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Placing Science for Natural Resource Management and Climate Variability: Lessons from Narratives of Risk, Place and Identity

Peat Leith* and Frank Vanclay

Abstract

Making salient, credible and legitimate knowledge for natural resource management (NRM) and adaptation to climate change is achievable when scientific knowledge is grounded in place. Making scientific knowledge locally relevant can be assisted by an understanding of the way 'placed knowledge' comes into being. Taking two prominent conceptions of place (Massey and Ingold), we ground these empirically using narratives from graziers in the eastern Australian rangelands. We examine placed conceptions of risk and uncertainty and the ways they are linked to narratives of identity, local environmental change, and understandings of place. Paying heed to narratives enables a reframing of risk and uncertainty into locally-meaningful forms. This fosters dialogue between various epistemic communities in ways that acknowledge and respect different ways of knowing and differences in the content of knowledge. It provides an analytical basis for scientists and institutions to reflect on the applicability of their information and technology in particular contexts. With this approach, scientists, policymakers and other rural community stakeholders can develop their awareness of how placed narratives link social practices and locally-legitimate understandings of good farm management and biophysical systems. This will help to 'place' science for NRM, agricultural extension and rural development.

Introduction

There is growing acceptance that intervention in local environmental and natural resource management (NRM) will require participatory approaches in which problems are framed locally and resolved through partnerships across scales as well as the domains of industry, science and policy (Prager and Vanclay 2010; Vanclay 2015). One of the central challenges to such approaches is in building linkages

between the knowledge of scientists and farmers. These groups tend to think and operate at different scales, have very different concerns, and even different ways of knowing – and in fact comprise different epistemic communities (Wynne 1996; Ison and Russell 2000; McCown 2001; Vanclay 2004). ‘Place’ has been promoted as a concept that can potentially forge more effective linkages between natural resource politics, science, and management. For example, Cheng *et al.* (2003) suggest that place provides geographical focus and an organising principle for collaboration on local action. Davenport and Anderson (2005) maintain a central focus on ‘place attachment’ as a driver of social and cultural meanings within localities, which they argue can usefully inform planning if elucidated through social research. However, the relationship between expert and ‘placed knowledge’ has not been widely examined except perhaps for ethnographic work with Indigenous communities (e.g., Suchet-Pearson *et al.* 2013), although calls for understanding the local knowledge of farmers and rural communities have been common for some time (e.g., Kloppenburg 1991; Vanclay and Lawrence 1994; Vanclay 2004). We consider that the production and modification of placed knowledge will be a critical point of intersection between scientific and local endeavours to understand and manage natural resources in the face of social and environmental change.

One area of research that has gained traction in linking science and NRM is oriented to remodelling the practices of scientists and scientific organisations, and is concerned with the design of institutions, and the methods and processes by which science and science policy can create policy outcomes (e.g., Cash *et al.* 2003; Sarewitz 2004; Turnhout *et al.* 2008; Leith *et al.* 2014; Leith and Vanclay 2015). A key finding of such research is that the usefulness of information depends not only on the perceived relevance and credibility of the information and methods involved in its production, but also on the perceived legitimacy of the actors, institutions and arrangements that contributed to the making of the knowledge and decisions (Wynne 1992a; Cash *et al.* 2003). Such work emphasises that participatory knowledge production is arguably as much about process (Cash *et al.* 2003), power (Wynne 1992b), ethics (Vanclay *et al.* 2013), reflexivity (Wynne 1996) and humility (Jasanoff 2003) as it is about content. The resultant knowledge should aim to be contextual and founded on trust rather than being simply scientific information presented as a product (Leith *et al.* 2014; Leith and Vanclay 2015). Combining these considerations, participatory knowledge production co-produces social and natural systems together, and is relational in that such knowledge is founded on the inter-relations between people, objects, discourses and institutions (Jasanoff 2004).

This article offers an empirical approach to inform intentional and reflexive co-production through an analysis of narratives that underpin local conceptions of place, identity, risk and uncertainty. This approach is suggested as a means of reconciling abstract scientific information about improving land management with specific ‘placed knowledge’ that informs land management as it is practiced locally.

