sharon, 62.

The main business is grazing cattle across 2,000 square kilometres of gibber plains, sand dunes, salt lakes and floodout country. To traverse its massive paddocks is to truly know Never Never Country and the Back of Beyond. And to make enough money to sustain a growing family requires a vast amount of knowledge about how to care for that country, says Jess Bell.

The key is knowing when to destock and restock and being able to move stock quickly when the tough decisions are made. Make the wrong decision – or make the right decision and then move too slowly – and the consequences can be great on a property that has an average annual rainfall of 150 millimetres a year, and desert as its neighbours to the east and west. Nobody grazes land that's drier than this corner of the Outback.

Bell says the families of the Birdsville Track have learned to deeply respect this arid land. "If you don't look after the country, it won't look after you. If you flog this country, it will flog you," she says. There are many tricks to the trade, refined and passed down through decades of trial and error.

The cattlemen of the Birdsville Track know to let plants set seed before they are grazed to make sure that the next time it rains they burst forth into life again. "You don't just automatically move cattle onto green feed," Bell explains.

There's also room for modern innovations. Bell has an honours degree in horticulture and has studied the nutritional value of some of the grasses and shrubs on which cattle graze at Dulkaninna. She also looked at the blood of cattle to see what they were eating and how healthy their diet was. The study showed that even in the midst of a terrible drought, the cattle were doing okay because of the diverse food sources available on Dulkaninna.

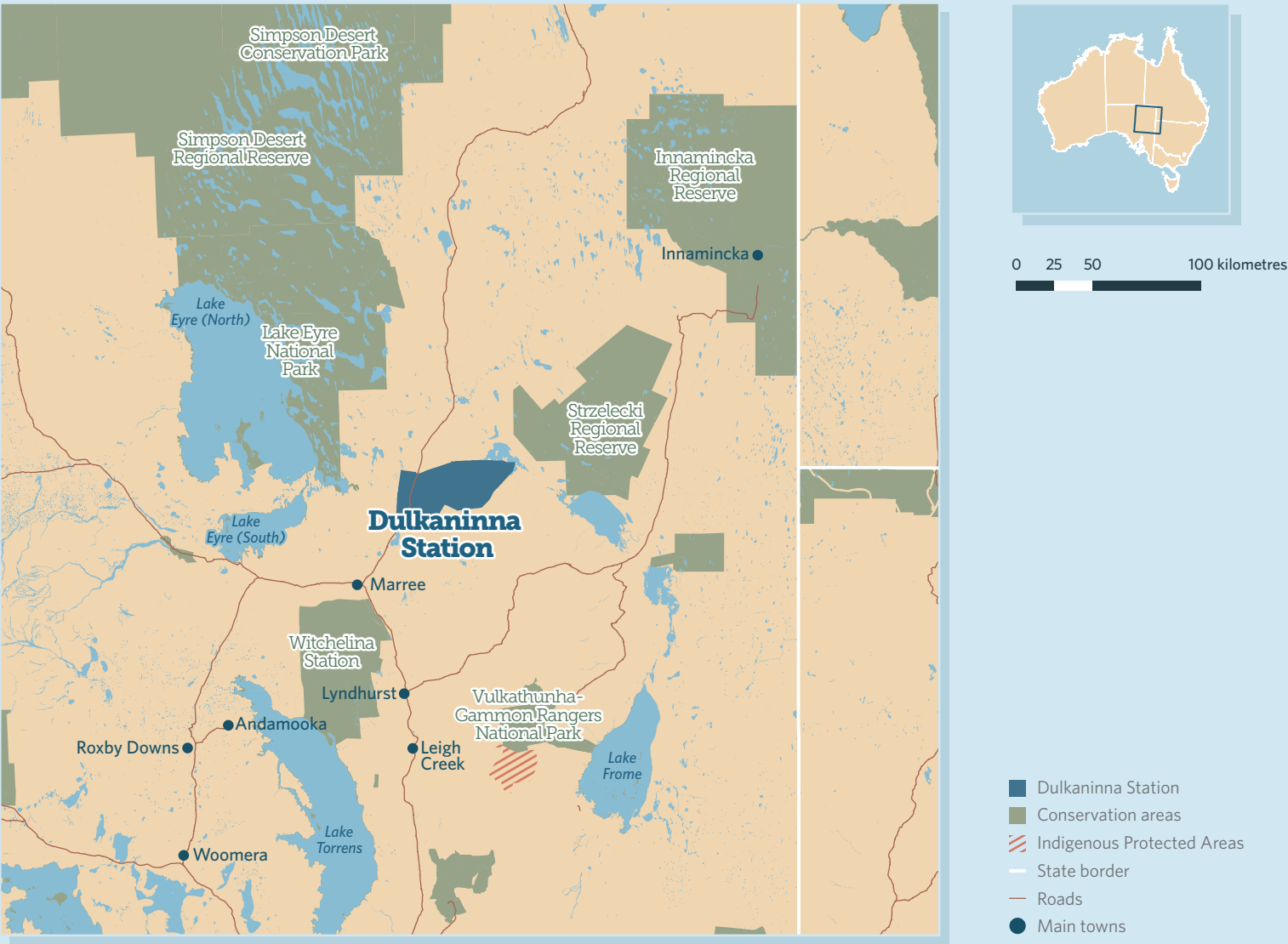
The nutritional study was made possible through funding from the national Landcare program, which Bell applied for through the Outback Lakes SA group with the assistance of Melissa Horgan and the SA Arid Lands National Resources Management Board.

It might look barren to the untrained eye, but Dulkaninna's vegetation contains many plants that are high in fibre and protein. There's barley and curly Mitchell grass, never fail, bindi-eyes, mulga, blue bush, river red gum, coolibah, cane grass, samphire, old man saltbush, river cooba, nardoo, poverty bush and dead finish – all adapted to the extremes of its environment.



Jess and David Bell and children.

Figure 15
Location of Dulkaninna Station in South Australia



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.

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A road sign marks the entrance to Dulkaninna Station (top), which contains saltbush plains (bottom right), sand dunes, salt lakes and flood-out country (bottom right).

In the old days, pastoralists on the Birdsville Track could deal with drought by selling off their stock, sitting it out and then buying back cows and bulls when conditions improved. But according to the Bells, overheads are now so great – for example, it costs \$15,000 a year for a public liability policy because a public road runs through the property – that not running stock is no longer an option. It's also too expensive to buy stock back in when the good times return.

So they are looking to buy another property in a more reliable rainfall region – a place they can send animals to fatten or use as a refuge when drought hits. “To balance those dry years, you need somewhere that can give you an income when this place isn't able to,” Bell explains.

Such a move would also help them expand their enterprise. The Bells would love to be able to give their three children opportunities to work in the family business, but as it now stands, Jess Bell says, Dulkaninna's “a one-family property, max”.

David Bell assumed the practical management of the property in 2007, when he was in his mid-20s. On the Birdsville Track, it's a moment referred to as “handing over the chequebook”, and the ritual formally took place in 2009. Daryl Bell, on the other hand, was in his 50s before he took control of Dulkaninna from his father.

David Bell says the early handover was needed so Dulkaninna could move with the times and continue to prosper. It needed a younger man at the reins; someone who, for example, could pay for things using the internet instead of a chequebook.

“I've seen so much of the opposite way of doing things,” Daryl Bell says of their decision to have an early handover of the property to his son and daughter-in-law. “My dad didn't get control of the station until he was in his 50s, and I was the same.

“But I thought, why not help them have a go when they're young? Let them try new things, and if they make a mistake, they're still young enough to get out of it. There's no use waiting until he's 60 to say ‘You can have it now, boy’ – his life's gone. I hope he does the same with his children,” he says.

David and Daryl Bell have worked hard to diversify Dulkaninna's income streams so it's not totally reliant on the cattle market and rain.

David Bell now does some things quite differently to his old man, including the core business of selling cattle. Dulkaninna needed an owner-manager who knew about marketing cattle to obtain the best price for its organic

beef. It was no longer good enough to just muster twice a year and accept whatever price was on offer at the saleyards.

Daryl Bell says of his generation: “We were price takers, not price makers. These young ones are price makers. If they can't get the price they want, they won't sell them. They're as smart as the processors and buyers.”

Bell says his son is a perfectionist, forever on the phone or the computer to make sure everything is the best, whether it be the best price for organic beef or fodder or the best new design for cattle yards or the best new motorbike tyre.

David Bell says his dad is a fantastic land manager, advocate and cattleman. He's like the godfather of the Birdsville Track, whom others go to for help and advice. But, Bell adds, his dad loathed doing the time in the office that's now a necessary evil.

The father and son have worked hard to diversify Dulkaninna's income streams so it's not totally reliant on the cattle market and rain. There's the Coolibah Camp tourism facility with hot showers, toilets and a camp kitchen on the banks of a pretty creek near the homestead. And Daryl Bell is your host at Beyond and Back Day Tours, taking people to see the Birdsville Track, Cooper Creek and Lake Eyre.

They run a contracting business, Kintala Contractors, with heavy machinery that does off-farm earthworks such as road maintenance for the mining sector. They do maintenance on the dog fence and contract mustering. There's also Kintala Performance Horses, which breeds and sells registered high-performance Australian stock horses and quarter horses for all forms of arena competition. Kelpie dogs raised, trained and sold on Dulkaninna are registered with the Working Kelpie Council of Australia.



Daryl Bell (at left) handed management of Dulkaninna over to his son David (at right) and daughter-in-law Jess when David was in his mid-20s.



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

The Bells and neighbours export certified organic beef to the United States (top). David Bell inspects (bottom right) and musters cattle (bottom left) in the stockyards at Dulkaninna.

Where David Bell does see another income stream for the station is through consulting. He believes his extended family possesses so much knowledge, on everything from weed and feral animal control to livestock mustering and station succession planning, that it can sell that expertise to government agencies, mining companies or others in the pastoral game.

A visit to Dulkaninna's online home page presents a virtual résumé of the collective skills the Bells have available for hire across the following categories: pastoral operations and management, pastoral infrastructure, assessment and monitoring, and project management and administration.

Do you need help understanding the Pastoral and Land Conservation Act or managing biodiversity on your property? Maybe you need support with setting up a tourism enterprise, building a road, writing a report or resolving a dispute with a neighbour? Call the Bells of Dulkaninna.

David Bell's mother, Sharon Bell, already had a biology degree and was on her way to Perth to study veterinary science when she met Daryl Bell in Marree. While on Dulkaninna, she has also acquired a degree in land management.

Sharon Bell's library reflects a woman with an inquiring, scientific mind. There are books on psychology, philosophy, the law, religion, politics,

science, history, exploration and, of course, the environment. The magazine collection includes *New Scientist* and *Vanity Fair*.

There's a photo in the lounge room of Daryl Bell being awarded his Order of Australia Medal for services to the pastoral industry and conservation. Sharon Bell has her own Centenary Medal for services to conservation in the rangelands.

