

Working Knowledge: characterising collective indigenous, scientific, and local knowledge about the ecology, hydrology and geomorphology of Oriners Station, Cape York Peninsula, Australia

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Abstract. The term, Working Knowledge, is introduced to describe the content of a local cross-cultural knowledge recovery and integration project focussed on the indigenous-owned Oriners pastoral lease near Kowanyama on the Cape York Peninsula, Queensland. Social and biophysical scientific researchers collaborated with indigenous people, non-indigenous pastoralists, and an indigenous natural resource management (NRM) agency to record key ecological, hydrological and geomorphological features of this intermittently occupied and environmentally valuable ‘flooded forest’ country. Working Knowledge was developed in preference to ‘local’ and/or ‘indigenous’ knowledge because it collectively describes the contexts in which the knowledge was obtained (through pastoral, indigenous, NRM, and scientific labour), the diverse backgrounds of the project participants, the provisional and utilitarian quality of the collated knowledge, and the focus on aiding adaptive management. Key examples and epistemological themes emerging from the knowledge recovery research, as well as preliminary integrative models of important hydro-ecological processes, are presented. Changing land tenure and economic regimes on surrounding cattle stations make this study regionally significant but the Working Knowledge concept is also useful in analysing the knowledge base used by the wider contemporary indigenous land management sector. Employees in this expanding, largely externally funded, and increasingly formalised sector draw on a range of knowledge in making operational decisions – indigenous, scientific, NRM, bureaucratic and knowledge learned in pastoral and other enterprises. Although this shared base is often a source of strength, important aspects or precepts of particular component knowledges must necessarily be deprioritised, compromised, or even elided in everyday NRM operations constrained by particular management logics, priorities and funding sources. Working Knowledge accurately characterised a local case study, but also invites further analysis of the contemporary indigenous NRM knowledge base and its relationship to the individual precepts and requirements of the indigenous, scientific, local and other knowledges which respectively inform it.

Additional keywords: hydro-ecological processes, indigenous knowledge, indigenous people, knowledge recovery, natural resource management.

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Introduction

Improving the knowledge base for environmental management is an ongoing priority, both for local resource managers and for the communities, funders and regulators who support and oversee their activities. The large geographic scale and relatively sparse human population in the Australian rangelands presents logistical and operational challenges, but also challenges to establishing and maintaining an appropriate human knowledge base to undertake operations. The indigenous land management sector continues to grow rapidly (Lane *et al.* 2009; Holmes 2010b; Altman and Kerins 2012; Hill *et al.* 2013) and large areas of

northern Australia are being devolved to indigenous control under communal tenures (Altman and Kerins 2012). This emphasises the need to both properly understand the knowledge base on which contemporary indigenous land management operates and to undertake research which targets gaps in that base (Ens 2012; Robinson and Wallington 2012; Walsh *et al.* 2013). This paper describes a collaborative knowledge recovery project between the Kowanyama indigenous community (acting through the Kowanyama Aboriginal Land and Natural Resource Management Office, the KALNRM) and researchers from the CSIRO and Griffith University.

The following sections introduce the project aims and key concepts, provide additional description of the field location and project methods, and provide some examples of key results. In the Discussion, the wider implications of the study are reviewed in terms of three issues: changing resource values and tenure regimes in Cape York Peninsula (CYP) and across the Australian rangelands more generally; issues of knowledge synthesis among socio-culturally diverse research participants; and the evolving knowledge base of contemporary indigenous natural resource management (NRM).

Project aims and key concepts

The preliminary aims of the project which underpins this paper were to:

- explore new concepts and methods for knowledge synthesis and modelling in remote rangelands contexts;
- undertake a knowledge recovery project to support local indigenous natural and cultural resource management aspirations for an ecologically valuable but poorly documented area; and
- investigate the relationships between local, indigenous, and scientific understandings of hydrological, ecological and geomorphological processes in the study area.

The local management priority was identified as Oriners Station, an indigenous-owned pastoral lease east of Kowanyama. Poor accessibility, periodic wet-season flooding, and the marginal pastoral quality of Oriners Station had resulted in minimal human presence during the 20th century, preserving ecological values but also resulting in limited knowledge of the area. What knowledge did exist was spread across a range of people who had only been intermittently present there – people with recognised traditional and ancestral ties to the Station area, former and current indigenous pastoral workers, non-indigenous pastoralists, NRM practitioners, and regional scientists. Knowledge recovery and synthesis objectives, therefore, needed to encompass participants from diverse backgrounds and a highly dispersed knowledge base. Preliminary assessment of these conditions indicated that commonly-used descriptors in knowledge studies (local, traditional, indigenous, scientific etc.) were not suitable or accurate for this case. However, initial investigations also showed that ‘work’ of different kinds had been the basis for most human presence in this area since Oriners Station was first demarcated as a property in the 1940s. A novel formulation, Working Knowledge, was developed to accurately conceptualise and characterise collective recent human experience of the area and provide a focus for the project. ‘Work’ is defined here as any activity that provides a material economic return and includes hunting and gathering, pastoralism and/or contemporary paid work in natural and cultural resource management (Strang 1997; Barber *et al.* 2012). Before moving to more specific project detail, the conceptual and descriptive advantages of the Working Knowledge formulation for the project objectives will be briefly identified. Although focussed on the specific case, these have wider implications for knowledge definition, integration and synthesis.

First, Working Knowledge explicitly references the generation of knowledge through labour and through residence associated with labour. Such knowledge is oriented towards particular economic activity and in that sense is not usually comprehensive, holistic, or encyclopaedic in a scientific sense, but functional and purposeful – it is knowledge that is useful for ‘getting things done’. Knowledge gained through such labour is also continually being ‘worked out’ in practice under changing conditions – it is knowledge as ongoing adaptive process rather than formal synthesis. These are two related senses in which Working Knowledge is useful terminology – it refers to knowledge gained through economically-oriented activity, and to the functional, provisional, and adaptive quality of the content of that knowledge.

Cross-cultural interaction and collaboration has been a key feature of the processes that have generated knowledge about Oriners Station, as indigenous and non-indigenous people focussed on a common program of pastoral or NRM work. The knowledge shared in service of such programs of work may be deliberately limited; indigenous cultural landscapes were rarely discussed with non-indigenous cattlemen (Strang 1997), who in turn seem to have rarely shared confidences with their indigenous workers about the deeper financial, business and economic structures behind their grazing operations. Yet labour and geography can be sources of commonality where culture is a barrier, and comparative knowledge of environment remained a source of interest to all of the research participants in this study. The occupants of ‘originally distinct indigenous and exogenous systems’ (Smith 2005) can nevertheless develop, share and progress collective knowledge about the country they have jointly laboured on and intermittently occupied, and the initial Working Knowledge formulation reflects this intention.

The formulation is also useful because it reflects another source for the project: knowledge derived from scientific work. Biophysical scientific work is specifically directed at gaining knowledge of the natural world using particular standardised techniques, (for example, systematic data collection, statistical techniques and peer-reviewed publications), and, in this respect, it differs from other forms of work which generate knowledge but do not have knowledge acquisition as their primary goal. Contemporary scientific research, however, is rarely resourced and undertaken purely for the sake of extending the boundaries of general knowledge. Rather it is directed towards particular priorities and desired effects, such as improving NRM decisions, as the current project demonstrates. Such influences shape the nature and conduct of the science undertaken, bringing it closer to other forms of economically-focussed labour. In a context in which it is being brought together with knowledge from other sources, characterising science as knowledge derived from a particular set of work practices also acts as an important levelling device. Scientific methods and descriptions are often privileged in discussions of knowledge, and identifying these descriptions as an outcome of (human) work is both empirically accurate and useful in re-casting that privileged position. In relation to this project, the Working Knowledge description for the scientific component was particularly apt, as it was generated and/or collated by J. Shellberg, who has conducted 4 years of intensive hydrological and geomorphological fieldwork in the

Mitchell River catchment, emphasising erosion processes (Shellberg 2011). This was a crucial aspect of the current project: the scientific practitioner worked in a similar manner to other locally resident research participants (and in collaboration with them), but with a stronger focus on scientific requirements and outcomes.