Placed knowledge is considered to be both the content and the forms of reasoning that are endemic within a locality. Placed knowledge might thus be considered to be localised forms of what Jasanoff (2005, p. 255) refers to as civic epistemologies: ‘the institutionalized practices by which members of a given society test and deploy knowledge claims used as a basis for making collective choices’. While Jasanoff

(2005) deploys this concept to grasp national styles of policy and political culture, we focus on the narratives that are indicative of the specific localised reasonings and understandings, and the way they are contested within the vast 'locales' of Australia's rangelands. Through in-depth interviews with graziers, we examine placed knowledge in relation to the management of land degradation and climate variability. In order to undertake this analysis, we first develop the concepts of 'place' and 'placed knowledge', which are inclusive and therefore applicable to diverse rural contexts.

Relational place

Drawing on the works of Tim Ingold (1993, 1995, 2000) and Doreen Massey (1993, 1994, 2005), we construct a view of place that highlights relations and meanings within interfolding local, regional and global contexts. Ingold (2000, p. 219) argues for a mobile conception of place: 'Bound together by the itineraries of their inhabitants, places exist not in space but as nodes in a matrix of movement'. It is through our travels and associated interactions with the animals, plants, rocks and landscape forms, as well as the books, instruments, computers and people that we come to make some sense of places. To rephrase Ingold (2000), we learn to know as we go. For Massey (1993, p. 66), place is not bounded by the movement of individuals, but by the interactions of power and knowledge across space and time, and the distinctly geographical histories of these interactions: 'What gives a place its specificity is not some long-internalized history but the fact that it is constructed out of a particular constellation of relations, articulated together at a particular locus'. Thus, we consider place is perhaps best described as being a matrix of relations generated regionally and globally, yet contextualised in and by the history of a specific locale.

Examining sense of place, or place attachment, is commonly invoked as a way of getting to grips with how a locale is embodied in a person's sense of self; in their identities, their relationships with others and the environments in which they roam, and their interests (Vanclay 2008). However, this way of thinking about place is limited and limiting. Massey (1993) argues that such identities are frequently constituted 'out of an introverted, inward looking history' (Massey 1993, p. 64); and that under such conceptions, places come to be constructed as bounded rather than porous, open-ended, networked and contingent. For Massey, place is thoroughly dynamic, and places should be viewed as processes. Massey (1993, p. 66) argues that places are 'constructed out of particular interactions and mutual articulations of social relations, social processes, experiences and understandings, in a situation of co-presence'. That is, place is inter-subjectively constructed to link the local and global. She posits a 'progressive sense of place' as a deeper understanding of the character of a place, which can only be conceived by linking that place to places beyond. What is needed is 'a global sense of local, a global sense of place' (Massey 1993, p. 68). Massey invokes the many potential identities of her inner London suburb to argue that 'each place is the focus of a distinct mixture of wider and more local social relations and, further again, that the juxtaposition of these relations may produce effects that would not have happened otherwise' (Massey 1993, p. 68).

Ingold and Massey both insist that place is not simply constituted locally, but that the wider world is always immanent in place. In this view, histories and cultures are generated in and through place, and meaning and narrative take precedence over any attempt at objective description (Dominy 2001). In people's narratives of places, humans, animals, plants, landscapes and the weather are always integrated, often through their close and ongoing interactions. Places are reconfigured via discourse; simultaneously people are also reconstituted (willingly or otherwise) (Cheng *et al.* 2003; Fleming and Vanclay 2010; Fleming *et al.* 2014). For instance, as landscapes become increasingly constructed as serving lifestyle, aesthetic and ecological goals for society as well as being agriculturally productive (Holmes 1994; Prager and Vanclay 2010), farmers are rebadged as 'stewards' or 'land managers'. For both Ingold and Massey, such constructions are part of a web of relations between people and things that stretch well beyond a locale. Maintaining a stronger focus on what happens within a landscape, Ingold (2000) argues that place should not be considered as the action of humans on the non-human world, but as the processes associated with the activities of people, animals, seasons, cycles and events, which are interactively incorporated into the ongoing constitution of places. This view presents place as an open site; a field of activity where humans and non-humans jointly and continually build and re-build place.