There have been other awards for conservation work on Dulkaninna as well. Between them, Daryl and Sharon Bell have served organisations such as the Marree Soil Conservation Board, the Cattle Council of Australia and the South Australia National Parks and Wildlife Service.

Daryl Bell was schooled by correspondence to Grade 3 level, and by the age of 9 was working full time cutting 100 timber fenceposts a day. David Bell reckons that what his father lacks in formal education, he more than makes up for with his hands-on knowledge of land, vegetation, animals, people and machinery. "He can walk into a room full of bureaucrats and he can easily mix it with them," says David.

And then there's Jess Bell, who has her horticulture honours degree and has worked from Dulkaninna as a Landcare co-ordinator and for the local Natural Resource Management board.



Kerry Trapnell

Annual rainfall at Dulkaninna is extremely low and highly variable.



Old saddle bags (top), horseshoes and stonework (bottom) capture the proud heritage of Dulkaninna Station, which was established in the 1890s.

David Bell says his family's wisdom on managing the Outback is sorely needed these days, because there's "too much education and not enough knowledge", particularly among bureaucrats.

He's proud of his parents' depth of knowledge, the way they've been involved in their community, and the way they've fought for things they believed in. He believes nearby Lake Eyre is in good health today because people like the Bells have been grazing this arid region responsibly for more than a century.

This is also the legendary land where Clancy of the Overflow went "a-droving down the Cooper where the western drovers go". And it's where cattle king Sidney Kidman forged a mighty empire, sending fat cattle down the track to the railhead at Marree. It was the 1884 arrival of the railway and the government's drilling bores for travelling stock between 1890 and 1916 that cemented the Birdsville Track as Australia's greatest droving route.

Daryl Bell is the last of the generation of drovers who walked cattle down the track before the road trains took over in the early 1970s. He has great memories of that hard life, which involved months away from home, long days in the saddle and a relentless diet of beef, potatoes and onions, with ever more curry powder added as the meat became ever more rancid.

"There's a bloody lot of history here," he says. "We're the oldest family on the track." Little wonder, therefore, that he and his son rejected the mining giant BHP when it offered a tempting price for Dulkaninna. Their attachment to their land and way of life is strong. They are adamant that they can manage this landscape better than any mining company, conservation group or government agency.

David Bell says of the cattle families of the Birdsville Track: "We're all conservationists."

In recent years, more and more of the Outback has been bought by various organisations and destocked so it can be managed for conservation purposes. David Bell says that, unlike the families that have traditionally run the big Outback stations, many of these newcomers have not become part of the all-important social fabric that helps make life bearable for people in such isolated regions.

Bell says it would help if conservation organisations found people to manage their properties who are family and community-oriented. "They don't call in and have a coffee," he says. "Most of the stations around here are family affairs. That's why these new people aren't fitting in. They need to find families that fit into the community to run their properties."



Kerry Trapnell

Floodout country produces valuable cattle feed after heavy rains.

He also resents the assertion by some that running cattle damages the Outback. “Conservationists say pastoralists are destroying things,” David Bell says. “But there are no more birds on their properties than there are here. Scientists have found all sorts of birds and mammals on Dulkaninna. We’ll get as many dunnarts here as you will over there. You don’t survive if you don’t respect the country out here. You won’t last 10 years.”

Bell says of the cattle families of the Birdsville Track: “We’re all conservationists.” He strongly believes that running cattle can be done in a way that does not harm the environment and leads to better land management, because it provides an economic basis for more people to be in the Outback, managing and making a living from the land.

Nowadays, he says, there are properties that could be generating millions of dollars a year in income from cattle but are producing no money and whose environments are suffering because their managers don’t have the human and financial resources to properly look after them. He believes these people also lack the passed-on knowledge of previous generations.

Bell’s assessment: “It’s a waste of good country. They can’t manage this country; it’s too big.

“The best thing they could do is certify us and pay us to be rangers. People come out here and see how we do things, and they see this works, this does make sense; that we’re doing the right thing here environmentally,” he says.

He believes some non-pastoral properties are also hampered by “too much bureaucracy and not enough money and know-how to properly control feral animals”. Dulkaninna has pastoral neighbours to the north who shoot hundreds of camels, brumbies and wild dogs a year, while in David’s view some other land managers aren’t fulfilling their control obligations for feral animals.

The floodout country of Dulkaninna’s Cooryaninna Creek is an awesome natural irrigation system that grows fantastic feed for the cattle and horses that graze there when it rains. But there’s no permanent surface water on Dulkaninna.

“You can get your average rainfall in two hours and then it won’t rain for two years,” Bell says. Even the smallest amounts of rain can have amazing results, particularly in the gibber country, where the rocks create a delicate web of pooled water.



A water bore at Dulkaninna has flowed continually since it was drilled in 1896.

Dulkaninna normally runs 2000 to 2500 cattle, and “we’ll fatten cattle better than anywhere else in Australia when we’ve got the feed”, Bell says. However, it’s the bores that tap the Great Artesian Basin deep below that make pastoral activity possible in this arid region. The water comes to the surface under high pressure so it can easily be piped long distances to stock watering points without the need for expensive pumping.

Dulkaninna relies entirely on four bores. The homestead bore is one of the original government bores, dating back to 1896. It has been flowing for more than 100 years, and there’s now a wetland near the homestead because of it.

Bell believes that in the years ahead, “the water issue is going to be massive”. The mining industry, including BHP’s nearby Roxby Downs

operation, has a growing appetite for water from the basin as well. He says the bores on some pastoral stations have failed, and the pressure in Dulkaninna’s bores has been reduced due to extra competition for the water. These days, he adds, it would cost between \$1 million and \$2 million to add a single new bore on Dulkaninna, and “you’d be gone” if the station’s bores failed.

Water is a vital commodity out here and has to be conserved, distributed and used wisely. To help conserve this resource, there has been an intensive program to cap and pipe bores that were previously allowed to spill their precious water across the landscape. Water use and management is likely to remain an ongoing critical issue in this part of the Outback.



Kerry Trapnell



Kerry Trapnell

Jason Dunn (bottom) flies a Cessna to help muster cattle from the air on the huge Dulkaninna Station (top).

Mustering day is a neighbourly affair on Dulkaninna. Jason Dunn from Etadunna Station to the north has turned up in his trusty old Cessna 172 to help from the air. In this paddock of more than 100 square kilometres, where you can look to every horizon and not spot a fence or any cattle, it's obvious why using planes delivers big savings in time and money. It's one of David Bell's innovations. On the ground, in 4WD and on motorbike, are more neighbours: father and son Shane and Clayton Oldfield of Clayton Station to the south.

To operate sustainably in a harsh and isolated place like the Birdsville Track, producers need to extract a premium return for their product. Like all the other cattle stations on the track, Dulkaninna is a certified organic beef producer, usually delivering a 25–30 per cent price margin over regular beef. Nobody out here uses chemicals on the animals or the land.

Organic accreditation was achieved in 2000, and most of the beef produced on Dulkaninna goes to the United States. The 280 beasts mustered from the paddock this day are worth about \$1000 each because beef prices are so high. A single B-double truck can now haul \$100,000 worth of potential profit from Dulkaninna.

Bell says you have to work hard for that premium – it costs about \$10,000 a year to maintain organic certification and it involves at least a week's worth of extra time in the office each year. Getting a premium price also means a lot more mustering and a lot more investment in better roads, fences and other improvements to make mustering more efficient. But it's well worth the effort.

Dulkaninna is a certified organic beef producer, usually delivering a 25–30 per cent price margin over regular beef. Nobody out here uses chemicals on the animals or on the land.

Outside influences have also made big differences to life on the Birdsville Track. Bell says the introduction of the anti-rabbit calicivirus would be one of the biggest in recent times. Rabbits used to decimate the vegetation, which contributed to regular, and epic, dust storms that caused station residents to eat their food beneath cloth sheets and clean their verandahs with shovels and wheelbarrows. Sometimes the dust storms would rage for days. Now, they are a rarity, because rabbits in this area have been almost wiped out by the disease, which was deliberately released in the 1990s.

The secret to survival on the track, Bell says, is not succumbing to the temptation to use such breakthroughs as an excuse to greatly increase stocking levels.

What would he like the next breakthroughs to be? The Birdsville Track is still entirely dirt and received phone service only in the early 1990s. David believes it's now time there was a paved bitumen surface and mobile phone coverage along its full length. Both would greatly increase his ability to run a sustainable business.

At the moment, Bell says, 10 to 15 millimetres of rain can be enough to close the road, so he can't truck cattle without risking a hefty fine. And mobile phone service might finally provide his family with reliable internet that will let them do the basics, such as downloading lessons for his children from the School of the Air.

There's a fantastic image of George Vernon Bell (1919-2007) hanging on the wall of the Marree roadhouse, honouring him as one of the district's great local residents. Like many young men, David Bell got on even better with his granddad George than he did with his dad, Daryl, although he learned a lot from both of them. The time he spent with his granddad while growing up greatly added to the young pastoralist's pool of knowledge about how to work and manage this stretch of Outback land.

It's this wisdom, handed down through generations, that gives Bell confidence that his generation of the family will also survive – and thrive – on Dulkaninna.

His grandfather taught him the importance of having cattle native to the landscape. "Because it's a land of extremes, you do much better with cattle that are born and bred on your place," Bell says. "They know where to walk to water, they know the foods to eat, they know where to go after a big fall of rain, and they know where to go when it's really dry. They adapt quicker in a land of extremes."

And most importantly, George Bell taught him that theirs was "long-term country, not short-term".

"There's no quick buck to be made out here," David Bell says. "It's absolutely long-term country. Don't overstock it, and treat every fall of rain like it's the last one you'll get. Every year's a drought year, and it's a bonus if it does rain. If you think like that, you're on the right track."

Breakout 1 **The benefits of working together**

One longtime survival mechanism for the Bells of Dulkaninna Station is Outback Lakes SA. It's a multipurpose organisation consisting of 10 family-run properties within a 100-kilometre radius of Marree.

Outback Lakes was born in the early 2000s out of frustration that local producers couldn't get any premium prices for their cattle, David Bell explains.

They developed their own quality assurance scheme to earn those extra dollars and, more importantly, the group started meeting four times a year just as the epic drought of the 2000s really started to bite.

Shane Oldfield of neighbouring Clayton Station recalls that those meetings became vital social occasions that got people off their properties, talking to each other and watching over each other closely.

"It was one of our big saviours in that 10-year drought," Oldfield says. "It was a godsend during that time for some of us. You would

talk and you had the same problems and you realised the weight of the world wasn't just on your shoulders. You could go and have a few laughs and come back with a different state of mind."

Outback Lakes has also given the station families a respected voice with the government and more muscle in lobbying for common causes.

"The big advantage is that you have a stronger voice when you speak as a group," Bell says. "It's just a good group of people. We can do anything."

Bell says Outback Lakes has also given a lot of its members the confidence to speak their minds, serve on other boards and take on lobbying work, which they wouldn't have been prepared to do before.

The ultimate plan is for Outback Lakes to become a brand you can look for and buy at city butchers and supermarkets – a brand that stands for clean, green and tasty organic meat.