Working Knowledge also refers to contemporary work at Oriners Station, which is largely based on NRM funding, resources and priorities. V. Sinnamon, KALNRMO-based, has resided at Kowanyama since 1972 and was heavily involved in the original purchase of Oriners Station. V. Sinnamon's perspective reflects a deep commitment to the right of Kowanyama people to govern and manage their own estates, but also to indigenous NRM and cultural landscape management as important forms of contemporary work, both in terms of maintaining ecologically-valuable landscapes and in promoting sustainable indigenous livelihoods in remote areas. Contemporary NRM is an increasingly important component of indigenous peoples' relationships with their country, particularly in regional and remote areas (Larsen 2008; Altman and Kerins 2012; Gorman and Vemuri 2012). Formalised NRM agencies and funding provides resources and opportunities for people to visit and care for places that matter to them, but in doing so it affects the timing of visits, the activities undertaken and the landscape features that receive priority. Present day Working Knowledge has its origins in past ways of living and working on Oriners Station, but also in these more recent activities arising from the intersection of community-based planning priorities with the opportunities available from state NRM and conservation institutions. The orientation of this project, and the categories for demarcating knowledge used within its outputs, reflect the priorities of this contemporary NRM work and, in this sense, the outputs themselves are 'working documents' (Barber *et al.* 2012).

With respect to identifying and positioning indigenous research participants, Working Knowledge was additionally useful for reasons relating to indigeneity, origin and authority. Two key accounts of indigenous knowledge of Oriners Station already exist – a cultural mapping of the landscape (Strang 2001) and an ethno-botanical study (Stewart *et al.* 1996). Both required specific, locally-held indigenous knowledge, as well as the right and the authority to share it, and, therefore, were conducted with appropriately recognised senior elders and traditional owners. The Working Knowledge focus of this project meant that the indigenous research participants included those with deep intergenerational and traditional ties to the area, but also people who were temporary working visitors. As a formulation, Working Knowledge significantly constrains the full spectrum of knowledge held by the former, who may be comfortable identifying all of what they know as 'Traditional' or 'Indigenous Knowledge', yet it simultaneously enables the inclusion of contributions by the latter. Protocols about ownership and authority mean that indigenous 'working visitors' may be unable or unwilling to comment on key aspects of the local landscape, particularly those subject to cultural restrictions (Smith 2005). Yet such people may have important observations and knowledge to share and they can contribute to a Working Knowledge study without the risk of being accused of misrepresentation. In this way, the formulation accurately described the indigenous

participants as well as usefully complemented pre-existing accounts of indigenous knowledge sourced from recognised traditional owners.

An initial assessment of the field conditions and sociological context led to the recognition that a novel formulation was required to characterise the main knowledge recovery objective of this study. The preliminary conceptual analysis presented above showed that Working Knowledge was useful in simultaneously:

- referencing the labour and residential history at Oriners Station;
- identifying the provisional and purposeful orientation of knowledge associated with work;
- characterising commonalities in the diverse assemblage of likely research participants;
- repositioning scientific knowledge with respect to other contributing knowledges;
- marking the contemporary NRM employment context relevant to the study;
- facilitating the inclusion of contributions by a wider set of indigenous people beyond traditional owners; and
- qualifying the project outputs as working documents.

The preliminary and conceptual analysis enabled an appropriate focus for the specific ecological knowledge recovery goals of the project, as well as placing the project within a wider conceptual frame that has implications for locations well beyond the field location.

Study site

Oriners Station lies at the northern edge of the Mitchell River catchment (Fig. 1) and is a key part of what is colloquially known by local indigenous people as 'forest country' to differentiate it from both the coastal lowlands of the Mitchell River delta and the higher hills of the Great Dividing Range further east. 'Flooded forest country' was the term used in this study to identify the two most often noted characteristics – the vegetation type and the seasonal flooding regime. Formally demarcated in the 1940s, the station was owned and operated for several decades by the Hughes family, non-indigenous pastoralists with over a century of residence in the catchment. It was purchased by the Kowanyama Aboriginal Council in 1990 and the property has subsequently been managed for natural and cultural values by the KALNRMO.

The homestead of Oriners Station lies on a permanent lagoon on Eight Mile Creek (Fig. 2) and ~20 km downstream are two further large permanent lagoons, named Mosquito and Jewfish, while a third, named Horseshoe, lies some distance to the north (Fig. 2). Numerous smaller lagoons lie within the creeks and tributaries, and swamps and wetlands lie on the floodplain, supporting a wide array of plant and animal life. The more heavily-watered areas are complemented by slightly higher elevation sand-ridge country covered in more sparse forest of ironwood and messmate with stony knolls of quinine and lancewood. Strang (2001) notes that 'for hunter-gatherers, the riverine country would have offered a huge and unusually reliable range of resources' and that there were long-term camp sites and regular patterns of movement through the area.

Post-colonial ownership and associated management of the Oriners Station was highly stable for long periods, with only the

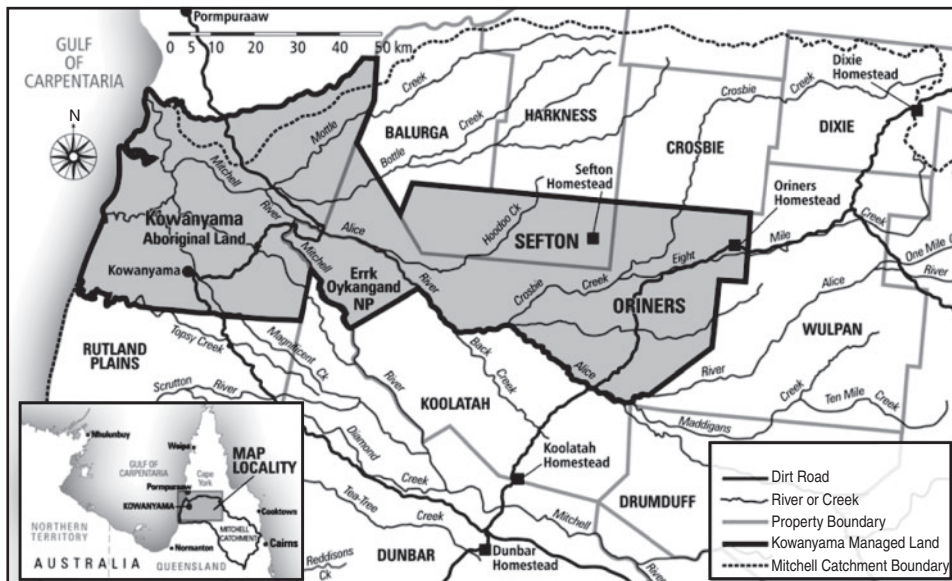


Fig. 1. Kowanyama managed land incorporating Oriners and Sefton Stations in the Alice River and Crosbie Creek sub-catchments of the Mitchell River catchment.

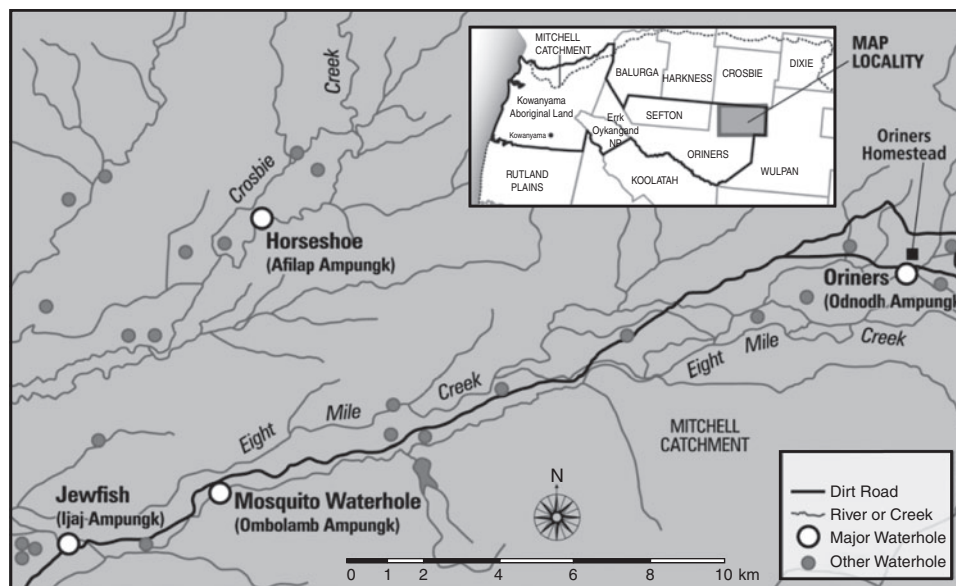


Fig. 2. Major named waterholes on the lower Eight Mile and Crosbie Creeks – Oriners, Jewfish, Mosquito and Horseshoe Lagoons.