Drawing Massey's and Ingold's perspectives together, we constitute place and placed knowledge as locally mediated and curated, but incorporating a diverse set of interactive parts: the work of people, animals, as well as inanimate entities within localities, combined with less endogenous elements including the climate, world commodity prices, technology, trade agreements, markets, media reports, etc. Our understanding of place meshes well with empirical and theoretical work from science and technology studies, and particularly the growing literature on the relational processes of the co-production of knowledge (Jasanoff 2004). Placed knowledge is socially constructed, however its relational characteristics mean it stems not only from social processes, but also with their interactions with technologies and other non-human entities and processes. Placed knowledge is an important subset of the wider category of socially constructed knowledge. The characteristic that differentiates it is its legitimization within and through a locality, not least in relation to processes within landscapes as well as locally accepted forms of talking and reasoning. Analysis of placed knowledge provides a potentially useful avenue for considering how scientific information is and can be incorporated into the reconstitution of places and practices within them.

Methodology

An empirical approach to grounding and examining these ideas of place and placed knowledge was developed as an integral part of a larger study (Leith 2009). Reflecting the perspective that places are mediated and curated by local people, we applied a form of discourse analysis drawing on the theoretical work of Billig (1989, 1989) and its subsequent applications in social research (Hajer 1995; Locke 2001). Billig (1989) concluded that people present argumentative narratives which may indicate either their ambivalence or firm positioning in relation to others. These narrative forms

were seen as a potentially fruitful means of examining the constitutions of place and placed knowledge because they are relational and emphasise degrees of narrative stability or contestation. The more stable narratives recur within a group and can become scripts: 'a culturally shared expression, story or common line of argument, or an expected unfolding of events, that is deemed to be appropriate or to be expected in a particular socially defined context and that provides a rationale or justification for a particular issue or course of action' (Vanclay and Enticott 2011, p. 260). Some narratives take the form of parables – cautionary tales that condone some forms of action and reckoning, often while discounting other forms of action or thought (Vanclay and Enticott 2011). For Billig and others (e.g., Potter and Wetherell 1986; Hajer 1995; Potter 1996; Macnaghten and Urry 1998), the relatively stable elements of talk are contested by people through argumentative strategies by which actors seek to persuade others of the merits of particular alternate positions or versions of reality.

Hajer (1995) contends that discourses constitute the way people use language and are immanent in that language use. This 'immanentist' perspective contends that in subjects talking about and holding particular positions, they are creating and/or stabilising particular rules, norms or knowledge claims. As Hajer (1995) argues, the rules, conventions and modes of expression only have meaning to the extent they are taken up; to comprise social order, they have to be constantly reproduced and reconfirmed in actual speech situations. From this viewpoint, a given discourse is reproduced and/or transformed by actors who argue within and/or against the bounds of that discourse. They position themselves by drawing on diverse discursive elements to create what Hajer (1995) calls 'storylines'. A storyline positions subjects and structures in relation to a narrative thread. 'Storylines are narratives on social reality through which elements from many different domains are combined and that provide actors with a set of symbolic references that suggest a common understanding' (Hajer 1995, p. 59). Thus storylines can be considered as the argumentative narratives by which old scripts and parables are challenged, and by which new ones emerge (Fleming *et al.* 2014).

The empirical data comprise in-depth interviews with 70 graziers, mostly in their homes, across three areas of the vast rangelands of western Queensland and New South Wales, Australia (see Figure 1). These three regions were selected to reflect the varying conditions in these rangelands. The scale and low population density in the rangelands creates an expansive sense of place; here cattle and sheep graziers commonly drive for hours to visit their friends and neighbours. The large property sizes (in the thousands of hectares) mean that inhabitants' sense of what is local is very large indeed.

The interviews were conducted between November 2003 and March 2004, during a protracted and particularly severe drought for many participants – and, as the analysis demonstrates, a drought which changed perspectives on place and landscape. Participants with diverse perspectives were selected in each area using a purposive snowball sampling technique. First, key people with wide networks were identified in the main towns in each of the three locations – Longreach, Bourke and Cunnamulla, and Hillston. They were asked to provide contact details of potential participants they thought would have diverging perspectives. Snowballing continued from this original sample. Interviews were transcribed, coded and analysed using N-Vivo.