A photograph of a riverbank with a dense line of trees and their reflection in the water. The trees are lush green and their reflection is clearly visible in the calm water. The sky is a clear, pale blue.

3.11 Balancing the needs of people and place in Kakadu

Kathy Wilson

*Team Leader, Southern Operations,
Kakadu National Park*

The tropical sun drops like a blazing rock behind a bustling scene on the legendary wetlands of the South Alligator River system. There are jumping frogs and barramundi, buzzing insects, magpie geese flying in formation over towering paperbark trees, flowering water lilies and spiky pandanus. Biodiversity abounds. But the animal at the top of the food chain here isn't just seen or heard.

"Can you smell that?" asks Kathy Wilson as she stands at the bow of a small boat creeping its way through this extraordinary landscape. "That's crocodile!"

It's a fishy smell that puts her instantly on alert, even after years of working as a ranger in Australia's premier crocodile ecotourism destination, Kakadu National Park. A loaded, high-powered rifle lies at Wilson's feet. Earlier in the day, she completed an exhaustive biennial target range test to prove to her bosses that she was deadeyed enough to deal with any croc situation using a variety of firearms.

The Australian saltwater crocodile – or 'saltie', as it's colloquially known – is a mighty beast that's not to be trifled with in 20,000-square-kilometre Kakadu. It's an animal that frequently occupies Wilson's mind.

Wilson leads the team of rangers who manage the southern half of the park, which contains Outback icons such as Yellow Water, Jim Jim Falls and Twin Falls. Crocodile management takes up about 20 per cent of her team's time. However, the reptile that has loomed large in Wilson's psyche since she was a teenager isn't the main challenge in safeguarding Australia's biggest terrestrial national park; navigating and sustaining a complex joint management arrangement requires continued negotiation and effort.

Kakadu is a wetland and bird-breeding site of global importance and is also home to many Traditional Owners and thousands of Aboriginal rock art sites. The national park is one of the planet's few World Heritage sites listed for both its natural *and* cultural values – a living cultural landscape that is jointly managed by Parks Australia, an agency within the federal Department of the Environment and Energy, and the clans of the Bininj/Mungguy people. An image of the Traditional Owners' creation ancestor, the Rainbow Serpent, adorns the Kakadu ranger uniform.

The national park is one of the planet's few World Heritage sites listed for both its natural and cultural values.

The Department of the Environment and Energy website says that "since the late 1970s Kakadu's Traditional Owners have leased their land to

the Director of National Parks to be jointly managed as a national park. Joint management is about Bininj/Mungguy and Parks Australia working together, solving problems, sharing decision making and exchanging knowledge, skills and information." The park's board of management has 15 members, 10 of whom are Indigenous.

However, despite the strong board representation, some Traditional Owners say their perspectives are not being sufficiently taken into account. The new Management Plan for Kakadu acknowledged the need for support and improved consultation with Bininj/Mungguy and the desire for greater opportunities for Traditional Owners.

A major requirement of Wilson's role is building good relationships 'on the ground' on a daily basis. On one hand, she consults with Traditional Owners about the way Kakadu is run, from croc and fire management strategies to letting them know when feral animal control is happening. On the other, she discusses their views and requests with park management and feeds responses back to Traditional Owners. At times, this results in some difficult conversations.

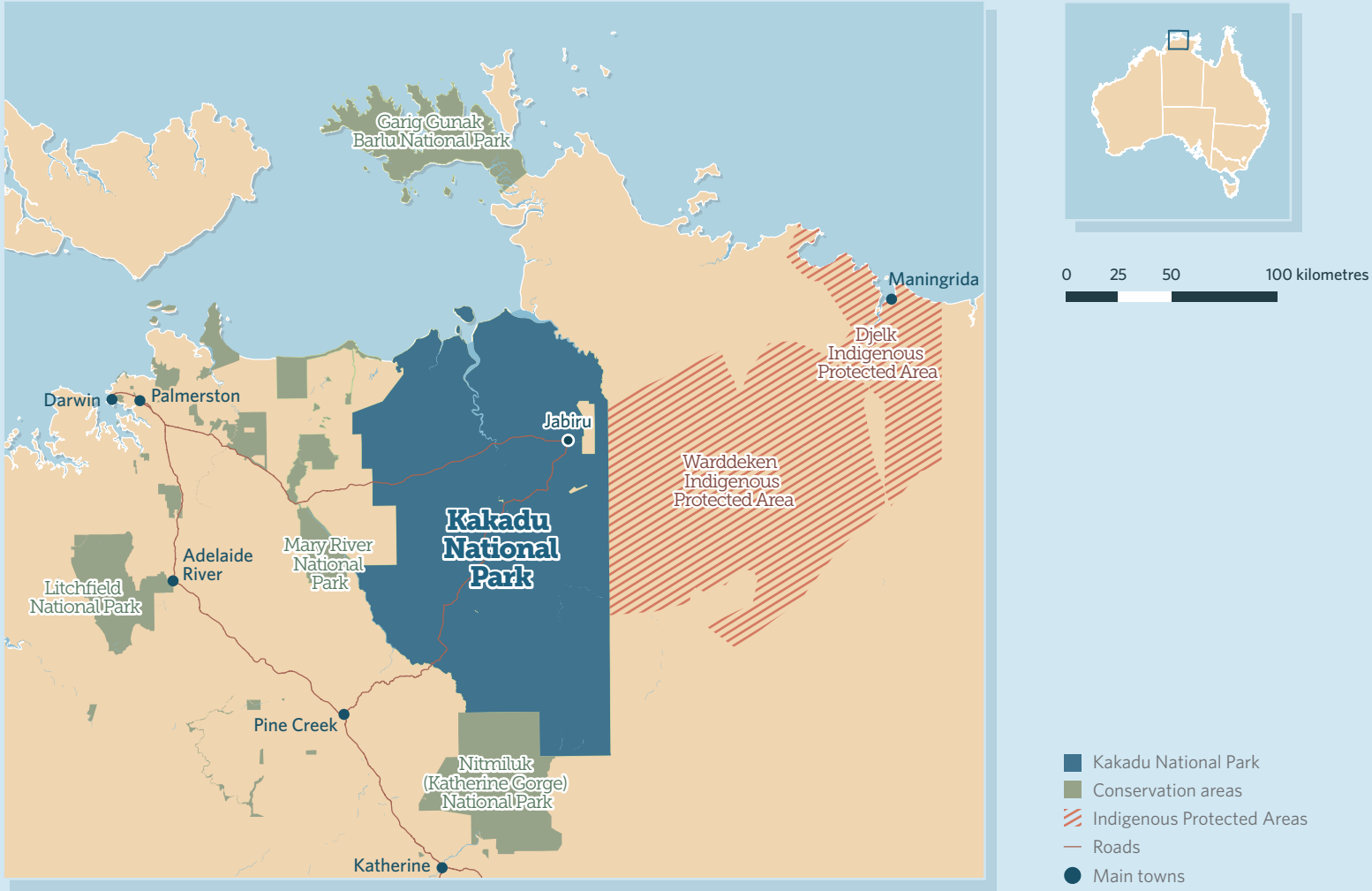
Wilson listens to Traditional Owners' concerns and works toward solutions. "That's why I took on the role of team leader – I wanted to make an extra effort to listen to the people and see what they have to say," she explains.

"We all endeavour to work closely together to uphold the principles of genuine joint management. We need to increase our efforts with consultation so we can work out shared solutions that everyone can feel happy about – more win-win situations," Wilson adds.



Parks Australia staff members and Traditional Owners meet regularly to discuss management issues.

Figure 16
Location of Kakadu National Park, Northern Territory



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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Morning mist rises above Kakadu's beautiful wetlands, which are of global importance for water birds (top). Ranger Fred Baird patrols the lush floodplain (bottom right). Magpie geese, egrets, herons, ducks and pelicans feed among the water-lilies (bottom middle). Plumed whistling-ducks watch from the shore (bottom left).

Managing crocodiles is far less complex but still presents its challenges. Wilson was born in 1966 – five years before crocs were first protected from wholesale culling in the Northern Territory because they were on the verge of extinction.

Her first close encounter with a croc came as a 13-year-old on her family's Northern Territory farm, where she and her eight siblings regularly swam at a nearby waterhole. One day she wandered down there with a pet water buffalo, and to her horror and amazement it was taken by a large crocodile. Croc numbers were on the way back up, and the Wilson family had been caught unaware.

“That was really confronting for us, because we’d been swimming there just the day before,” Wilson recalls. “It opened my eyes about how amazing these crocs are: I’m in awe of them. They’re incredible animals; the way they’ve come back from near extinction and the way they adapt to how the landscape changes with the seasons.”

These days, her concern is keeping croc numbers strong while keeping safe the 170,000 or more tourists who visit Kakadu each year to see them in the wild.

Tonight, Wilson is on one of the annual spotlight croc surveys she conducts in September, toward the end of the dry season, when the wetlands have shrunk and it’s easier to get an idea of croc numbers by counting the pairs of eyes that glow coal-red as they stare back at her bright beam.

As the powerful spotlight rakes across the water and adjacent banks for two hours, about 50 crocodiles are spotted, and their species (saltwater or freshwater), size and location are recorded where possible.

It’s easy to get the impression that crocs are all that Wilson worries about this time of year. The wetlands are shrinking fast, so the territorial crocs are crowded together into smaller areas. At the same time, as the waters warm up, the barramundi are biting, so there’s the greatest influx of anglers to the park. The consequences are inevitable: cranky crocs sometimes lashing out at boats or chasing a fisherman’s catch as it’s being reeled in.

When a problem croc is reported, Wilson and her rangers will head out, harpoon it, haul it to the side of the boat, tie it up and then ‘process’ it: taking vital measurements, determining its sex, giving it a number and marking it so it can be identified again.

Wilson says that’s usually enough to solve the problem, because the croc comes to associate boats and people with the pain of the harpooning. Still, every season a few reoffend and usually are dispatched by rifle. They can’t simply be moved to another area of the park, because “everything is finely balanced in nature,” says Wilson. “That animal will just upset the balance and cause more problems somewhere else.”



Rangers monitor Kakadu's crocodiles every year (top and middle). Feral pig carcasses are used as bait to entice crocodiles into sturdy traps (bottom).



At the start of the dry season, rangers remove crocodiles from the scenic Jim Jim Pool (left) so that visitors can swim relatively safely in the popular waterhole (right).

In early June, at the start of each dry season and before tourists are allowed into areas where swimming is permitted, the Jim Jim ranger team spends weeks camping out to prepare places like Jim Jim Falls for reopening to the public. The team conducts crocodile surveys and sets traps to check whether any salties have moved in during the wet season.

This is Wilson's favourite time of year, when there are cool south-east breezes, all is green and lush, and the Milky Way looks brighter than ever.

It's a chance for everyone to simply enjoy being out on country with one another. "Even though it involves long days, and the work often goes into the night, it's just really good fun in the evening around the campfire having tea together and telling stories and having a laugh," Wilson says.