Hughes family and Kowanyama people responsible for the station since its creation.¹ Oriners Station has never supported large human populations and, although cattle grazing has had modest and localised impacts around water bodies (Barber *et al.* 2012), overstocking damage is generally less than elsewhere in the Mitchell River catchment (Shellberg *et al.* 2010; Shellberg 2011). Mining impacts are also less than elsewhere (Strang 2004; Barber *et al.* 2012) with few available mineral resources (Darby 1993).

The area is not a focus for major water-resource development plans (Queensland Department of Environment and Resource Management 2007) and is not currently on a major tourist route (Strang 1996). However, hunters and adventure tourists do visit the area regularly when roads are passable and a major road development under construction through Oriners Station could rapidly increase tourism, the associated management load, and impacts on environmental and cultural values. To this point, the

¹Nearby Sefton Station was owned by the Finch family from 1967 until purchased by Kowanyama in 1996. Much material gathered for this study applies equally to Sefton and to the country north of the Alice River more broadly.

isolation, stable private ownership, and lack of development of Oriners Station has meant that it is scientifically under-investigated but it is known to contain unique geological, hydrological, ecological, and cultural features which make the area of significant regional conservation significance (Barber *et al.* 2012).

The original inhabitants of this area suffered badly during colonial violence and were under pressure to relocate to missions, but much of that history is not properly recorded (Sharp 1952; Strang 1997). The major identified language groups are the Olkol and Kunjen but, in terms of this study, three major functional categories of indigenous people are most relevant:

- (1) Those with recognised traditional associations who form the basis for the current Olkol native title claim over the area that includes Oriners. These people are spread over a wide region incorporating Kowanyama, other CYP communities, and larger regional centres such as Cooktown, Mareeba and Cairns;
- (2) Those involved in ongoing Oriners Station management (primarily Kowanyama residents and employees of KALNRMO), often known locally as the 'Oriners Mob'; and
- (3) Those with significant experience of Oriners Station during their working lives.

Some indigenous research participants were members of all three categories but most were a member of one or two. In total, 10 senior people were interviewed. Those people without recognised traditional and ancestral ties to the Station area represent a continuation of the tradition of people from elsewhere working on the country, and developing knowledge and connections associated with that work.

The non-indigenous Hughes family have owned Mitchell River pastoral stations since the early 1900s (Strang 1997), and the resulting collective depth of local knowledge far exceeds that held by pastoral operators with a much shorter residential history. In addition, current Oriners Station indigenous people, notably from the Yam family, grew up on the nearby Hughes-owned Koolatah Station (Fig. 1) and provided skilled labour for Koolatah Station (and Oriners Station) through several decades in the 20th century. Koolatah has been sold and indigenous pastoral labour has dramatically decreased, but members of the Hughes family still operate nearby Highbury and Drumduff Stations, resulting in ongoing interactions with indigenous residents of the Mitchell River catchment. The perspectives of the Hughes family on the landscape may differ considerably from those of indigenous residents (Strang 1997) but the collective longevity of their residence, their knowledge of Oriners Station and their pre-existing relationships with all of the indigenous cattlemen interviewed made them crucial contributors to the current project. Four Hughes family members were contacted and three (Cecil, David and Colin Hughes) from three different generations were formally interviewed for the study.

Methods

A combination of semi-structured interviews, field visits to key locations, and literature surveys was used. The first two methods were the focus for generating local knowledge from former and

present day workers at Oriners Station, and the field visits and literature surveys were important in generating additional scientific information. Shellberg's previous hydro-geomorphic research (Shellberg *et al.* 2010, 2013; Shellberg 2011) about the lower Mitchell River catchment were augmented with additional scientific analyses of the Oriners Station landscape from local and regional datasets (Barber *et al.* 2012). Formal scientific sampling of Oriners Station was not part of the research scope and was not undertaken.

Literature sources

The ethno-botany study (Stewart *et al.* 1996) and cultural mapping (Strang 2001), previously mentioned, are important sources of information about Oriners Station. Strang's wider work (Strang 1997, 1999, 2005) is geographically focussed on the main Mitchell River but includes many of the same research participants (both indigenous and non-indigenous) and the relevance of this study to her work is one aspect of the Discussion. Linguistic resources include an on-line dictionary (Hamilton 1996) and an historically-nuanced examination of kinship and communication (Sommer 2006). Biophysical scientific literature and local and regional datasets were located (Barber *et al.* 2012) but few were focussed directly on Oriners Station, and so primarily provided regional context and proxy data. Also of relevance were local community planning documents, sourced from the Kowanyama archives, most notably an extended consultancy report examining Oriners Station in the context of wider out-station communities closer to Kowanyama (Burdon Torzillo and Associates 2000).

Interviews

Interviews were conducted during the period from 2010 to 2012 in different Queensland locations, including Kowanyama, Mareeba, Laura, Coen, Highbury Station and Nebo. The research was conducted in accordance with CSIRO human ethics approvals and all interviews were recorded and transcribed. Information was also recorded during field visits to Oriners Station in 2010 and 2011. Initial discussions between the authors and the KALNRMO staff generated a preliminary list of topics:

- (1) Individual experience of the station area,
- (2) Knowledge of its history,
- (3) Presence/absence of key animals and plants,
- (4) Water flows and cycles, including floods and the location of permanent water sites,
- (5) Seasonal observations,
- (6) Observations of inter-annual variation,
- (7) Observations of permanent change,
- (8) Comparison with other areas of the CYP, and
- (9) Contemporary management problems and priorities.

These topics were used to guide semi-structured interviews. Experience of Oriners Station varied significantly among participants; some had seen the area regularly throughout their [long] lives, some had intensive experience of it several decades ago but had not seen it since, some had seen it in distinctive phases (such as during heavy wet seasons) and a couple of people were younger to middle-aged who had been involved in the past two decades of contemporary management. Responses to

particular topics correspondingly varied and topics were explored in greater depth when it was clear the participant had knowledge of that area. Interview data was iteratively reanalysed, refined, and collated using NVivo analysis software, resulting in a final refined list of key topics and issues presented in the project report (Barber *et al.* 2012). Researcher-generated qualitative models were used to summarise and reflect the relationships between key themes and management issues and drafts of the primary project report were distributed to all participants for correction and addition.

Gender

The research participants for this study were all men. This reflects the orientation of residence during the pastoral era (Strang 1997), and to a lesser degree the pattern of residence (particularly wet-season residence) by indigenous people since the property passed back to Kowanyama. This residential orientation, combined with the unavailability of some key potential female research participants early in the research, led to a deliberate decision to focus the study on men's knowledge, thereby leaving space for a complementary and comparative future study of women's knowledge and experience of Oriners Station as well as their aspirations for it. Women were integral to pastoral homestead life – some were experienced horsewomen and cattle workers (Strang 1997; Hill *et al.* 2012) and, following the purchase of Oriners Station, they did important work in community planning and in the establishment of basic infrastructure. However, a subsequent study of women's knowledge may adopt an alternative orientation to the cross-cultural Working Knowledge approach used here.

Results

The publicly-available project report (Barber *et al.* 2012) provides extensive content from the study. This includes surveys of the relevant local natural scientific literature and summaries of key biophysical datasets available. These datasets and associated scientific observations encompassed climate, rainfall, topography, drainage, geology, hydrology, fluvial geomorphology soils, land systems, erosion, vegetation, fire frequency, and the presence of feral and native animals. Regional government and scientific survey data was synthesised and combined with information from historical air photographs and remote sensing to place Oriners Station in a regional perspective. This scientific literature was complemented by a review of the ethnographic, linguistic, and ethnographic literature associated with Oriners Station, particularly the work of Strang (1997, 2001). The report also summarises and analyses the extensive interview data collected and includes observations of: geographic and inter-annual variability; long-term environmental change; rainfall and drainage patterns; water levels and water quality; human and animal presence; and landscape processes. The data was then synthesised into qualitative models of seasonal processes in the landscape which are the subject of this paper. The

report contains an additional set of models focused on the dynamics of key permanent lagoons which will be the subject of a subsequent publication.

The following section of the paper provides some representative examples of the interview content focused on topics that emerged as key to the resulting models: soil type and stocking rates; permanent lagoons and flood levels; animal movements; fire management; and resources available to manage tourists and trespassers. The models themselves form the second component of the Results section, and are oriented to future management.