Figure 1: Map showing the location of the three study areas in the eastern Australian Rangelands

Coding was thematically focussed on the diverse constitutions of place, identity, risk and uncertainty, especially in relation to the large seasonal and inter-annual variability in rainfall that typifies the study areas. The interviews and subsequent analysis sought to examine graziers' narratives detailing how they dealt with and made decisions about such variability, and then how they related to seasonal climate predictions and other climate information (for details see Leith 2009).

Narratives of the eastern Australian rangelands

A variety of aspects of life were presented by our participants as being the driving force for their commitment to the land and their work. In particular, there were some statements that point to a variety of ideals and identities as scripts: 'being your own boss' (autonomy), 'it's all I've ever known' (limited knowledge/awareness of alternate options), 'it's a great place to raise a family' (idyllic agrarian sentiment), 'being outdoors, working with stock' (attachment to their particular work), 'you have a feeling for the land' (love of country), 'people in the city should know that I'm putting food on their table' (agrarianism), 'you don't have people breathing down your neck' (isolation/solitude as a positive concept), 'you know that if something is done well, it is because you did it, and you take responsibility if things don't go well' (pride in one's own work). Alongside these scripts, which express a generally positive sentiment, there were others which identified the financial pressures on graziers. The cost-price

squeeze and associated 'belt tightening' (Vanclay 2003) were strongly linked with the need to run family farms as a serious business in order to remain solvent.

These scripts tended to be given in response to a question about what graziers valued about life on the land, which came towards the end of the interview. It followed in-depth discussion about coping with climate variability, and particularly the intense drought of 2002–2003, which preceded the research. After relaying the emotional and financial hardship of culling or losing stock and making life-critical decisions on which their livelihoods and ways of living depended, many participants re-interpreted this question: 'You mean, why do I stay here?' This open question, intended to round off the interview, became a focal point because graziers spoke freely about place and identity. Typically, the language of the participants became more evocative and poetic at this point as they talked about their imperatives to continue on the land. Among these, autonomy was ubiquitous – 'being my own boss', 'taking responsibility for what I do', and 'making my own decisions' were described as fundamental reasons for staying in agriculture and on the land.

In itself, the idea that graziers find value in autonomy is not new. Research on farmers' scripts and parables suggests that such recurrent narratives can serve to uphold traditions of farming practice via stabilising normative narratives, which condone certain forms of practice and reject others (Vanclay *et al.* 2007; Enticott and Vanclay 2011; Vanclay and Enticott 2011). For example, the parable of the 'lazy farmer' emphasises the dangers of not adhering to the hard work ethic so prevalent in agriculture (Vanclay *et al.* 2006). The lazy farmer invariably fails (economically and socially) in the storied landscapes of Australian agriculture. Beyond this, work must take a certain form as can be seen in the parables of: 'the tinkerer', who spends too much time fiddling in the shed (Howden and Vanclay 2000); and, from some of the interviews for this research, the 'desktop grazier', whose stock are compromised because the manager is sitting in front of the computer watching markets and weather forecasts instead of checking the dams and bore drains for bogged animals. Scripts and parables that graziers, extension officers and researchers use to describe and mythologise farming styles are deployed flexibly by farmers with regard to their social acceptability (Howden and Vanclay 2000; Vanclay *et al.* 2006). However, how these narrative elements contextualise the ways farmers and graziers make knowledge, the ways different knowledge travels among them, and how these narrative elements come to influence decision-making have not been fully examined.

Discursive social psychology is useful here. In this literature, language is examined with respect to how it is used in positioning identities in relation to each other as well as broader discourses to which they attend, uphold, and critique (Billig 1989; Shotter 1993; Shackley 1997). Even the most stable storylines (scripts) – e.g., relating to the autonomy of participants – point to tensions between the participants' narratives and broader societal discourses, regulations, policies and practices. Put another way, an individual often frames their freedom in relation to what constrains it. For example, many participants commented that their way of life had been altered and their quality of life eroded by the growing imperatives of compliance and accountability associated with managing forms of risk and liability. One grazier explained that the occupational health and safety (OHS) regulations made it his personal responsibility to ensure that his son's friends were properly 'inducted' before they took to the