"In the Outback, being a team player is crucial; you simply can't achieve what you need to over such vast areas on your own."

All through the dry season, the rangers constantly check and bait traps around the popular tourist areas. It's a job that involves some serious four-wheel driving, boat travel, trudging on foot through dry creek beds, scrambling over rocks, all the while hauling big chunks of meat – usually the leg of a wild pig or water buffalo the rangers have shot. The traps are of an ominous size and construction, big enough and tough enough to hold a croc more than 5 metres long.

Kakadu is a life-and-death challenge that Wilson and her team embrace every day. With a smile as wide as an Outback horizon, she can't hide her passion for the landscape, its Traditional Owners, its crocs and her role as a senior ranger. For her, working in Kakadu is not just a career or a calling; it goes deeper. She is more than married to the job: "The job's my life; it's not just a job."

With characteristic Outback humility, Wilson is also quick to point out that she's "nothing special; it's the people around me, the team I work with who get the job done."



Rangers light a mosaic of small fires early in the dry season to prevent large wildfires (left). Feral cattle, pigs, buffalo and horses damage Kakadu's wetlands (right).

The collective "synergy" of the ranger team is all-important. "I couldn't do my job if it wasn't for the people on my team and the people who support us back in the park's administration and head offices," she says. "In the Outback, being a team player is crucial; you simply can't achieve what you need to over such vast areas on your own.

"You've also got to be self-sufficient to a certain degree - I'm a very independent person," she adds. "But I know when I need help, and I appreciate how much more we can achieve when the team is working well together and everyone's pulling their weight."

Much of the rangers' efforts are directed at managing the major environmental threats of fire and feral animals. Fire has always been a big part of life in Kakadu, but now there is too much fire, and particularly too much fire at the wrong time of year.

"Fire is probably the number one management issue," Wilson says. "A lot of money and effort are put into trying to stop late-season fires. We try to get in early to break up the country into a mosaic pattern [of burnt and unburnt areas]. Early-season fires are less destructive, and hopefully we do enough to stop late-season wildfires that burn out large tracts of land.

"The main issue with fire is the threat to biodiversity. Those late-season fires in the open woodlands are just so devastating. You have 100 per cent scorch. Trees fall down, so if you've got possums or sugar gliders in the trees they lose their homes, they get killed, burnt. And at this time of year, the fires also burn the logs on the ground that might have bandicoots or snakes in them."

Wilson hopes that the park's joint managers can work more effectively together in the future to better address fire issues.

“We are putting more resources, time and effort into patch burning,” she explains. “We are encouraging Traditional Owners back into the landscape, to burn their country themselves – especially the areas they want to return to later in the season to hunt buffalo or cattle.

“The Kakadu board is working collaboratively to understand the importance of preventing late-season fires and to improve overall biodiversity,” she adds. “That way we can do the work on the ground to achieve the best outcomes – for the people and for the country.”

The famed Yellow Water wetland is not only a haven for crocs; it also is home to feral animals: pigs, buffalo, cattle and horses. Their grazing damages native vegetation and causes erosion. They spread weeds that fuel more damaging wild fires.

Feral animal control is another challenge facing the park. Management of feral animal populations is a priority for the Kakadu board due to the environmental damage they do to the national park, but some Traditional Owners want sufficient numbers on hand to hunt as a food source. Food at the local supermarket is expensive; local water buffaloes, on the other hand, provide a cheap, delicious meal.

Ferals such as wild horses and cattle are viewed as pets by some Traditional Owners who once worked on pastoral stations. Buffalo have been part of the landscape so long that some people no longer see them as feral.

“Many people like these animals, but on the other hand, they destroy country and ruin cultural sites,” Wilson says. “These large feral animals also pose a potential hazard to park visitors.”

Despite these complex challenges, Wilson says the Indigenous connection in Kakadu makes her job so special, and the presence of Traditional Owners in the park is a blessing. The joint management aspect makes her role even more exciting and adds a deeper cultural connection as well.

“As you move through the country, you can feel it,” she says. “It’s a privilege for me to be able to get firsthand information from them, hear what they really feel and share their lives. They take the time to help me see their point of view.”

Wilson hopes to be a ranger in Kakadu until she retires. “This place isn’t a stepping stone for us,” she says of herself and her team. “We’re here for life.”

She began working at the park in the early 1990s, left for a few years and has been back permanently since 1999. Despite that lengthy service, she says, it’s still too early to reflect on achievements. And there’s simply not enough time for reflection, given how much still needs to be done to safeguard this iconic Outback landscape.

Often in her ranger career, Wilson has been the first female to be employed in a certain role. There were a few problems with some of her male colleagues when she first started, but that’s a thing of the past. She has been accepted in the (once) blokey ranger world and feels supported in her role.

“I think it’s because I had a fair bit of experience in the bush and I’m easy going,’ she says. “I’m open to change, I’m open to suggestions. ... I’m happy to listen and learn, and I’m keen to give anything a go. That’s made a big difference.”

There are challenges in joint management, but Wilson believes they also show a way forward. Everyone may not always agree on the details, but what’s most critical is acknowledging the deeply shared values inherent in caring for the land, its nature and its people. The result can be a shared long-term vision and common objectives, with people working together and respecting one another’s knowledge, experience and perspectives.

Wilson is also proud of the fact that at the Jim Jim ranger station where she’s based, all the other rangers are Indigenous – something she sees as “a big win”.

She believes Indigenous Ranger programs are vital for the health of the Outback, for empowering Indigenous people and preserving their culture, and for the broader community.

“I think Kakadu can showcase how the Outback can be effectively managed in future,” Wilson says.

“You’re getting people back out on country, and when people are on country, essential environmental management skills can be shared. And the country is cared for and the cultural knowledge can be passed on to the next generation.”



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell



Kerry Trapnell

A multitude of colourful birds visit Kakadu's wetlands, including rainbow bee-eaters (top left), forest kingfishers (top right), egrets – this bird is in breeding plumage (bottom right) – pelicans, magpie geese and whistling-ducks (bottom left).

Breakout 1 **Joint management: A work in progress**



Traditional Owner Jessie Alderson was born at Kakadu and still lives there.

Kakadu is one of Australia's first jointly managed national parks – here the Gukburlerri (Aboriginal) Traditional Owners share the decision-making with Guhbele (non-Indigenous) managers employed by the Australian Government.

Jessie Alderson, one of Kakadu's senior Traditional Owners, was born beside the park's Leichhardt Lagoon more than 60 years ago. Her Murumburr clan country includes Yellow Water, one of Kakadu's most famous attractions, with its boat rides through a wetland alive with crocs, barramundi and birds. She loves eating turtle, emu and flying fox.

Alderson lives within the park with her extended family at an old buffalo hunters' camp called Patonga Station. It's one of many Aboriginal outstations dotted throughout the park. She served for many years as a ranger and on the park's joint management board. She has worked closely with Kathy Wilson for many years and sat on the selection panel that gave Wilson the job as team leader for the southern half of the park. She describes Wilson as a "strong

person", and the two have had some robust debates over the years.

Alderson says the years she spent as a ranger were the best of her life. She had spent a long time away from Kakadu until she was "called back" by the land and reconnected with her country.

Alderson respects people such as Wilson, who have years of on-ground experience. However, she believes there are too many non-Indigenous Rangers. And too many of the Indigenous Rangers who do work there are not from Kakadu, while locals need more opportunities to find jobs on their own land, she says.

Alderson acknowledges that ecotourism is the best long-term direction for her people and their traditional country, even though she sometimes feels ambivalent about the national park. She'd like to see Traditional Owners more involved in developing fresh ideas about how to attract more tourists to the park.

Breakout 2 **Visitor numbers**



Approximately 200,000 tourists visit Kakadu every year.

Kathy Wilson believes Australians would feel more inclined to care about the future of the Outback if they visited it more often and gained a better appreciation of its natural wonders.

But people aren't coming to Kakadu in the numbers they used to. In 1985, approximately 100,000 people visited the national park. Visitation increased rapidly in the late 1980s, and during the early

1990s, visitor numbers averaged about 230,000 a year.

For the past decade, annual visitation has been around 200,000, despite the impact of the global financial crisis. There are still plenty of grey nomads, but not enough young people are visiting Kakadu.





3.12 Managing and conserving Australia's bush heritage

Luke Bayley

*Executive Manager,
West, Bush Heritage Australia*

What was once a lonely, narrow dirt track wandering across one of Australia's most fascinating environmental projects is now a wide, busy haulage road. Every few minutes, huge four-dog road trains roar past, rushing iron ore from a neighbouring mine to the nearest railhead.

This is Charles Darwin Reserve, a former sheep station situated on the border between the wheat-growing and pastoral areas 350 kilometres north east of Perth in Western Australia (WA). Bought with private money, the property is a veritable ark of native plants and animals and is being rejuvenated in a way that would bring joy to the great naturalist its name honours.

This jarring industrial haulage road is not everyone's idea of what conservation should look like, but welcome to the Outback. It's a place where environmental projects often live side-by-side with mining projects, and conservationists make the best of the relationship.

It's certainly a reality that Luke Bayley has no problem with on this isolated conservation reserve. He has been here for over four years with his partner, Fiona Stewart, who helps him manage the reserve, and their two children. Bayley has no desire to live anywhere else, even though he has recently joined the executive ranks of the reserve's owner, Bush Heritage Australia (Bush Heritage), and is now responsible for overseeing the organisation's West Region and its Aboriginal Partnerships Program.

"This place is where I feel safe and inspired and needed," Bayley says of Charles Darwin Reserve. "I didn't grow up in the Outback. I ended up here as my career's evolved, and now it's definitely my home.

"I love the landscape – the big sky, the weathered rocks and the harshness. The beauty when it all comes together is very inspiring, and it resonates with who I am," he says. "I also find it an endless journey – I'm always discovering new things, so I like the unravelling nature of the place and the work. And I also like the challenge. There's a lot of work to do out here across many spheres and sectors."

Bought with private money, Charles Darwin Reserve is a veritable ark of native plants and animals and is being rejuvenated in a way that would bring joy to the great naturalist its name honours.

Bush Heritage is a not-for-profit organisation that acquires and cares for Australian land and partners with Aboriginal people to manage land of outstanding conservation value. It owns 38 properties across Australia,

encompassing more than 6 million hectares. Its aim is to secure and protect the country's biodiversity and natural landscapes.