Interview data

Soil type and cattle stocking rates

The interview data demonstrated that the fragile soils of Oriners Station require careful management, particularly of cattle numbers and soil disturbance, as comments by Philip Yam and David Hughes respectively demonstrate:

Marcus Barber: what about the soil up there? Is that the same as here at Kowanyama?

Philip Yam: No, it's different, that's all sandy country.² There's a few places with good dirt in them, but most of them are all sand ridge, doesn't matter where you go, it's all sand ridges everywhere.

Marcus Barber: What does that mean if you are trying to look after it? Are there different things you need to do?

Philip Yam: Some of it, you don't like digging in the place because you'll have holes. They'll get washed out. You don't want to have to take too much dirt off the top. You'll end up with creeks [gullies]. A lot of that sand ridge country is really thin and falls apart. You lose that [top] dirt, then it's all gone. It won't stay together for a long time, because sand ridge country is different. Soon as the top gone away, that's it. The water just keeps eating it out.

David Hughes: Once you start to get into that Alice River forest country, ~12 mile out off the Mitchell [River], once you get into that forest there, you drop off. The strength of that country for cattle is halved, at least. So for instance on the best of the Mitchell, you run a beast [every] 18 acres. You go out on that Alice River, Crosbie [Creek], 8 Mile [Creek], any of that country, then you are back to a beast about [every] 45 acres.

Marcus Barber: What is it that limits it?

David Hughes: Protein. There's plenty of grass, bulk grass, just no protein [in it]. So it's poor grazing country, it's light grazing country, it's country that is fragile, that's another word for it. And to be able to get the best out of it, you must understand it because there is no room for mistakes. If you

²Philip Yam uses 'sandy country' and other variants (sand ridges, sand ridge country) as a general regional descriptor in contrast to the Mitchell River delta. In context, it refers to both the sandy ridges and the alluvial soils along the Oriners Station floodplains and tributaries. These alluvial soils are sodic and are very prone to erosion. The actual sand ridges bordering those floodplains are 2–5 m deep and are more resilient to erosion.

make mistakes in that country with cattle and pasture, it will cost you dearly. It's fragile in the sense that if you burnt it wrong, fenced it wrong, overgrazed it, that type of thing. That country does not lend itself to being cut into small areas. You've got to let the cattle have the full variety. But one of the positives of that area is what we call top feed, there's a lot of top feed in that country, a lot of edible trees and shrubs.

Floods and large permanent lagoons

The sandy ridges and silty floodplain soils absorb water in the wet season, with low-lying areas becoming extremely boggy and limiting access and mobility. Another distinctive wet-season feature is periodic surface flooding along creeks and floodplains, with pastoral-era residences regularly flooding above a metre. Three separate recollections of the flood regimes at Oriners Station highlight this.

Edwin David: It used to [flood] right up into the house, right up into the hut there. The white stockman's shed used to have water in it. You can't get about see, when it was really wet.

Ezra Michael: Yes, there was water on the floor [of the shed at Oriners Station], the water used to come right up from the river and right on to the floor. Just up to there (gestures to mid-calf level). There was water everywhere.

Colin Hughes: No I've never been there [at Oriners Station] when it was actually flooded around the station, but I know Dad [Herbert Hughes] had marks on the wall of the old house, and it used to get about waist-deep. This is the old house. It came about waist high, 1.2 or 1.3 m. That was quite a regular thing, [but] not every year.

These flood regimes were important in recharging larger permanent lagoons in the region which are important features and an ongoing management priority, as comments from Michael Ross demonstrate:

Marcus Barber: When you say you are worried about the water, is there something in particular?

Michael Ross: Just a general sense. Them big lagoons in the photo. If it is not looked after. You look at the pigs ripping it to pieces and then you get human tourists leaving rubbish and you don't know what they are putting in the water. They could poison it. You don't need them sort of things happening. Pollution on them nice big lagoons. They been there before our time and they all in good condition, bit of rough and tear around there, but you got to look at the flow in the wet season, well in the wet season you can't move in Oriners. As far as I know, you couldn't even move. Walk out to the back step, and in the horse paddock maybe, then you bog, you are out of sight. That is boggy country. And you can't move very much.

Animal movements

It is not only human movement that is constrained by the water regimes at Oriners Station. Water constrains and enables the

movements of animals in quite complex ways. Cecil Hughes commented on pig movements:

Cecil Hughes: Well, you take the pigs for instance. If there is water everywhere, they spread out. If the water dries out, they come back where the main water is. That means in the peak season you don't see them much, whereas in the dry time you do. They get more concentrated. They come back onto the main water.

The movement of heavier introduced animals, however, is constrained by the boggy ground, as Philip Yam observed in watching animals immediately in and around the homestead, which was carefully sited on a firmer patch of ground:

Philip Yam: When it rains up there, all these wild horses, cattle, they all come back in, right back in close to the homestead, because that must be pretty hard ground for them. They don't stay out on the ridges. When the rain is gone they go back out.

When the wet comes, pigs spread out away from permanent water holes, while horses and cattle must leave or restrict themselves to hard, high ground away from the flooded creeks and the boggy tributaries between sand ridges. Flooding of flat country along creeks create large areas of surface water and 'flooded forest' and this, in turn, enables the wider movement of aquatic animals, such as fish and turtles, during the wet season, as a comment from KALNRMO coordinator Viv Sinnamon demonstrates:

Viv Sinnamon: I remember stories old Lefty Yam told of platform fish traps capturing fish moving across the flooded forest. The fish were migrating – replenishing and redistributing those valuable aquatic resources across the forest estate. Fishing at Oriners depends on the seasonal renewal of waterholes – the red claw and freshwater prawns, freshwater turtles and the occasional barra. Those are still caught by hand, line and drag net.

Such data suggests complex spatial and temporal patterns of animal movement and distribution.

Fire

A further factor important in managing soil and grass resources and animal distributions is fire. David Hughes reflects on good pastoral fire management practice for Oriners:

David Hughes: One of the management practices we used was early burning, and that has two effects, it gives you a good firebreak for later in the year, and it also brings your cattle together. And if you do that properly, you get carry-over grass, that's what you've got to manage. And one year you might go through and burn all your watercourses and leave your ridges. And the next year you've got old grass on your ridges, so you go through and burn the ridges and leave the watercourses. It's a very important part of the management of that country. If you burn it early, and you get those green shoots coming through, that green shoot, if you do it right and stock it right, that will take you through to about October. And then, when October comes, a lot of your waters are drying up

now, getting dirty, and that grass has gone off so the cattle will come back onto the main waters, and, if you've taken them out there with a burn, they've still got lots of soft grass on the good waters.

David Hughes notes that the early dry season is the time to initiate proper variable burning regimes in space and time. Early dry-season fires are important in providing stock feed and driving animal movements. They are also important in limiting the destructive effect of uncontrolled high-intensity late-season fires, which are often lit by humans during the major period of human movement through the Oriners landscape in the middle and late dry season. Recent research indicates that even early-season burning regimes need to be conducted appropriately to avoid deleterious landscape effects (Crowley *et al.* 2009).

Residence, resources and intrusions

Oriners Station is managed by the KALNRMO from their base at Kowanyama, which lies over 100 km away across rough roads with numerous river crossings. Resources to establish and maintain a presence there is an ongoing challenge, particularly as visitation by non-locals increases. A younger member of the Oriners Mob reflects on the difficulties encountered by contemporary managers:

Louie Native: I was thinking [about] when the tourists come through there, when me and Phillip [Yam] was out there [alone]. We haven't got any cook, and I've gotta be racing up and down. I'm doing the cooking and I gotta do Phillip's job too, help him along. Then [the tourists or hunters] come along, and [if] we were going to go chase them, then we weren't going to be able to worry about our job, what we was doing [at the Station]. We needed two more blokes there to help out. All the time we needed [more people] there. If we're doing the work he can be getting another vehicle and running off and chasing these fellers. Asking 'where are they going?' They're always telling me they're going down to Koolatah [Station]! But they're not going to down to Koolatah, they are taking off to the Sefton road. That's the things that was happening to us.

Monitoring and managing access to Oriners Station is an important part of contemporary work, and new road development will only increase that workload. Louie's comments demonstrate both the commitment and the resource constraints that are characteristic of KALNRMO operations. Taken together, the above comments highlight a range of features – fragile soils, flooding regimes, concerns about lagoon health, animal movements, fire management, and the presence of human beings (indigenous managers, hunters and tourists). These features, and some key relationships between them, are crucial elements of the synthetic qualitative models developed out of this data.