paddocks on their motorcycles in the continual work of checking water levels, fences and stock: 'This place goes out 30 miles – if they fall off their bike out there, I am personally responsible!'. The law in this case appeared to be utterly at odds, to the point of ridicule, with this grazier's reality, thus providing an argumentative site for the interlinked expression of autonomy and self-sufficiency in the bush. The written legislation, instead of re-orienting the grazier towards an enhanced responsibility for property-wide OHS, pulled against the culturally-constituted code in which responsibility for each person's own body was borne by each individual, including teenagers. The legislative attempt to govern the interactions of bodies and technologies from a distance – what O'Malley (2000) referred to as the 'new prudentialism' associated with neo-liberal government – was taken as an example of the distance of government from the realities of the rangelands. This distance often acted to delegitimize the knowledge of governments about realities of life in the bush. Participants juxtaposed aspects of their identities (e.g., autonomy and responsibility) against imposed compliance to link and reclaim placed knowledge.

The desire for autonomy and independence are also in tension with practice and change driven by the markets. Mainstream commodity-focussed agriculture requires economies of scale, and farmers are often driven to 'get big or get out'. Yet, this imperative of scale conflicts with the widely-touted scripts of autonomy. For example, after re-iterating his appreciation for being his own boss, one grazier expressed his lack of willingness to manage other people, which constrained his ability to get big:

I enjoyed the management of the place, but not the management of the staff. Because you spend all your time finding things for everybody to do, and sorting out their arguments and listening to their whingeing. Put me right off it. So I reckon, if you have any more than one worker – the annoyance factor – I don't want to be there. I would like to be big enough to have one full-time [worker] just to do all those petty things that I hate (laughs) – and to be here when I go away [meaning 'so I can go away every now and then'].

This example is indicative of the use of scripts as expressions of constraint and ability in relation to practice, as well as the tendency to relay scripts in the context of oppositional bads. Autonomy is pitted against the responsibility of mediation and responsibility for and towards others. Oppositional narratives about place also recur in most of the interviews, and particularly in response to questions about what graziers value about life on the land:

You can see nature at close quarters. You get this big rain, and then the grass is growing, you might see a brolga, which you haven't seen for years, and waterbirds. You know, I suppose that's part of living, if you like that sort of thing. Whereas in the cities, it's motor cars and people and smog and rushing around.

Storylines of relational place: being financial, being conservative and managing deep uncertainty

While most graziers represented their stocking strategy as being 'conservative' (i.e., having less than maximum stocking rate) – which may reflect the social acceptability of this strategy – there was nevertheless a tension between being 'financial' and being

'conservative' among their narratives. Some argued that they or others could not get ahead and be prepared for future droughts without 'pushing' (to the limit) the resources available to them by carrying more stock in good seasons, and thus risking rapid decline in the natural resource base when conditions deteriorated. Cashing-in on good seasons was described as an obligatory step to increasing the resilience of the operation through achieving a more viable position in relation to debt, infrastructure and equipment, stored fodder, and access to land and water. The burden of expenses, particularly boarding school fees (necessary because of the vast distances to high schools in rural Australia) and debt repayments (due to low and often declining equity), was considered to be a precursor to a high stress lifestyle of variable and responsive stocking, and was seen as an inevitable and essential path they had to follow, rather than it being undertaken as a voluntary strategic management choice. In this sense, the experiences of debt and country were intertwined in complex ways that allowed each to ramify on the other. As one grazier summarised:

I have always said to my kids that there is no way that the country can stand having to pay for itself every generation. You don't want your kids having to buy you out so that you can retire – and that is what causes the overstocking: the financial pressures. The land degradation is all tied up with the financial pressures.

Although the tensions between the scripts associated with looking after country and maximising profit were often deployed as key issues to balance in decision-making, there were recurrent storylines that problematised these scripts for many graziers. These storylines emphasised that the same outcome might be reached via very different approaches. Graziers frequently advocated their particular strategic approach, and less frequently the approaches of other people in their district. However, individuals were often unwilling to define normative practices that might confer 'good management'. When asked about good management, there was a tendency not to place judgement on others. Economic survival, by whatever means, through the trials of seasons and markets, was often presented as the benchmark of 'good management'. In their accounts, survival was not directly linked to making good decisions, but was borne through two distinct elements: financial security and luck.