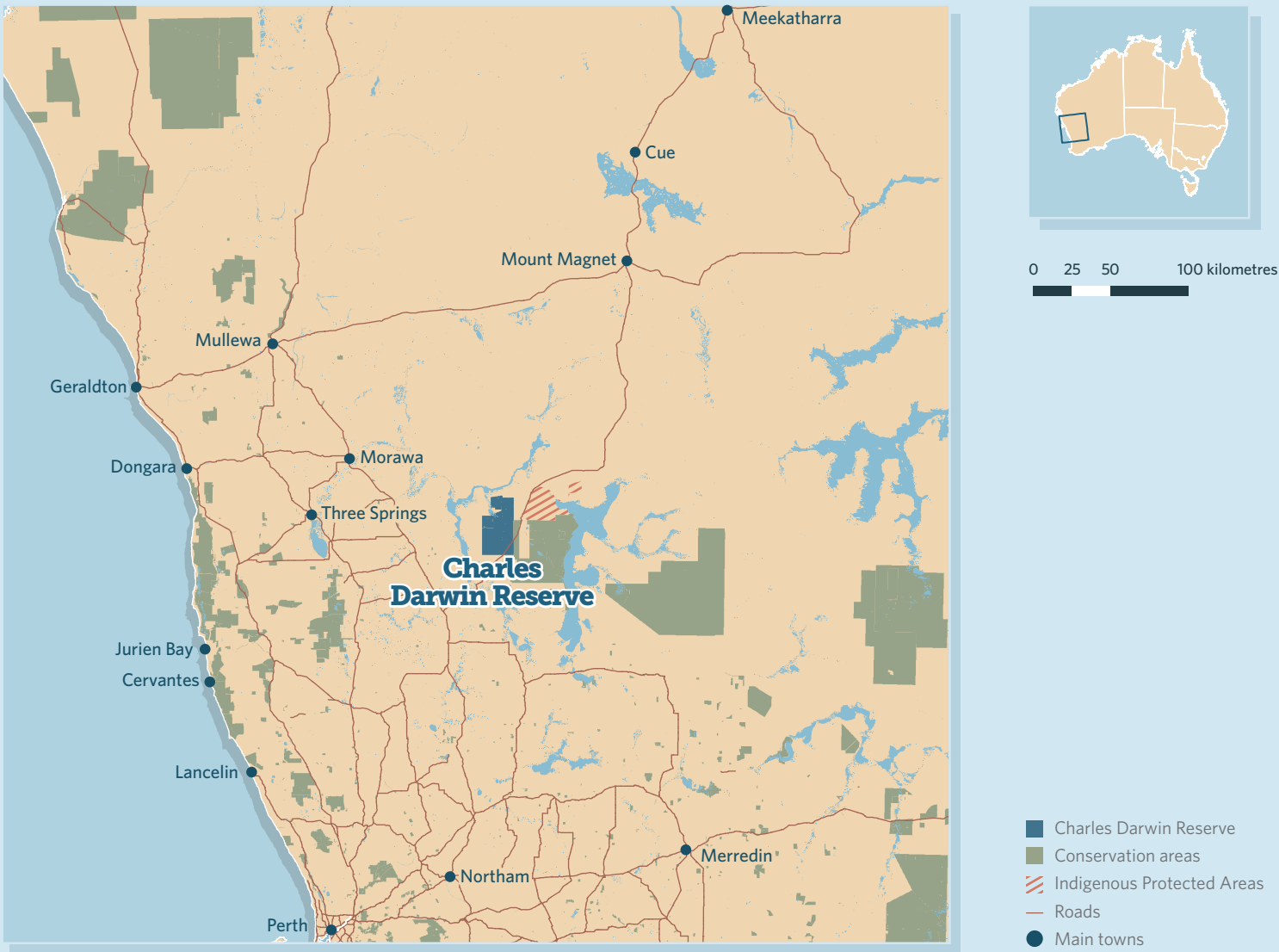
Bush Heritage bought the property, also known as White Wells Station, in 2003, when it was a clapped-out pastoral property plagued by weeds, erosion, soil compaction, wildfires and feral animals. Protecting this land was seen as a vital step toward conserving some of the last remaining stands of vegetation types that were once widespread across south-western Australia and creating a strategic refuge for animal species.

Since its conversion into a conservation reserve, the 68,000-hectare property has been intensively managed and monitored to gradually restore its natural environment. The results have been stunning and are most evident in the amazing displays of wildflowers, the establishment of a soil crust (cryptogamic crust), and the growth of widespread native grasses, now that grazing pressure from livestock and feral animals has been removed.



Trees and shrubs were cleared by dragging a heavy chain before the reserve was purchased.

Figure 17
Location of Charles Darwin Reserve in Western Australia



Sources: Department of the Environment and Energy and Department of the Prime Minister and Cabinet. See the appendix for details.
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The many faces of Charles Darwin Reserve: Colourful native daisies flower beside a fallen branch (top left); Luke Bayley and Fiona Stewart inspect an enormous salt lake (top right); low chenopod saltbushes clothe the red sands (bottom right); and old eucalypts glow in the early morning light (bottom left).

To make similar property purchases easier and more secure for organisations such as Bush Heritage, Bayley wants to see a reformed pastoral lease system that embraces the reality that some properties are no longer viable for running livestock and are now principally being used for other purposes, such as conservation and tourism. Buying leasehold pastoral land can be a big problem, because conditions of the lease can require the running of stock, the clearing of timber and even the elimination of some native species.

“There’s a lot of uncertainty about tenure if you drill down into the detail of the existing pastoral lease system,” Bayley says. “Having a rangeland lease that recognises and supports conservation and Aboriginal land management as legitimate activities would be a big step forward. We would like to know we could buy land and put long-term covenants on it; it would be great to provide that certainty for our donors.”

Bayley’s views about mining in the region might seem out of character for a committed conservationist – until you realise they are grounded in the real-world practicality required of any Outback land manager. As far as he’s concerned, mining in the neighbouring Mount Gibson ranges is contributing to Charles Darwin Reserve’s success story. He believes that as long as it leaves environmentally and culturally sensitive areas alone, mining can be a good thing for the Outback generally, because it brings in people, money, infrastructure and skills that are much needed in a landscape where those things are otherwise retreating.

As part of their agreed environmental offsets, two regional mine operators jointly fund the Gunduwa Regional Conservation Association (Gunduwa), which brings pastoralists, Traditional Owners, conservationists, miners and local government officers together to work on making this corner of the Outback a healthier place, regardless of property boundaries.

“There’s so much energy and synergy and positivity in this group,” Bayley says, excited about the work being done by Gunduwa, which he chairs, and the opportunities that lie ahead.

Every six months, one mining company distributes \$50,000 in grants to the local community. Mine money is also funding the Gunduwa Regional Conservation Association to encourage local groups to collaborate on regional biodiversity and land management. Gunduwa is currently funding projects totalling \$130,000 and is considering supporting landscape-scale Indigenous Ranger initiatives in the mid-west region of WA.

Gunduwa is also funding work to identify where native animals retreat to during hard times so that monitoring and protection can be focused on those areas. And a \$40,000 mining contribution made possible an ambitious aerial survey to identify malleefowl nests across the area.

“The malleefowl is an iconic animal under a lot of pressure, so this survey work is extremely important,” Bayley explains.

Contributions from mine operators and local businesses also directly support Bush Heritage’s work at Charles Darwin Reserve. Sponsoring the annual Blues for the Bush open day and concert and lending resources for firefighting are just two examples.

The upgraded haulage road has made life in such an isolated location more livable for Bayley’s family. It has improved access to the local school, which is 67 kilometres away, and also helps Stewart get to her other job as a mental health clinician. “That infrastructure enables us to enjoy living in this part of the world,” Bayley says.

As part of their agreed environmental offsets, two regional mine operators jointly fund the Gunduwa Regional Conservation Association (Gunduwa).

Of course, working with neighbouring miners and pastoralists also has its challenges. “It’s a relatively conservative part of Australia, so it can be hard to fit in when you’re doing something different,” he says. But Bayley prides himself on his pragmatism and loves working with people who have very different world views from his own to achieve outcomes for the environment.



Bush Heritage Australia has given this old pastoral property a new lease on life.

Bush Heritage encourages its reserve managers to become actively involved in their local communities, and Bayley hasn't let his employer down. He's the chairman of the local school board; organises Blues for the Bush, which has been held at the reserve since 2013; is the local Auskick footy coach; and continues to build strong relationships between Charles Darwin Reserve and schools. "Having kids ourselves has really helped us integrate into the community," he adds.

Bayley grew up a long way from the Outback – in the Dandenong Ranges in outer Melbourne, among lyrebirds and cool, moist glades of mountain ash. He swapped all that for the heat and big horizons of the Outback when he moved to WA to work on the reserve.

He chose Bush Heritage because it was an organisation he admired; he hated his previous work in rural policy; he wanted to be responsible for an actual piece of land; and he wanted to make the world a better place. He wanted to be a farmer of biodiversity instead of wool and wheat.

Bayley loves life in the bush, loves the autonomy that Bush Heritage gives him and loves the opportunity his family has enjoyed living on the reserve. "Our kids don't realise it yet, but they're part of something pretty special – looking after this precious country," he says. "The Outback gets under your

skin, and you realise how much opportunity there is to do things differently and better."

In the Outback, he feels that he is needed and his contribution is most valued. He particularly loves finding common ground among stakeholders and achieving results that benefit all.

"The reason I think my future is here is because I can see there's a lot of work to do," he explains. "I'm in a position where I can take a leadership role. I can see issues and I can build good relationships to resolve them. I think there's a bright future out here.

"The Outback just needs to be reimagined," he says. "We've got to work out how to catapult the Outback into the next century. We can't do things the way they were done in the past. This is where our future is. This is where we are meant to be. Being out here, it feels like we're on the cusp of something. It's like the frontier. It's tough and it's challenging."

Bayley sees a major new Outback economy in the restoration of landscapes that have been depleted. He believes the rangelands are "losing their vibrancy" as people continue to be lost from the Outback despite the economic boost brought by mining.



"Having kids ourselves has really helped us integrate into the community," says Luke Bayley, with partner Fiona Stewart (left). Bayley and Stewart inspect fruiting saltbushes at Charles Darwin Reserve (right).

The way Bayley sees it, wealth from the Outback through commodities such as wool and gold helped build modern Australia. Now the Outback is exhausted and largely ignored. It deserves to be nurtured and nursed back to health. “It needs our respect and ideas,” he says. “It’s a place we’ve still got lots to learn from.

“To keep the land healthy in this part of the world, we need to keep ensuring that there are large parcels of land that are not being pressured for production, whether that be for mining or grazing. We need reserves staggered around the Outback that create buffers and support habitat just for the purpose of keeping nature healthy.”

Although Charles Darwin Reserve lies on the northern edge of the WA wheat belt, most of it miraculously escaped being cleared. It was once earmarked for broad-scale clearing and grain growing but remained a pastoral property instead. The mighty metal chain that would have been dragged across its shrub lands and woodlands, flattening the lot, lies rusting and half buried not far from the homestead. The land’s myriad environments are therefore still intact, a reminder of the nature that once covered thousands of square kilometres of south-west Australia but has long been lost to agriculture.

One of the really important aspects of the reserve’s recovery has been simply “giving the land a rest” after decades as a pastoral station so that nature can rejuvenate itself, moisture can once again penetrate the soil, and native plants can grow back. “That approach is working a treat, and we’re seeing lots of response from native grasses, sandalwoods, quandongs and other species,” Bayley says. In fact, the environment on the reserve remains relatively natural and diverse in “a region that’s been flogged”.