Qualitative models

Systematisation, synthesis, and modelling of local and/or indigenous knowledge were a key initial aspiration for this research. The participants' cultural diversity, geographic

dispersal, and sporadic history of interaction with Oriners Station made a participatory modelling process impracticable with the time and resources available. However, sufficient consistency of themes and responses enabled the construction of preliminary diagrammatic models by the authors. These models highlight and integrate key landscape processes of management significance: seasons, water, animal movements and distributions, human activities, weeds, fire and erosion. Converting complex interacting processes into simple causal directional diagrams necessarily involves many omissions and simplifications. Nevertheless, these models highlight important relationships and processes, aiding comprehension, management planning and resource allocation. Complementary qualitative models focussed on key processes affecting permanent lagoons in the area are presented elsewhere (Barber *et al.* 2012).

The models below are broken up into three seasonal categories (the wet season, the early dry season and the late dry season) to reflect the dramatic differences in seasonal conditions and the impact they have on human and animal activity. Following the presentation of the three initial models, indigenous residence in the area is reconsidered, and the early dry-season model is then redrawn with the inclusion of additional Oriners Mob residence. The differences highlight the significance of indigenous residential presence for key environmental and management processes.

Model A: Wet season

Research participants consistently commented on the flooded creeks and boggy ground at Oriners Station preventing movement and access – horses cannot be ridden, anyone living at the homestead must stay close by or walk along ridgelines, and no outside access is possible except by helicopter. Oriners Station has not been inhabited during the wet season in recent times, so people are not present in the wet-season model shown here (Fig. 3). The Working Knowledge presented above suggests patterns and relationships between animals and water at the most general and functional level. At the height of the wet season, animals can be categorised into four functional categories:

- (1) Aquatic animals – movement and dispersal is enabled by abundant surface water;
- (2) Native land animals – primarily wallabies, goannas, dingoes and birds. Movement may be mildly restricted by boggy ground and/or mildly enabled by abundant surface water depending on the circumstances;
- (3) Cattle and horses – following dispersal to feed on fresh grass in the early wet season, their movement is then heavily constrained; and
- (4) Other smaller introduced land animals – primarily pigs, but may also include adult cane toads feral cats and foxes. Movement may be mildly restricted or enabled in a manner similar to category 2.

In the model, the onset of the wet season sparks an initial dispersal of all terrestrial animals, but then the boggy ground has particular implications for some introduced species; they are re-concentrated on high ground or leave the area completely. Physically lighter and/or more water-tolerant species have different and less constrained patterns of movement. In terms of

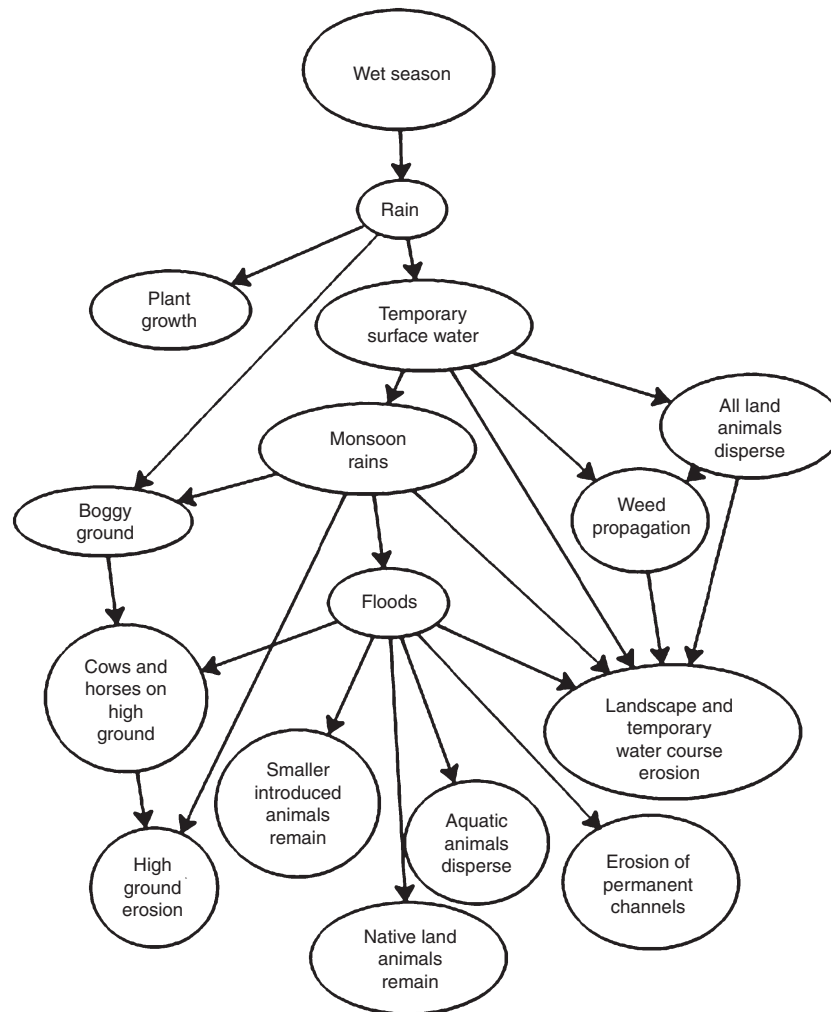


Fig. 3. Model A: Oriners Station landscape interactions in the wet season.

landscape processes, rainfall and surface runoff are the main source of soil erosion, but the presence of animals, particularly cattle, pigs, and horses, can initiate erosion or increase its effects during the wet season, and this process is incorporated into the model. Other factors contributing to soil erosion (inappropriate fires, road use and weed dispersal) are incorporated into the dry-season models below.

Model B: Early dry season

Figure 4 shows the early dry season when temporary water sources are still available and food is also abundant. In the pastoral era, this was when cattle workers started burning the drying grass to attract cattle to the resulting regrowth. This now happens far less across the region as helicopter-mustering reduces the need to concentrate cattle using fire, and at Oriners Station mustering no longer occurs regularly. Access difficulties from the west has meant that Oriners Mob presence in the late wet/early dry season is currently rare and the road from the east may be passable more quickly than the road to Kowanyama, providing pig hunters with uncontrolled access. The distribution of aquatic

animals begins to contract as the water recedes, with a corresponding increase in the dispersal of cattle (and horses) as boggy areas reduce in extent.

Model C: Late dry season

Two key differences between the early (Fig. 4) and late (Fig. 5) dry seasons are water availability and human access, which in turn affect animal distributions, fire regimes and erosion processes. Kowanyama people are able to access Oriners Station and will be intermittently present, but at the time of this study were not residing there and/or undertaking fire management activities other than protective burning around the homestead infrastructure. A systematic fire management regime in partnership with the Queensland government commenced in 2012 with major efforts focussed in the early dry season (see below). Without permanent residence, influencing access by tourists and hunters is difficult, increasing the chances of high-intensity, destructive, late dry-season fires lit by careless or uninformed people. As well as fire, the presence of hunters and tourists has implications for weeds and erosion surrounding

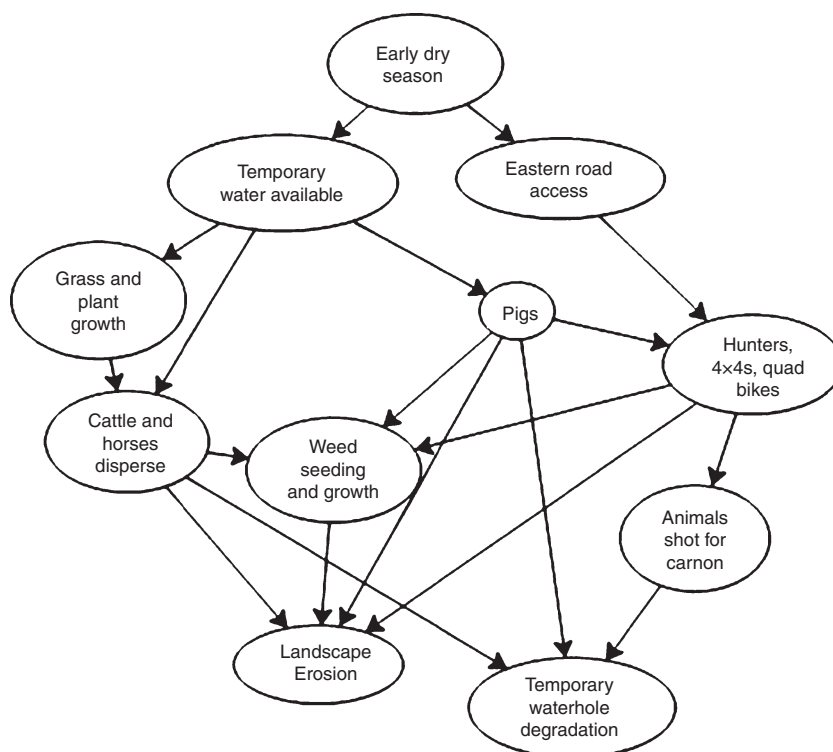


Fig. 4. Model B: Oriners Station landscape interactions in the early dry season.