Firstly, decision-making was often talked about in the context of graziers' infrastructure, finances and the buffering these provided in tough times. Participants acknowledged that some graziers were 'financial' (i.e., had reserve capital) and thus were more flexible in the face of drought. Others were described as never able to achieve this sort of security despite being 'good managers'. Being 'financial' thus connoted ability to position themselves so that they could take better advantage of situational conditions, which, by implication meant they didn't have to 'flog their country' – they could accept lower prices while stock were still in good condition rather than waiting to sell, hoping for stock prices to rise and/or rain to fall. As one participant put it: 'People with debt, they've got to take the gamble ... if you are driven by the dollar, you have to push for that extra dollar, and that is where they run into trouble'.

Secondly, participants often spoke of chance or luck as being an important factor in delivering outcomes, both good and bad. For participants, the unpredictability of rain and the markets was often referred to in terms of chance rather than risk. For example, one older grazier commented that 'two inches of rain will make a good

manager out of a fool', and another said that 'an inch of rain could make a good man out of me'. One grazier suggested that climate variability was 'the great equaliser' because it was unpredictable, and that this was perhaps just as well, because if it were to be predictable, then the big companies would be able to capitalise on forecasts more effectively than family-run operations, and then they would marginalise the latter. In these and other comments, graziers' management appeared to be oriented to the indeterminacy (Wynne 1992b) or deep uncertainty associated with the impacts of climate variability. Climate variability is one among many elements of a socio-environmental system that can be considered indeterminate; a system typified by uncertain interactions between human and environmental factors across scales that are fundamentally too complex to predict (Wynne 1992b; Leith 2011). Preparedness for the emergent phenomena associated with climate, market and other uncertainties was a dominant motif in the argumentative narratives of participants.

An example of such emergent phenomena is the effects of 'how rain falls' in the context of annual rainfall to date, temperature, grazing history and other factors. In Longreach and the Warrego, for instance, moderate rainfall in their dry season (winter) is known as 'spoiling rain' because it can destroy the quality of summer-grown Mitchell Grass, turning it 'black' and depleting its nutritional value, depending on how much and when precisely rain fell in the previous summer and autumn. On the other hand, different sorts of winter rainfall can grow 'herbage', which is nutrient rich and, almost literally, makes 'the sheep grow wool'. This rainfall was largely talked of as being a 'lucky bonus' and not to be counted upon. On the other hand, spoiling rain was more likely and its prospect appeared to mediate interpretation of how long the feed on hand at the end of the summer growing period would last.

Further south in Hillston (with a winter dominant rainfall regime), rain at different times promotes the growth of different types of plants. Such plants are diversely palatable and variously able to protect the loose soils from wind erosion if conditions become dry. Thus, how rain falls over a long period creates a fodder distribution, and also local conceptions of how resilient the grazing system will be the following season. These interactions between the landscape and the sequence of weather events are the climate of a place in a way that weather records and statistics could never be (McIntosh *et al.* 2000; Leith 2009; Leith and Vanclay 2015).

The uncertainty about how prior conditions can conflate to influence local and regional changes in feed and groundcover conditions found their most pressing form in the Warrego region in relation to influxes of large numbers of kangaroos at the height of the preceding dry. Many graziers considered that kangaroos were largely responsible for causing the drought (i.e., a lack of stockfeed) and some even referred to the 2002–2003 drought as a 'kangaroo drought':

What the kangaroos have done to us over the last couple of years, it puts us ahead of any other drought [i.e., makes it worse]. A lot of our decision-making in the past would have been still working today, but for the kangaroos. They [the kangaroos] were very similar to a mouse plague, [having] the same devastating results. They just ate us out within probably nine months, 12 months. So the theory of looking after your country, and all that sort of stuff, managing stocking rates and all that sort of stuff, went straight out the window. It was irrelevant! The bloke that looks after his paddock, he was the one [who] got eaten out [by the kangaroos]. And I can see it happening again in the next major

drought, in 10 years or whatever, because the [kangaroo] numbers will have built up [again]. And we [meaning Australia as a whole] have done that – we’ve ... done so much with the waters in this country; we’ve spread the waters around, and we have created that [perfect] environment for them. That’s where the government – they can’t see the exceptional circumstances [the terminology used in the granting of government assistance] – I mean, half of us wouldn’t have been in that position but for the kangaroo plague. There is absolutely no benefit in conservative stocking, and that sort of stuff, while we have these problems.