At first glance, the land appears to be a flat, featureless, scrubby monoculture. But embedded within its size and subtle nuance are incredible beauty and diversity. There are 15 land systems in total on the property, and 12 vegetation types containing many hundreds of different plant species. The reserve also straddles the eucalypt/mulga line.

“Charles Darwin Reserve is a very diverse environment,” explains Bayley. “Bush Heritage purchased it for that reason. It’s got this interface between the south-west botanical region, which is a very rich floristic part of the world – it’s one of only two global biodiversity hotspots in Australia – and the semi-arid rangelands, where it’s dryer and you’re starting to get mulga belts and little patches of spinifex.

“There are salt lakes in the middle of the reserve that have a unique vegetation community, and you’ve got patches of salmon gum, york gum and gimlet gum woodlands,” he says. “There are greenstone and granite outcrops. It’s a rich, biodiverse property.”



Shallow salt lakes at Charles Darwin Reserve support distinctive vegetation communities (top). Goannas persist, but most of the reserve’s mid-sized native mammals have disappeared (bottom).

The size of the reserve – 20 by 36 kilometres – means it can offer genuine protection for a diversity of habitats. According to the Bush Heritage website: “It is recognised as one of the few remaining areas of bush in south-western Australia that is large enough for ecosystems to function naturally, if weeds and exotic predators are controlled, fire is kept out of long unburnt ecosystems and drainage patterns are restored.”

“There are little gems everywhere – you just have to slow down and look,” says Stewart. She is from the Victorian High Country, where she was more accustomed to seeing snow gums than the “scruffy” york gums, with buckled branches of burnished bronze, that populate the reserve.

Like Bayley, Stewart has been seduced by this special part of the Outback. She says living in remote Australia has given her a real appreciation of the deep connection with country that Indigenous Australians have known for millennia.

Bayley agrees and is excited that this emerging period of conservation and restoration for the Outback involves engaging meaningfully and over the long term with Indigenous Australians to learn from their land management knowledge and supporting “people going back onto their traditional country and tending it”. He’s concerned about the possibility that the state government might shut down hundreds of small Indigenous communities throughout WA, saying it would be “a disaster”.

One of the really important aspects of the reserve’s recovery has been simply “giving the land a rest” after decades as a pastoral station so that nature can rejuvenate itself.

“Having those Outback communities is part of our heritage and the Outback’s future,” he says. “If you haven’t got people out there, it becomes no man’s land, and no-one knows what’s going on. We need to be promoting economic opportunities in Aboriginal communities so people can stay on country and care for their land.”

Bayley has fostered a strong relationship with the Badimia people, the Traditional Owners of Charles Darwin Reserve. He helps care for their *gnamma* waterholes in the rocks, and his favourite place is the Red Hand site, an initiation place for boys where hand stencils have been painted onto the rock walls.

The Outback of the future will still contain mining and pastoralism, Bayley says, but those activities, along with conservation, “will be underpinned by respect for Traditional Owners and their knowledge, and this will help form exciting partnerships. We can do so much more if we work together”.



Wildflowers stabilise the soil and provide bold splashes of yellow (top) and pink (bottom) every spring.

Despite all its environmental charms, the reserve is an ecological apocalypse because of its loss of mid-sized mammals. The brush-tailed possums, bilbies, bettongs and stick-nest rats are long gone. All that's left are old nests and burrows. This disaster is largely due to feral predators.

"The main land management challenges we're facing are really around controlling feral animals," Bayley says. "We've got on top of a handful of those issues – mainly feral foxes, goats and rabbits – but the big issue for us is the feral cat, which is a common threat throughout the Outback.

"It's an issue we're always working on in Bush Heritage and in partnership with other organisations," he says. "But the cats continue to prey on reptiles and small mammals, and we've already lost all the mid-sized mammals in this part of the Outback."

Despite the present-day challenges, Bayley is optimistic that in five to 10 years Bush Heritage will be in a position to begin reintroducing locally extinct mammals onto the reserve. The brush-tailed possum would be a "good candidate" to start with, then maybe the stick-nest rat, which is being bred behind predator-proof fences on a nearby reserve managed by another private environmental group, Australian Wildlife Conservancy.

While Bayley concedes that "regaining the mammals is going to be a long haul", he's pleased to say there have also been some big wins at the reserve. Goats and weeds are finally under control and are no longer having a significant impact on biodiversity. Native vegetation is being regenerated, the soil is stabilising, and there's an ever-increasing number of resident bird species being recorded every year.



Bayley uses camera traps to monitor native and feral animals.

Volunteers – a crucial element of the reserve’s success – now need to weed only around the old stock camps, front paddock and wells. “They’re nearly on top of the weeds after a decade,” says Bayley. “And we’re getting a healthy skin back on the soil.”

With hard-hoofed animals removed and ‘brush packing’ (fallen shrubs lying on the ground surface) used to slow the flow of surface water, the soil’s healthy cryptogamic covering – held together by liverworts, lichens and mosses – is once again in place. Bayley says stabilising the soil in this way “means we’re keeping water on the reserve; it’s not rushing off, and this is reducing soil erosion and giving plants and grasses the chance to flourish”.

“It’s lovely seeing the grasses starting to spread out from under the shrubs,” he adds. “And to see the foliage of palatable shrubs like the sandalwood and quandongs starting to drape down to the ground.”

Once harvested for their aromatic oil, mature sandalwood trees are now a common feature on the property. With the grazing pressure from feral goats and sheep removed, the sandalwoods are looking healthy. But there are few seedlings sprouting, so Bayley gets visiting schoolchildren to help with an important activity once performed by one of the native animals that’s now sadly absent from the reserve.

Burrowing bettongs used to collect the sandalwood nuts and bury them for future consumption, thus helping to spread and position them for germination. Now that the bettongs have disappeared from the landscape, school students are taking up this task, collecting the nuts and burying them, bettong-like, in the hope that the seedlings will come back.

While the proliferation of wildflowers is an obvious sign of a landscape returning to its natural beauty, possibly the most telling change has been in the salt lake landscapes, which were heavily grazed by sheep. What was previously barren is again alive with multi-hued succulents, saltbush and samphire.

The health of the reserve as it recovers is constantly monitored and meticulously documented by Bush Heritage so the donors who fund it know exactly what their money is achieving. At fixed monitoring sites, ecologists annually take photos and identify, count and monitor the health of native plants as well as weeds and undertake annual fauna surveys and climate monitoring.

Native fauna and feral animals are similarly monitored using traps, cameras, sand pads and spotlighting. Bats and birds are also counted, radio tracked and banded. The reserve has tried new feral animal baiting systems and is part of a 30-year climate change observation program to see how native species respond to the expected drier and hotter weather.

One of the most important jobs over summer is monitoring and fighting fires to make sure they don’t spread into a destructive inferno across the much of the property. Too much of the reserve has been subjected to such fires during the many years since patterned mosaic burning stopped being carried out by the area’s earlier Indigenous inhabitants. Nowadays, the fires are too hot and frequent for threatened animals such as the malleefowl, which prefers bushland that hasn’t burned for 40 years in order to source the leaf litter it requires for its enormous egg-incubating mounds.

While fires and feral cats pose ongoing threats, Bayley’s greatest concern remains the need to tell people in Australia and overseas about the work being done by Bush Heritage and why conserving large tracts of the Outback and its biodiversity is so important.

While the proliferation of wildflowers is an obvious sign of a landscape returning to its natural beauty, possibly the most telling change has been in the salt lake landscapes, which were heavily grazed by sheep.

“We can be doing the greatest work in the world out here in the Outback, but if other people don’t know and care about what we’re doing and why – well, you’d have to ask, ‘What’s the point?’” he says with a shrug. “We can do it to make ourselves feel good and for the good of the country, but the Outback is such a special place that it needs to remain relevant and connected with the whole of our society.”

His vision for the future of Charles Darwin Reserve, and the Outback generally, starts with getting more people out on the land to help manage it and share its stories far and wide. He wants more partnerships with Aboriginal custodians of the Outback, collaborative research projects and visits from school groups.

“The Outback’s given Australians, and the world, so much, and we have a responsibility to give it a great deal of our thought and effort in the future,” he says.

Breakout 1 Honouring Charles Darwin's legacy

Charles Darwin Reserve is named in honour of the great 19th-century naturalist and geologist whose evolutionary theory revolutionised scientific understanding about the origin of species on Earth.

When a young Darwin visited Australia in 1836, his fascination with the continent's unique animals led him to write something profound in his journal. He dared to break from the biblical orthodoxy that governed science and for the first time committed to paper a kernel of the idea that later evolved into his legendary work, *On the Origin of Species by Means of Natural Selection*:

"Early in the evening I had been lying on a sunny bank and was reflecting on the strange character of the animals of this country as compared to the rest of the world. A disbeliever in everything beyond his own reason might exclaim, 'surely two distinct creators must have been at work'."

Darwin also observed the deadly impact that European settlement was having on these strange animals and predicted that for many, "their doom is fixed".

A significant donation from Chris Darwin – Charles Darwin's great-great-grandson – was instrumental in helping Bush Heritage Australia purchase White Wells Station. Chris Darwin lives in Australia and has since become a Bush Heritage ambassador. He was inspired by his concern about species extinctions and by this statement, which his forebear wrote not long before his death in 1882: "I feel no remorse from having committed any great sin, but have often and often regretted that I have not done more direct good to my fellow creatures".

Nearly 200 years after Charles Darwin's visit to Australia, Luke Bayley, Bush Heritage's resident manager, lives each day with the legacy of the naturalist's wisdom and warnings as he helps to rebuild this corner of the Outback. The reserve's astonishing diversity of life is a testament to Darwin's theory of evolution – and also a daily reminder of the prescience of his prediction about extinctions.

"It's a great name to be attached to," says Bayley. "I like to think he would be over the moon that an organisation like Bush Heritage is using his legacy to help the Outback."

But Bayley thinks that if Darwin were to turn up at the reserve tomorrow, the great man of science would also be perplexed and asking plenty of questions.

The reserve is an oasis of scientific endeavour and is being used to study climate change, control methods for feral animals, the relationship between bird populations, and the impact of fires. However, Bayley reckons that Darwin would be asking why they don't know much more about these important ecological questions. Why don't they know more about how Indigenous Australians managed this landscape before the arrival of Europeans? Why, after all this time, haven't they learned how to control feral cats and prevent the extinction of native wildlife?

"And given things are so bad in Australia in terms of native species extinctions," Bayley adds, "I think he'd want to know why it took us all so long to realise that you need to get private investment involved in protecting nature."

Breakout 2 **An Outback land manager's toolkit**



Rock outcrops provide vantage points over the huge reserve.

What do you need in your toolkit to become an Outback leader and landscape manager like Luke Bayley of Bush Heritage Australia?

It's a job that involves fundraising, marketing, negotiating property purchases, and managing staff and volunteers. It also involves changing tyres, hunting, firefighting and fencing.