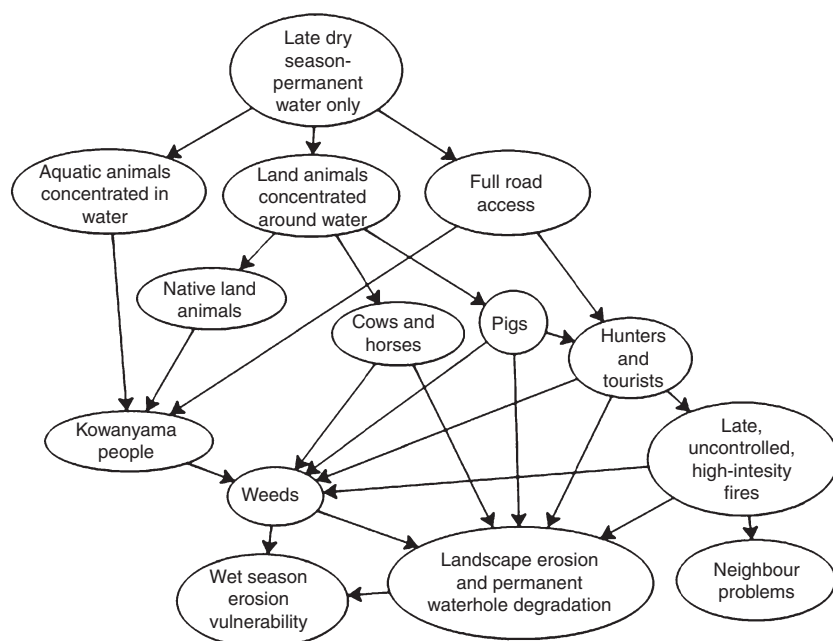


Fig. 5. Model C: Oriners Station landscape interactions in the late dry season.

permanent waterholes. Animals are concentrated in and around permanent water in the late dry, but the impacts of that concentration differ with respect to native and introduced

animals – native animals attract Kowanyama people to the area and are not as heavily implicated in erosion formation and weed propagation.

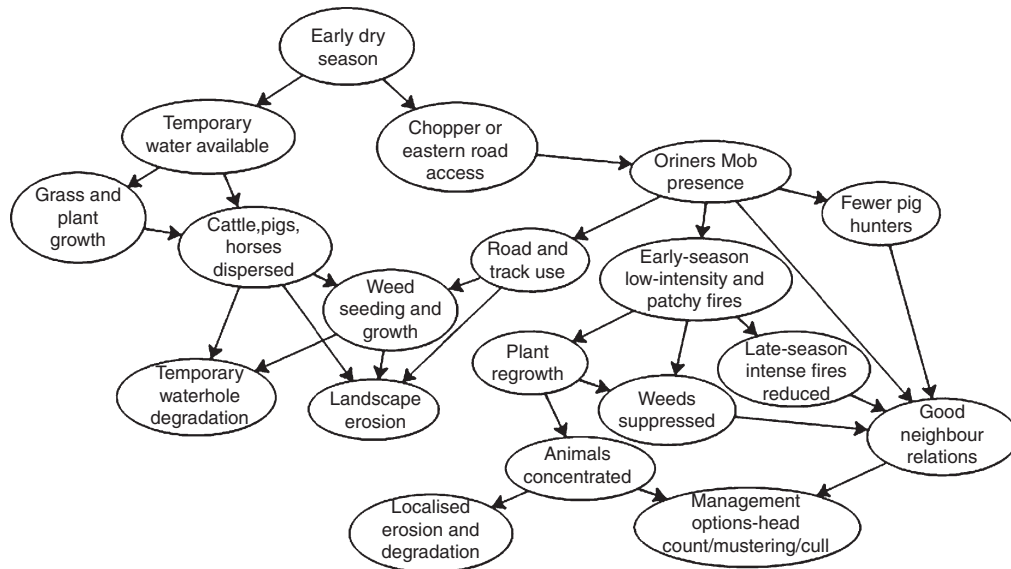


Fig. 6. Model D: Oriners Station landscape interactions in the early dry season incorporating residence by the Oriners Mob.

Model D: Increased indigenous residence in the early dry season

The processes, actions and events taking place in one season may have their biggest impact on the landscape in subsequent seasons. Such effects could be shown by placing the existing models in sequence with appropriate links between them, or by constructing a different model focussed on the relationships between seasonal processes. However, impacts also occur cumulatively across years, notably with respect to fuel loads for fire, weed propagation and erosion. Rather than considering these matters in more detail here, the final model will focus on the significant ecological consequences of more consistent indigenous presence at Oriners Station. In the wet season this presence has been sporadic in recent times, but even when it does occur, human activity is highly constrained by the conditions (Barber *et al.* 2012). Therefore, the main impact of additional Oriners Mob presence occurs in the early dry season. The model below (Fig. 6) shows this, highlighting implications for road use and maintenance, weed management, fire regimes, the presence of other people and relations with neighbours. Comparing Fig. 6 and Fig. 4 highlights the significance of the consistent early dry-season presence of indigenous land managers. This result was mostly recently manifested in a coordinated fire strategy begun in 2012 in a KALNRMO partnership with Queensland Fire and Rescue Service and Cape York Sustainable Futures. Low-intensity early dry-season burns were lit to create effective late dry-season fire breaks covering 32% of Oriners Station. Further support is required to underpin field monitoring to inform ongoing adaptive fire management but the activity in 2012 supports the conclusion of the models, that larger and more consistent residence by Oriners Mob people for a greater proportion of the year will be beneficial to the landscape.

Discussion

Three key conclusions from the modelling analysis can be identified: the significance of consistent indigenous residence to ecological management (Barber *et al.* 2012); the confirmation and further refinement of existing KALNRMO management objectives, particularly in relation to key water assets (Barber *et al.* 2012); and the value of adopting the Working Knowledge approach in sourcing data from a range of sources to underpin such models. The hydrological, geomorphic and ecological processes identified above will be investigated in more detail in a subsequent publication focussed on permanent water holes. The Discussion focuses on three geographical and epistemological implications of the present study: (1) changing land tenure and resource values in the CYP and wider rangelands; (2) the relationship of Working Knowledge to pre-existing analyses of settler colonial and indigenous perspectives of landscape from this area; and (3) the (re) conceptualisation of knowledge foundations for wider indigenous NRM in Australia. These implications are interrelated, but will be discussed in turn.

The purchase of Oriners Station reflects an early example of pastoral tenure being selectively displaced by indigenous ownership focussed on alternative land uses, in what Holmes has called 'multifunctional occupance' (Holmes 2010a, 2010b). Indigenous land ownership now constitutes 27.5% of the total area of the Australian tropical savannas (Holmes 2010b) and land managed by the indigenous sector now represents Australia's second largest land use after grazing (State of the Environment Committee 2011). This change in land tenure and policy direction has further encouraged indigenous aspirations regarding legal recognition of traditional resource rights and the adoption of indigenous management objectives. It is both empowering and testing community-based groups by generating opportunities

and responsibilities for indigenous environmental governance (Larsen 2008). Indigenous land managers face an increasingly large management task, yet need to abide by complex local, regional, state and federal rules.