The deep uncertainty of the grazing environment, which is articulated in the above quote in terms of the increasing availability of surface water and a few good years, presents storylines that challenge the notion of private property rights in the rangelands. Like rabbits in previous centuries (Ingersoll 1964), kangaroos are perceived as a vector of land degradation, targeting the ‘best managers’ with grazing pressure beyond control. Because of their ability to travel fast and far, kangaroos effectively undermine the leasehold and freehold arrangements. For several graziers, droughts appeared to result from the socio-environmental history and even the evolutionary pre-history of specific places in relationship to the region in which they were embedded. While it was the build-up of rabbits during wet seasons that was implicated in the major Australian droughts of the nineteenth and twentieth centuries (McKeon *et al.* 2004), in the case of kangaroos, the local impacts of their movement are contingent on previous seasons as well as the actions of land managers across a region over a long period of time. Kangaroo numbers are thus linked to government policy and its implementation, including the regulation, monitoring and management of populations of other native and feral herbivores on public and private land.

In farmers’ narratives, kangaroo numbers are also affected by market forces that are themselves dependent on the effectiveness of emotive market campaigns. For instance, lobbying to prevent the sale of kangaroo products in British supermarkets was described as potentially changing the economics of managing kangaroo populations and thus increasing the severity of kangaroo droughts. As McKeon *et al.* (2004) demonstrate, such market drivers of action in the rangelands can contribute at least as substantially as rainfall variability to degradation at a landscape scale. Such considerations were described as being meaningful to decision-making among graziers, but in ways that were difficult to pinpoint. These signals were incorporated into decisions in ways that were ‘hard to put into words’. They informed what was commonly referred to as a ‘gut feel’ – an intuitive tussle with deep uncertainty. Having a good gut feel was regarded as being an essential element of being a good grazier, or a good farmer.

Gut feel stems from interpretation of multiple issues on the run, as well as from careful deliberation over a long period of time (see Kahneman 2011). It is informed substantially by experience, yet this experience appears to be mediated by narratives that are used to make sense of the past and the present. In the interviews, such experience was often condensed into scripts or parables that emphasised traditions and institutionalised ways of interpreting and responding to situations. These scripts and parables, however, were often contested as people, individually and socially, tried to make sense of the unforeseen and previously unexperienced events. Emergent phenomena and unprecedented experience, couched in locally legitimate language and reasoning, are the basis of storylines that can reconfigure placed knowledge. In our

research, they appeared to be a key mechanism by which gut feeling was built and renegotiated, thus enabling analysis and unpacking of what might otherwise be essentialised tacit knowledge. For instance, storylines about complexity, emergence and uncertainty, as in the kangaroo drought, reinforce more stable scripts relating to luck while also countering scientific narratives about rational risk management.

Conclusion

In our interviews, narratives that linked place, identity, risk and uncertainty stake out a knowledge-terrain that is situated, relational and evolving within a locality. It is not parochial but inclusive of a vast array of external influences, reflecting the perspectives of both Ingold and Massey that relational place is an open and porous site. A key point was that this view of place can help us gain a clearer view of placed knowledge, one that is built through experience and conversation, as well as through the interactions and relations within and beyond a locale. While the placed knowledge of climate might be mediated and curated locally (McIntosh *et al.* 2000), it comprises a diverse and complex set of interactions, interdependencies, discourses, and conflicts (Leith and Vanclay 2015).

Such an understanding of place and knowledge is usefully informed by the historical context in which these interviews were conducted. It was a time that will be remembered in Australia for many years and perhaps even for generations to come. This is not just because it was a major drought; it was a time when events unfolded in ways that were unfamiliar to graziers. Their prior knowledge was destabilised by the events and by the new narratives that were being created and used to make sense of these events. Through narratives of phenomena such as the 'kangaroo drought', older scripts were being destabilised by newer storylines, which appeared to have the potential to result in new forms of reasoning, sense-making, and place-making. Such moments are increasingly prevalent with a changing climate and provide all stakeholders interested in agriculture and natural resource management with opportunities to learn.