Bayley has a bachelor of applied science in parks, recreation and heritage and is studying for a graduate diploma of economics. He's a graduate of the prestigious Australian Rural Leadership Program, with a long history of working as an adviser in the agriculture sector.

He's got his front-end loader ticket, firearms licence and qualifications, and certifications to use herbicides for weed

control and poisons for pest control. He has completed courses in remote area first aid, four-wheel driving, Outback survival, incident management and firefighting.

It goes without saying that he's also a bush mechanic, handyman, bookkeeper, IT guy, amateur plumber and electrician.

Team all that with a passion for community involvement, music, art, his family, Indigenous culture and conservation and you have the classic Renaissance man – and skilled land manager – of the Outback.

Valuing donors, volunteers and visitors

It costs about \$260,000 a year to operate Charles Darwin Reserve, nearly all of which is provided by Bush Heritage Australia's donors.

Continued on next page.



Researchers and citizen scientists monitor climate change at Charles Darwin Reserve.

The money pays for ecologist wages, remote sensor cameras, solar generators, diesel, feral animal baits and a host of other expenses.

Bush Heritage wants to grow its supporter base to 50,000 people who will collectively help raise over \$20 million a year to fund (and expand) its work. Luke Bayley believes the best way to do this is by continuing to tell the story of how vital this work really is. "If we're going to continue doing good work across the Outback, we need to continually build awareness and support for what we do," he says.

People are learning more about Charles Darwin Reserve by participating in scientific field trips, school excursions, camping trips and the annual open day and music festival, or offering their time and labour as volunteers.

A constant stream of visiting volunteers, birdwatchers, scientists and students keeps the reserve's visitor accommodation centre

occupied during much of the amenable season between April and October. (Summer in that part of Australia can be incredibly hot: Bayley recalls one day when his thermometer stopped working at 50°C and many of his chooks died.)

Blues for the Bush and Charles Darwin Open Day are unique partnerships with the Perenjori Shire that bring people to the Outback each year to learn about the bush, celebrate diversity and dance.

Campsites and self-guided walking and driving tracks enable visitors to enjoy the reserve's myriad landscapes and explore historical features such as old gold-mining shafts, beautiful stone wells built by Benedictine monks, and Aboriginal *gnamma* waterholes and rock art.

"These visitors, and especially our volunteers, are all contributing to our work to protect nature while also helping the local community and the local economy," Bayley says.



"For a land with so few occupants, there are many extraordinary people in the Outback. Each one has a story to tell, and lessons from the land to share." Professor John Woinarski.



Glenn Walker

4. The challenges of maintaining and restoring country

Professor John Woinarski, Charles Darwin University

As the preceding profiles illustrate, there is much commonality in the major threats to lands and environments across the Outback: feral animals, weeds and fire. Comparably, there are also almost pervasive challenges and impediments in seeking to control these factors.

These common factors include few people, high costs, insufficient resources, poor accessibility, limited infrastructure and governance capability, fickle support schemes, scarce collaboration and, in some cases, lack of know-how.

In many parts of the Outback, there are now fewer people managing country than there have been for tens of thousands of years, and yet the number, variety and near-intractability of some threats are unprecedented.

It may seem counterintuitive, but much of the decline in biodiversity in the Outback is occurring in areas that are most remote from population centres and human activity.

4.1 More land managers needed

It may seem counterintuitive, but much of the decline in biodiversity in the Outback is occurring in areas that are most remote from population centres and human activity. This is occurring because many of the feral animal, weed and fire threats now occur almost pervasively across the Outback and, especially where there are no managers attempting to control them, their detrimental impacts are increasing. More so than ever before, the country needs people to care for it.

Many of the accounts in this book talk of the limited budgets currently available to landholders to look after their country. Available investments in the management of feral animals, weeds and fire across the Outback are variable and sometimes hard to clearly identify, but typical budgets for such environmental management range from a few cents up to \$2 to \$4 per hectare each year.

4.2 Funding inequality

Government support for management is limited and sometimes fickle. Typically, Outback regions receive only a small fraction of government

investment relative to the natural resource management funding given to more densely settled regions.

And yet costs for management in many Outback areas are often high: Much of the country is relatively inaccessible (in many cases the only practical means of access is by aircraft), land holdings are very large, and travel costs to bring equipment or specialist personnel to a remote property may be expensive, as noted in the account here by Doug and Marg Sprigg (p. 110).

Furthermore, at least in poor seasons, some businesses will lose money or be economically marginal at best. Such property holders may view land management actions aimed at achieving long-term objectives as low priorities relative to the immediate need to remain viable.



Kathy Wilson (at left) and Jessie Alderson discuss park management at Kakadu (top). Traditional Owners like Alderson have enormous knowledge of their country. Sustainable land management builds on the experience of Outback residents such as Daryl Bell at Dulkaninna Station (bottom).

In all cases here, landholders dispense their precious available resources for looking after country frugally and efficiently. Management is targeted carefully and strategically to priority problems by attempting to protect the highest value or most susceptible assets, and by seeking to achieve long-term benefit.

In all cases, more money would be welcomed and would allow landholders to achieve more long-lasting and broader-scale control of threats (or control of more threats), and more enduring benefits.

Some preliminary assessments indicate that the budget required to effectively manage priority threats to biodiversity in Outback regions ranges from \$1 to \$10 per hectare per year. This substantially surpasses the typical current level of allocation. Effectively, this means that land managers are falling ever further behind and that most threats – and their impacts – are increasing.

4.3 Distinct policy settings required

Another feature of remote Outback communities and properties is that governance structures are often frail, vulnerable and incapable of providing services that would be expected in more settled areas. Many small Outback communities face numerous exceptional social and economic challenges, have limited available expertise, and are highly dependent on external funding sources that are often short-term and subject to marked and unpredictable changes in direction that are externally imposed.

Environmental problems that may be difficult to resolve, or that may present gradual incremental declines rather than abrupt changes in natural values, often receive low priority relative to immediate daily requirements to address stark social problems.

4.4 Valuing the people and nature of the Outback

In part, this book is a plea to government, industry and others outside the Outback. Many in this book are humble and work without expectation of commendation or publicity. But here we are acknowledging that what they do is important and effective – and necessary.

Their management work will help to restore and retain the health and productivity of lands directly across most of Australia, and indirectly across the continent as a whole. It will allow those lands and our nature to be passed on to the next generations in good (and often, in better) condition. It cherishes and cares for our legacy.

The benefits of this work far outweigh the costs. The land management activity also provides significant contributions to local and regional economies, employment opportunities, education, community integrity

and governance, and health, as described in accounts here by Rarrtjiwuy Melanie Herdman (p. 26), Les Schultz and David Graham (p. 84) and Michael Ross (p. 124).



Jeff Lee and other Indigenous Rangers work to protect the environment and strengthen ties to traditional lands (top). Ranger Georgina Gellett searches for ghost nets in the Dhimurru Indigenous Protected Area; her story, like all of those in this book, speaks of successes and hopes for the future (middle). A unique and intact natural heritage, exemplified by the striking Sturt's desert pea (bottom), is a major drawcard for tourism in the Outback.

These contributions from land management are particularly important given the socially disadvantaged status of many Outback remote communities. But much of the work described in this book relies on good long-term policy settings infused by a recognition of the value of and need for sustainability, and on financial and other contributions from government, industry and others.

Such investment is often limited and insecure. It needs to be more dependable and more substantial, because the problems that land managers are seeking to overcome are broad-scale and deeply embedded.

4.5 Signs of hope

One reading of the accounts here is of a hopeless and unrelenting battle against an ever-increasing array of threats, of just a few individuals engaged in a campaign that needs many more people, of challenges that are far beyond the reach of available resources, and of land and nature being incrementally devalued. However, there are now more grounds for optimism than pessimism, and many recent examples of threats being contained and nature recovering, and of the broad-scale achievement of major conservation policy and management advances.

In part, the stories in this book talk of success and hope. Indeed, a purpose of this book was to demonstrate to our society more broadly that the

Outback is not a dysfunctional basket-case but is an extraordinary national asset – a land of wonder – that is being carefully and capably nurtured by many people who are making extraordinary progress in solving problems.

There is also joy, satisfaction and serenity in the lives of people in this book. The Outback may be a harsh and demanding place, but it is the backdrop to a way of life that matters, and that is richer and more grounded than that available to most people in most cities. It is a grand way of life, explicitly celebrated here by Ann Ballinger (p. 72) and implicit in the accounts of many others.

4.6 Success of Indigenous land management

One striking feature of the Outback over recent years is the spectacular growth in the number and extent of Indigenous Protected Areas and Indigenous Ranger schemes: Examples here include Ngadju Conservation, Dhimurru Aboriginal Corporation and Olkola Aboriginal Corporation. These represent far more than simply changing the officially recognised purpose of a parcel of land. They are demonstrations of commitment to looking after country, and of the particular applicability and fit of Indigenous knowledge to land management in Australia. These programs have nurtured land, communities and culture and have contributed to far better governance across large areas of the Outback.



Ann Ballinger inspects a solar panel at Stockholm Station; such new technologies expand opportunities for Outback enterprises (left). The Outback's unique sights—like the reflection seen in this beautiful salt lake in Ngadju country and the Great Western Woodlands—can provide great joy, satisfaction and serenity (right).

One striking feature of the Outback over recent years is the spectacular growth in the number and extent of Indigenous Protected Areas and Indigenous Ranger schemes.

Collectively, they have framed far better networking across the Outback, more sharing of knowledge about what management actions work, and greater collaborative and effective management across vast areas. These programs are here to stay.

Their return on investment is unusually good. But they remain insecurely and inadequately resourced. They can and need to grow more, and to be more widely celebrated and recognised as essential components of the future of the Outback.

One notable achievement from these Indigenous land management programs is the broader dissemination of Indigenous land management expertise. For example, Aboriginal landowners have demonstrated the utility of fine-grained use of fire, with clear evidence that such management has led to improvements in fire regimes and, in some areas, to increases in biodiversity.

4.7 Managing the Outback 'both ways'

In complementary fashion, the wider availability of ranger jobs has stimulated an increase in land management training for Aboriginal people and others, increasing access to and understanding of scientific and technical knowledge of Outback ecosystems and management approaches.

These two approaches – traditional and modern – are being more widely applied across all Outback lands and will help to craft a land management practice that is uniquely Australian, based on a considered mix of Indigenous and scientific approaches, and that best matches the distinctive Australian environment.

In accounts here, Rarrtjiwuy Melanie Herdman (p. 26), Tony Cockburn (p. 50), Michael Ross (p. 124) and Kathy Wilson (p. 150) all talk about the benefits of – indeed, the need for – 'both ways' of managing country.

4.8 Reform to encourage diversification

The need for a broadly similar mixing of old hard-learned ways with modern science is also a theme in accounts of some pastoralists in this book, such as the Bell family (p. 136).

In pastoral leases covering 40 per cent of the Outback, there has been

a trend in some districts toward an increasing diversity of uses. Pastoral leases were devised in the 19th century to encourage cattle and sheep grazing in the then-separate colonies prior to Australian nationhood.