The broader-scale analysis of Holmes (Holmes 2010b, 2010a) is directly applicable to the situation on the CYP. In 2007, the Queensland government created a new class of protected area, called National Park (Cape York Peninsula Aboriginal Land) – NP(CYPAL). This process enabled existing National Parks and a series of former pastoral properties purchased through government funds to revert to indigenous land jointly co-managed in perpetuity through a combination of local indigenous owners and Queensland government staff (Larsen 2008). Properties directly adjacent to Oriners Station, including Crosbie, Wulpan, and Dixie Stations (Fig. 2), have been included in this process, as have others in the wider area to the north and east. If land tenure and management negotiations continue to be implemented as planned, Oriners Station will lie at the heart of over 10 000 km² of interconnected land being managed for a combination of conservation, heritage, indigenous, and/or sustainable pastoral values. As local elders are well aware, this has important implications for the connectivity of people and their knowledge as well as the connectivity of the country – land, water, plants and animals (Barber *et al.* 2012). For Kowanyama people, connectivity, good neighbour relations, and the sharing and coordination of resources have been crucial negotiating principles with government and adjacent landholders as the land area for which they are responsible has continued to expand.

The maturity and scale of KALNRMO operations, the location and commercial purchase of Oriners Station, and the Working Knowledge approach adopted here, take on additional significance in this context. Agreements of the NP(CYPAL) entail a range of conservation and management requirements that can be experienced as either advancements or hindrances by individual indigenous people or communities. For example, older indigenous cattle workers may value activities (such as horse riding and cattle grazing) that have been perceived by government staff as incompatible with high-value conservation areas (Barber *et al.* 2012). Oriners Station is a commercially-purchased pastoral lease solely managed by an indigenous organisation using a knowledge base which overtly crosscuts or hybridises the forms of management characteristic of cattle stations on the one hand, and National Parks on the other. The Working Knowledge approach identified here reflects that circumstance but also demonstrates the landscape and ecological significance of maintaining the consistent presence of active indigenous land managers in such areas. The presence or absence of such managers can have a cascading series of effects (Liedloff *et al.* 2009), highlighting the role that they (and adjacent pastoral operations) can play in cooperatively managing large tracts of country (Altman and Whitehead 2003). The hybridised knowledge base and the ecological significance of indigenous presence in the landscape are two crucial lessons from this study. They suggest how other properties in this region, and beyond, will need to be resourced and managed in the future, and that the knowledge foundations which underpin that management effort will need to be properly conceptualised.

In terms of that conceptualisation, several the participants in the Working Knowledge project were involved in a longer and

more detailed study of environmental and landscape values undertaken almost 20 years previously (Strang 1997). In 'Uncommon Ground', Strang (1997) uses extended ethnographic fieldwork to analyse the differing ways that indigenous people and settler pastoralists, respectively, understand, use and ascribe meaning to their surroundings. She outlines the implications for environmental relationships and produces a summary of contrasting environmental values: the implicit, holistic, mystical, relational and small-scale perspective characteristic of indigenous people; and the explicit, specialised, scientific, independent and larger-scale perspective characteristic of white Australians (Strang 1997). Strang (1997) qualifies these broad-scale generalisations in a range of ways, but such identifications of differing philosophies are not unique to university researchers. Smith (2005) presents a senior CYP indigenous man's analysis of the wider Australian and local indigenous philosophies of land management which contains a similar contrast.

Such analyses would suggest that the Working Knowledge approach taken here is unlikely to succeed. However, rather than a detailed ethnographic comparison of contrasting regional environmental values, we focussed on the empirical recovery of ecological knowledge about a particular area. To adopt the language of the title of the book by Strang (1997), the Working Knowledge project focussed on 'common ground', at least at the level of empirical observations of landscape – key fauna, major processes, and histories of variability and change. The project presumed (and demonstrated) that multiple groups of people have knowledge of Oriners Station based on a history of work and associated intermittent residence. Focusing on particular individuals with distinctive personal working histories 'on the ground' (Ingold 2010), rather than on broad socio-cultural generalisations, can make a collective Working Knowledge synthesis more viable than would initially be suggested by the table of opposing values in Strang (1997). Furthermore, even though the divergent categories and demarcations have been identified and discussed here, the contrasts should not be drawn too strongly. Pastoral success in the Mitchell River catchment continues to rely upon understanding and acting upon scientific information, upon NRM principles and precepts, and (in cases such as the Hughes family) on lessons learned directly from indigenous inhabitants. Contemporary indigenous managers rely on indigenous cultural traditions but also have a legacy of previous pastoral experience and acknowledge the value of biophysical scientific knowledge (KALNRMO 2010). In searching for commonality, we do not suggest that observations made by participants are identical, or that the explanations for them are always complementary, but the study indicates how overlaps and commonalities of labour experience can help to create the conditions for a working synthesis, for the identification of common ground, and that these processes of convergence in perspective are ongoing (Strang 1997).

This narrowed focus on work history, material experience and observation of a particular area enables a synthesis that may be problematic at a broader scale and/or using a less disciplinarily-constrained and utilitarian focus. Such an approach, however, has particular implications for the status of the project results. They are deliberately comparative in tone and they identify, position and constrain multiple perspectives (indigenous, pastoral, scientific and NRM) in the service of generating

Working Knowledge syntheses of contemporary management relevance. From an indigenous standpoint, the scope of Working Knowledge is highly constrained – functional and materialist rather than holistic and culturally comprehensive – not least because potentially important forms of work (such as ceremonial work) are not included. From a scientific perspective, some or much of it may lack rigour and appropriate empirical foundations. From a pastoral perspective, it may not be sufficiently engaged with key species or with generating economic returns, and from a conservation perspective it may be too accommodating of recent and destructive historical changes in landscapes. The specific conditions of this study (and the guiding concept behind it) both enable and constrain existing perspectives in different ways.

The changing regional tenure regimes and the combination of constraint and ‘common ground’ that characterise Working Knowledge at Oriners Station, both emphasise the issue of contemporary operational knowledge base used in the rapidly expanding indigenous natural and cultural resource management sector. The provisional operational knowledge base that underpins contemporary indigenous land management is not usually collated, articulated and/or developed into an integrated synthesis of the kind manifested in formal scientific knowledge or, less commonly, in elaborated Indigenous Knowledge regimes. Although much project definition and operational decision making in contemporary indigenous NRM may be based on scientific principles, ongoing aspirations for genuinely local indigenous management create openings for a broader set of knowledge to be influential (Hill *et al.* 2012). This is particularly so in situations (such as the case of Oriners Station) where scientific information is scarce (Fabricius *et al.* 2006).

An account which meets this demand by incorporating provisional scientific, local and indigenous knowledges into a working synthesis also provides some formal foundations for an adaptive management cycle (Allan and Stankey 2009). Adaptive management is an iterative scientific and social process that aims to reduce management uncertainty and, as a formal approach, it makes similar empirical and material assumptions to those made here. The two align well in suggesting a provisional, iterative and ongoing process to accumulating management-relevant knowledge. Where Working Knowledge is additionally useful is in highlighting what is left out and/or compromised in such collaborative syntheses – the result may contain elements of, but not all of, what may be counted as local, indigenous or scientific knowledge. We place no value judgement or hierarchy on Working Knowledge as a concept with respect to other descriptors but do note its local utility in this case, and its potential implications for related contexts elsewhere.

Finally, it is useful to note that ‘work’ is a particularly value-laden term in contemporary government rhetoric and policy-making activities, which have interrogated the viability of indigenous settlements that are remote from the centres of market-based economic activity (Altman and Kerins 2012). Working Knowledge explicitly references the utilitarian and pragmatic nature of contemporary indigenous NRM work, which is increasingly reliant upon external-funding regimes and focussed on (auditable) results overseen by non-local institutions and bureaucratic governance structures (Smith 2005; Gorman and Vemuri 2012). Yet Working Knowledge also references past

histories of work (including subsistence activities often invisible to the cash economy), highlighting the continuities of these increasingly formalised activities with a longer historical process of material and economic engagement with the landscape. Maintaining and enhancing the multiple values of indigenous savanna landscapes will require diverse forms of work, the resources and partnerships to support that work, and appropriate understanding of the developing adaptive knowledge base which underpins it.