It is likely that some scientists overly-simplify systems to produce tractable answers to solvable problems that may not exist as problems to the intended 'users' (Vanclay and Lawrence 1994; Vanclay 2004). In being driven by imperatives and incentives to develop answers, science can easily alienate itself from its target audiences by imposing a technical and linear rationale between problems and solutions. Making problems appear governable through specific forms of managerial intervention – what Li (2007) called 'rendering technical' – belies the political, ethical and social elements of more complex problems such as 'the kangaroo drought'. This issue appeared as a collective action problem in an institutional environment typified by individualism, private property rights and weak public institutions. Meanwhile, the scientific production of rainfall probabilities was seen by at least some participants as being a potential threat to family farming. If such forecasts ever became reliable enough to consistently predict feed production, then corporate entities would be better positioned to capitalise on these predictions than family farm operations. Thus, arguably, indeterminacy and contingency benefit the non-productivist values associated with family farming, and expert systems are constituted as undermining them.

This is not to argue that scientific information and understanding were not valuable to our interviewees, or more widely. Rather, we suggest that where schisms exist between placed knowledge and expert knowledge, they undermine collective and local endeavours to understand and undertake effective NRM. Dialogical and argumentative narratives, such as those highlighted in our results, can both ground and legitimise scientific knowledge and build the credibility of placed knowledge. Although scientific information is incorporated into placed knowledge through the local contestation and reconstitution of places, scientists and scientific organisations are rarely equipped or encouraged to specifically align or articulate their technical understandings with local renderings of place. There is even less capacity to bring placed knowledge effectively into scientific debates so that it can reframe technical questions and redefine research priorities (Kloppenborg 1991; Agrawal 1995; Raymond *et al.* 2010).

We suggest that such linking work can occur through the analyses of the scripts and parables used at local scales, and that this approach is relevant far beyond the rangelands of Australia. The form of narrative analysis applied in this paper can help make explicit the reasonings people use to make sense of complex environments and of their relationships with them. It can also be applied symmetrically to examine credibility contests within and among scientific and policy communities (Leith and Vanclay 2015). The approach provides a means of examining how ways of knowing are changed through unforeseen events and emergent phenomena. In this analysis, relatively stable scripts were being challenged by argumentative storylines through local observation and experiences (e.g., the kangaroo drought) and thereby potentially reforming placed knowledge.

Placed knowledge is also influenced from outside a locale. Scientists and policy-makers play a role in the constitution of placed knowledge and its ultimate effect on practice, whether or not they actively engage with the processes of placed knowledge. Too often, scientific information is delivered in alien technical terms that do not resonate with local renderings of identity, place and uncertainty (Wynne 1992a), but this does not always have to be the case (Leith and Vanclay 2015). Where conditions are changing rapidly and understandings are being re-configured – as is increasingly the case with climate change – there is potentially a strong demand for science and policy that effectively links technical information with local placed knowledge. Such co-production should aim to enable learning to address the emerging challenges and opportunities across all groups. We have suggested that a means of understanding what these challenges and opportunities are is in the scripts, parables and storylines of placed knowledge, in rural areas at least.

Taken together, Massey (1993, 1994) and Ingold (1993, 1995, 2000) provide a useful theoretical scaffold for analysing places and placed knowledge in process. Ingold's notion of place as 'a matrix of movement' and Massey's sense of interrelations among and amongst places can be usefully tested through the argumentative approaches to discourse analysis. In the Australian rangelands, graziers' narratives of their experiences and observations constituted local phenomena via complex interactions of discourses and events which operate across scales in unpredictable ways. Yet, living in one place for most of a lifetime – or, as in many of the cases we considered, over several generations – creates what graziers call 'a feeling for the country'. Such a level of appreciation is built through lived experience, augmented by

the stories passed between generations. Experience and social memory becomes embedded in scripts and parables, which are deployed in expressions of local values, identities, collective knowledge and (un)acceptable practice. People live and breathe these constraining and enabling discourses of their locale. In decision-making, these discourses provide filters through which events and interactions are mediated. Greater awareness of these processes among the scientists and organisations who seek to engage with farmers and other local peoples will lead to enhanced effectiveness of the rural development programmes in which they participate.

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