Over 150 years later, some properties and some districts are no longer viable as commercial operations due to varying combinations of poorer quality country for grazing, distance from markets, increasing costs and decreasing returns and, in places, degradation by overgrazing for a century and more.



Government and private conservation reserves provide a wide range of meaningful work experiences for young Australians. Patrick Clements (top) repairs broken equipment at Rinyirru National Park, while Felicity L'Hotellier (foreground, bottom) sets a cage trap to survey native mammals at Australian Wildlife Conservancy's Scotia Sanctuary.

While the current leases mostly mandate that they are for grazing operations only, diversification into other enterprises has been widespread. In some cases, these new enterprises, such as tourism, carbon farming, conservation and use as living areas, have been authorised by state regulators.

However, in many cases, the new uses have no strong legal foundation and this lack of legal status is tacitly overlooked by state bodies. Diversification of uses in the vast pastoral zones will likely accelerate in future years as the legal foundation for non-grazing uses is formalised and native title rights are further settled.

4.9 Success of non-government conservation

One of the consequences of this diversification is a substantial growth in the number and extent of conservation reserves owned or managed by non-government conservation organisations in the Outback, such as the Scotia Sanctuary (p. 65) and Charles Darwin Reserve (p. 165) examples presented here.

In many cases, these reserves have been crafted out of lands formerly devoted to unsustainable and unprofitable pastoral operations, and this diversification in land management and enterprise is itself a major improvement for Outback lands generally.

These non-government reserves typically have biodiversity conservation as their primary objective along with a substantial environmental research and monitoring capability, and they apply evidence-based and adaptive management. Many have demonstrated great success in management, resulting in the return of and marked increase in species formerly long lost from those environments.

While non-government conservation organisations may have championed this approach, there are also very notable examples of biodiversity recovery on some reserves managed by governments, and in projects substantially resourced by major mining companies. Indeed, the extent of cross-sector collaboration in conservation management is itself a notable feature of many successful Outback land management programs.

4.10 Signs of a modern Outback

There have been improvements in government policy and practice. Whereas once there was little constraint on the introduction and spread of foreign plants that purported to improve pastoral productivity, this is generally no longer the case because of the compelling evidence of these plants' detrimental impact on other Outback landowners, and the difficulty of controlling these weeds once they have spread.

Gradually, government policy is also changing in its treatment of 'pastoral' lands, with a recognition that the devotion of such a high proportion of the Outback exclusively to a single land use represents a stifling of opportunity and needed diversification.

There are also improvements in the environmental regulation and responsibilities associated with mining ventures, and many such ventures now see a significant contribution to local and broader-scale environmental management as an accepted and appropriate way of doing business.

Land management techniques are improving, and advances in technical capability have allowed many management actions to be undertaken more innovatively, extensively and efficiently. For example, increasingly fine-scale, more frequent and cheaper satellite imagery is now used routinely by most Outback land managers for fire monitoring and management, and for assessment of greenhouse gas emissions and carbon trading.



Louise Price inherited her grandfather's love of Oikola country, as well as the famed hallmarks of Outback families: hard-working, adaptable and innovative.

Imagery is also used for broad-scale and longer-term property planning and monitoring, for management of feral animals and weeds, and for identification of biodiversity refuge areas. Most rangers and many other landholders also now routinely use Global Positioning Systems (GPS) to record and store information about the occurrence and distribution of feral animals, weeds, threatened species, fires and other features. In addition, more portable, sturdier and longer-lasting laptops and tablets allow many managers to upload or download information (including material from increasingly accessible government and other environmental databases), even in very remote parts of their lands.

More sophisticated transmitters allow for threatened animal species to be tracked in a manner that provides information on distribution, habitat use and other factors that is far more detailed and useful than what was possible even a few years ago.

Surveys and management activities for Outback wildlife are increasingly including the application of remote automated cameras, remote listening devices and environmental DNA, making it easier to detect many elusive threatened species, such as the night parrot. Drones are now being used for surveys of some feral animals, weeds and threatened species in the Outback and are likely to play an increasing role in environmental management.

In some areas, virtual fences are being trialled to constrain the movements of livestock, and stock are tracked with GPS collars to allow pastoralists to better understand and manage their use of country. Transmitters are also used routinely to locate aggregations of feral animal species to allow more effective pest control.

Many windmills and artificial water sources are now routinely managed by remote electronic systems. Renewable energy sources are increasingly used to power remote Outback communities and some land management activities. Increasingly sophisticated modelling of weather and climate patterns and forecasts allows many land managers to better match stocking rates to current and future sustainability.

Many of these tools provide novel and far more extensive insights into how remote Australia functions, allowing for an unprecedented level of broad-scale and long-term understanding of its ecology and management requirements.

Outback residents have long needed to be adaptable, and to look for innovative solutions that work to reduce costs and increase the practicability of managing large areas.

Many have embraced these technological advances as tools that allow for new ways of seeing and understanding their country over larger spatial

scales and longer time periods. They recognise that the new tools also provide some solutions to the challenges faced by a small number of people with few resources working on large landscapes with many environmental concerns.

In many ways, the Outback is in better condition now than it was a generation ago. If others can respect and learn from the people speaking in this book – who collectively have helped make those improvements – it is likely to be in even better condition in generations to come.



Kerry Trapnell



Kerry Trapnell

Fiona Stewart and Luke Bayley explore Bush Heritage Australia's Charles Darwin Reserve (top). Increasing the diversity of land uses strengthens local communities, economies and the environment. At Nallan Station, Dustin Clinch cradles his daughters Bonnie and Maddison (bottom). If others can learn from the people profiled in this book, the Outback will be in even better condition in the years to come.

Appendix

Full data sources for maps and figures

Figure	Data sources
All maps: Coastline	Geodata Coast 100K 2004. Commonwealth of Australia (Geoscience Australia). Available from https://data.gov.au/dataset/geodata-coast-100k-2004 .
All maps: State borders	Department of the Environment and Energy, 2012. Interim Biogeographic Regionalisation for Australia (Regions - States and Territories) v. 7 (IBRA) [ESRI shapefile]. Available from http://intspat01.ris.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7BFB89EEC9-5ABE-4CCD-B50E-7D485A3BAA4C%7D .
All maps: Localities and roads	Geodata Topo 250K Series 3, 2006. Commonwealth of Australia (Geoscience Australia). Available from https://data.gov.au/dataset/geodata-topo-250k-series-3-packaged-personal-geodatabase-format .
Figure 3. Aboriginal lands	All states: Native Title Determinations (National Native Title Register). National Native Title Tribunal, Commonwealth of Australia. Available at http://www.ntv.nntt.gov.au/ . Downloaded January 2016. NT: NT Aboriginal Land Trusts dataset. Department of Lands, Planning and Environment Northern Territory. Obtained July 2016. WA: ALT Estate (DAA-003) Department of Aboriginal Affairs, Western Australia. Download June 2016. SA and QLD: Map data based on Australian Land Tenure 1993 dataset (Geoscience Australia, Commonwealth of Australia) and updated using a digitized version of the 2016 Indigenous Estates and Determination map created by the National Native Title Tribunal. Available at http://www.nntt.gov.au/Maps/Indigenous_Estates_and_Determinations_A1L.pdf .
Figure 4. Pastoral leases	NT: Pastoral Leases dataset supplied by the Department of Lands, Planning and the Environment. Obtained October 2015. WA: Pastoral properties dataset supplied by the Department of Agriculture and Food, Western Australia. Obtained November 2015. SA: Pastoral Paddocks. Department of Environment, Water and Natural Resources, South Australia. Obtained October 2015. QLD: Cadastral Data-Queensland series, Department of Natural Resources and Mines. Obtained June 2016.
Figure 5. Indigenous Protected Areas and government and private conservation reserves	Indigenous Protected Areas Declared. Environment Branch, Indigenous Employment and Recognition Division, Department of the Prime Minister and Cabinet and the Environmental Resources Information Network (ERIN), Department of the Environment and Energy (c) Department of the Environment and Department of the Prime Minister and Cabinet, 2016. Available from http://www.environment.gov.au/fed/ . Downloaded August 2016. Reserves based on CAPAD 2014, and updated with state and private conservation group data. Collaborative Australian Protected Areas Database (CAPAD) 2014. © Commonwealth of Australia, Australian Government Department of the Environment and Energy, 2014. Available from http://www.environment.gov.au/fed/ .
Figure 6. Dhimurru Indigenous Protected Area	Indigenous Protected Areas (IPA) Declared. Environment Branch, Indigenous Employment and Recognition Division, Department of the Prime Minister and Cabinet and the Environmental Resources Information Network (ERIN), Department of the Environment (c) Department of the Environment and Department of the Prime Minister and Cabinet, 2016. Available from http://www.environment.gov.au/fed/ . Downloaded August 2016.
Figure 7. Nallan Station	Pastoral properties dataset supplied by the Department of Agriculture and Food, Western Australia. Obtained November 2014.

Continued on next page.

Figure	Data sources
Figure 8. Rinyirru National Park	Collaborative Australian Protected Areas Database (CAPAD) 2014. © Commonwealth of Australia, Australian Government Department of the Environment and Energy, 2014. Available from http://www.environment.gov.au/fed/ .
Figure 9. Scotia Sanctuary	Collaborative Australian Protected Areas Database (CAPAD) 2014. © Commonwealth of Australia, Australian Government Department of the Environment and Energy, 2014. Available from http://www.environment.gov.au/fed/ .
Figure 10. Stockholm Station	Rural properties - Queensland. Department of Natural Resources and Mines, Queensland. Available from http://qldspatial.information.qld.gov.au/ . Downloaded May 2015.
Figure 11. Ngadju Native Title area	Native Title Determination Applications (Register). National Native Title Tribunal, Commonwealth of Australia. Available at http://www.ntv.nntt.gov.au/ . Downloaded November 2015.
Figure 12. MMG Limited's Century Mine	Queensland mining and exploration tenure series. Department of Natural Resources and Mines, Queensland. Available from http://qldspatial.information.qld.gov.au/ .
Figure 13. Arkaroola Wilderness Sanctuary	Located using Arkaroola Wilderness Sanctuary website. Available from http://www.arkaroola.com.au/ .
Figure 14. Olkola country	Indigenous Land Use Agreements (Registered or in Notification). National Native Title Tribunal, Commonwealth of Australia. Available at http://www.ntv.nntt.gov.au/ .
Figure 15. Dulkaninna Station	Pastoral Paddocks. Department of Environment, Water and Natural Resources, South Australia. Obtained October 2015.
Figure 16. Kakadu National Park	Collaborative Australian Protected Areas Database (CAPAD) 2014. © Commonwealth of Australia, Australian Government Department of the Environment and Energy, 2014. Available from http://www.environment.gov.au/fed/ .
Figure 17. Charles Darwin Reserve	Collaborative Australian Protected Areas Database (CAPAD) 2014. © Commonwealth of Australia, Australian Government Department of the Environment and Energy, 2014. Available from http://www.environment.gov.au/fed/ .

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