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References

- Allan, C., and Stankey, G. (2009). ‘Adaptive Environmental Management: A Practitioner’s Guide.’ (CSIRO and Springer: Melbourne.)
- Altman, J., and Kerins, S. (Eds) (2012). ‘People on Country: Vital Landscapes, Indigenous Futures.’ (Federation Press: Sydney.)
- Altman, J., and Whitehead, P. (2003). ‘Caring for Country and Sustainable Indigenous Development: Opportunities, Constraints and Innovation.’ CAEPR Working Paper No. 20. (Centre for Aboriginal Economic Policy Research, Australian National University: Canberra.)
- Barber, M., Shellberg, J., Jackson, S., and Sinnamon, V. (2012). ‘Working Knowledge: Local Ecological and Hydrological Knowledge about the Flooded Forest Country of Oriners Station, Cape York.’ (CSIRO: Darwin, NT.)
- Burdon Torzillo and Associates (2000). ‘Oriners – Sefton: Desired Directions (Draft Report).’ (Burdon Torzillo and Associates, Pty Ltd: Alice Springs, NT.)
- Crowley, G., Garnett, S., and Shephard, S. (2009). Impact of storm-burning on *Melaleuca viridiflora* invasion of grasslands and grassy woodlands on Cape York Peninsula, Australia. *Austral Ecology* **34**, 196–209. doi:10.1111/j.1442-9993.2008.01921.x
- Darby, P. (1993). ‘EPMs 8798, 8799, 8800 and 8801 Hann River Queensland, Final Report with Appendix on Heavy Mineral Content of Samples (Amdel BHP Minerals).’ (BHP Minerals: Melbourne.)
- Ens, E. (2012). Conducting two-way ecological research. In: ‘People on Country: Vital Landscapes, Indigenous Futures’. (Eds J. Altman and S. Kerins.) pp. 45–64. (Federation Press: Sydney.)
- Fabricius, C., Scholes, R., and Cundill, G. (2006). Mobilizing knowledge for integrated ecosystem assessments. In: ‘Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment’. (Eds W. Reid, F. Berkes, T. Wilbanks and D. Capistrano.) pp. 165–182. (Island Press: Washington, DC.)
- Gorman, J., and Vemuri, S. (2012). Social implications of bridging the gap through ‘caring for country in remote Indigenous communities of the Northern Territory, Australia. *The Rangeland Journal* **34**, 63–73. doi:10.1071/RJ11037
- Hamilton, P. (1996). Oykangand and Olkola multimedia dictionary. Available at: www.oocities.org/athens/delphi/2970/index.html (accessed 22 October 2013).
- Hill, R., Grant, C., George, M., Robinson, C., Jackson, S., and Abel, N. (2012). A typology of indigenous engagement in Australian environmental management: implications for knowledge integration and social-ecological system sustainability. *Ecology and Society* **17**, 23. doi:10.5751/ES-04587-170123

- Hill, R., Pert, P., Davies, J., Robinson, C., Walsh, F., and Falco-Mammone, F. (2013). 'Indigenous Land Management in Australia: Extent, Scope, Diversity, Barriers and Success Factors.' (CSIRO Ecosystem Sciences: Cairns, Qld.)
- Holmes, J. (2010a). Divergent regional trajectories in Australia's tropical savannas: indicators of a multifunctional rural transition. *Geographical Research* **48**, 342–358. doi:[10.1111/j.1745-5871.2009.00630.x](https://doi.org/10.1111/j.1745-5871.2009.00630.x)
- Holmes, J. (2010b). The multifunctional transition in Australia's tropical savannas: the emergence of consumption, protection and Indigenous values. *Geographical Research* **48**, 265–280. doi:[10.1111/j.1745-5871.2009.00629.x](https://doi.org/10.1111/j.1745-5871.2009.00629.x)
- Ingold, T. (2010). Footprints through the weather-world: walking, breathing, knowing. *The Journal of the Royal Anthropological Institute* **16**, S121–S139. doi:[10.1111/j.1467-9655.2010.01613.x](https://doi.org/10.1111/j.1467-9655.2010.01613.x)
- KALNRMO (2010). 'Kowanyama Wetlands Program: Technical Advisory Group Terms of Reference.' (Kowanyama Aboriginal Land and Natural Resource Management Office: Kowanyama, Qld.)
- Lane, M., Robinson, C., and Taylor, B. (2009). 'Contested Country: Local and Regional Environmental Management in Australia.' (CSIRO Publishing: Melbourne.)
- Larsen, K. (2008). Aboriginal traditional owner aspirations for National Park homelands and the Cape York Peninsula Heritage Act 2007 (Qld). In: 'Protecting Country: Indigenous Governance and Management of Protected Areas'. (Eds D. Smyth and G. Ward.) pp. 51–70. (AIATSIS: Canberra, ACT.)
- Liedloff, A., Christophersen, P., McGregor, S., and McKaige, B. (2009). Representing Indigenous wetland ecological knowledge in a Bayesian Belief Network. In: '18th World IMACS Congress and MODSIM09 International Congress on Modelling and Simulation'. (Eds R. Anderssen, R. Braddock and L. Newham.) pp. 2842–2848. (Modelling and Simulation Society of Australia and New Zealand and International Association for Mathematics and Computers in Simulation: Cairns, Qld.)
- Queensland Department of Environment and Resource Management (2007). 'Water Resource (Mitchell) Plan. Water Act 2000.' (Department of Environment and Resource Management: Brisbane.)
- Robinson, C., and Wallington, T. (2012). Boundary work: engaging knowledge systems in co-management of feral animals on Indigenous lands. *Ecology and Society* **17**, 16. doi:[10.5751/ES-04836-170216](https://doi.org/10.5751/ES-04836-170216)
- Sharp, L. (1952). Steel axes for stone age Australians. *Human Organization* **11**, 17–22.
- Shellberg, J. (2011). Alluvial gully erosion rates and processes across the Mitchell River fluvial megafan in Northern Queensland, Australia. PhD Thesis, Griffith University, Brisbane, Australia.
- Shellberg, J., Brooks, A., and Spencer, J. (2010). Land-use change from indigenous management to cattle grazing initiates the gullying of alluvial soils in northern Australia. In: '19th World Congress of Soil Science: Soil Solutions for a Changing World'. 1–6 August 2010. (Eds R. Gilkes and N. Prakongkep.) pp. 59–62. (World Congress of Soil Science: Brisbane.)
- Shellberg, J., Brooks, A., Spencer, J., and Ward, D. (2013). The hydrogeomorphic influences on alluvial gully erosion along the Mitchell River fluvial megafan, northern Australia. *Hydrological Processes* **27**, 1086–1104. doi:[10.1002/hyp.9240](https://doi.org/10.1002/hyp.9240)
- Smith, B. (2005). 'We got our own management': local knowledge, government and development in Cape York Peninsula. *Australian Aboriginal Studies* **2**, 4–15.
- Sommer, B. (2006). 'Speaking Kunjen: an Ethnography of Oyikangand Kinship and Communication.' (Pacific Linguistics, Australian National University: Canberra, ACT.)
- State of the Environment Committee (2011). 'Australia State of the Environment 2011 – in brief.' Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities. (Commonwealth of Australia: Canberra, ACT.)
- Stewart, G., Hamilton, P., Yam, L., Yam, P., and Charlie, P. (1996). 'Preliminary Plant Usage List for Oyikangand, Olgol, and Pakanh Language Groups – Olgol Cultural Documentation Project.' (Kowanyama: Kowanyama, Qld.)
- Strang, V. (1996). Sustaining tourism in far north Queensland. In: 'People and Tourism in Fragile Environments'. (Ed. M. Price.) pp. 51–67. (John Wiley: London.)
- Strang, V. (1997). 'Uncommon Ground: Cultural Landscapes and Environmental Values.' (Berg: Oxford, UK.)
- Strang, V. (1999). Familiar forms: homologues, culture, and gender in North Australia. *The Journal of the Royal Anthropological Institute* **5**, 75–95. doi:[10.2307/2660964](https://doi.org/10.2307/2660964)
- Strang, V. (2001). 'Country bla we': Kunjen country on the Cape York Peninsula.' Unpublished and restricted report for the Kowanyama community. (Kowanyama Aboriginal Land and Natural Resource Management Office: Kowanyama, Qld.)
- Strang, V. (2004). Poisoning the rainbow: cosmology and pollution in Cape York. In: 'Mining and Indigenous Lifeworlds in Australia and Papua New Guinea'. (Eds A. Rumsey and J. Weiner.) pp. 208–225. (Sean Kingston Publishing: Wantage, UK.)
- Strang, V. (2005). Meaningful differences: dis-integrated management in the Mitchell River catchment. In: 'Sustainable Communities, Sustainable Environments'. (Ed. M. Minnegal.) pp. 60–69. (SAGES, University of Melbourne: Melbourne.)
- Walsh, F., Dobson, V., and Douglas, J. (2013). Anperinrentye: a framework for enhanced application of indigenous ecological knowledge in natural resource management. *Ecology and Society* **18**, 18. doi:[10.5751/ES-05501-180318](https://doi.org/10.5751/ES-05501-180318)