

Learning to be drier in the southern Murray-Darling Basin: Setting the scene for this research volume

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[Australian history] is like a giant experiment in ecological crisis and management, sometimes a horrifying concentration of environmental damage and cultural loss; sometimes a heartening parable of hope and learning. (Griffiths 2003: 16, cited in Mackinnon 2007: 73).

Overview

We finalised our set of papers for this special edition of *Australian Journal of Adult Learning* in late September 2009. We sought to emphasize and broaden our interest and concern about our *Learning to be drier* theme in this edition to the 77 per cent of Australians who live within 50 km of the Australian coast, the

majority of whom also live in major cities and urban complexes (Prime Minister's Science, Engineering and Innovation Council, PMSEIC 2007: 3). On 24 September 2009, a massive dust storm swept across New South Wales, dumping millions of tonnes of red dust on capital city areas of Australia unaccustomed to dust: Canberra, Sydney and Brisbane. Snow, laced with the same red dust fell the same day in the Australian Alps, as attempts at breaking the historic and prolonged deadlock between the Australian federal government and states about water trading rules, as part of achieving a national 'plan' for the Murray Darling-Basin, again broke down. On 1 October 2009 the New South Wales Office of Water circulated a news release, making 'an initial allocation [in the Murray Valley] to general security users of 1 per cent' of their entitlements, and asking all water users 'to be as conservative as possible with their use in what continues to be the worst drought ever experienced'.

Eight researchers contributed team papers to this special edition from the four sites in the southern Murray-Darling Basin. Collectively, we bring wide and deep academic backgrounds, theoretical perspectives and experiences from a wide range of work, research and life contexts, in mainly rural and regional Australia. While the research plan detailed below was essentially common, each two-person team grappled with and selected its own preferred combination of theoretical perspectives for their paper. The method and the qualitative (mainly interview) data were therefore treated somewhat differently across different sites. While the four site papers were researched, developed and written relatively independently by two-person teams, our joint, sixth paper attempts to 'stand back'. In sum, we collaboratively seek to critically analyse and draw some conclusions about what might be common or different about the diverse approaches to learning about being drier, drawn from four very different land use contexts, in the same Basin, across three different Australian states.

In this first paper we undertake a brief review of the literature related to the background of water in the southern Basin, and of the literature related to adult and community learning about water. We also describe the overall method of the project, in order to set up the context for the four, site-specific case studies that follow. These 'site' papers are presented in terms of their perceived positions in the broad Basin or water catchment. The first site paper, *Water, weeds and autumn leaves: learning to be drier in the Alpine region* (Foley & Grace 2009) examines water-related learning issues in the Victorian Alpine region, particularly from the perspective of diverse community frames of reference (Bekhout, Hertin & Gann 2006). In this alpine 'water harvesting' area, the learning has to do with the many impacts of drying, aside from less snow and water runoff, particularly to do with wildfires, weeds, conservation and tourism.

The second site paper, *Bearing the risk: learning to be drier mid-river* (Golding & Angwin 2009) looks at water-related learning issues in a site centred on the Hay Shire, in the western Riverina of New South Wales. In this site, water from the Murrumbidgee and Lachlan Rivers had, until ten years ago, been critically important in developing new crops and industries for irrigation on the riverine floodplain, in an otherwise very dry natural environment. With progressively lower water allocation percentages in the past decade after a decade of drought, climate change (or possibly both), there is evidence that the options, resources and opportunities for learning to adapt to and bear the risks of further drying in this site, are becoming very limited.

The third site paper, *Learning to be drier: a case study of adult and community learning in the Australian Riverland* (Brown & Schulz 2009), is based in the intensively irrigated Murray River in the South Australian Riverland around Renmark. It identifies a number of forms of new learning: to produce, to be efficient, to survive, to live with uncertainty, to be sustainable and to share. It provides evidence that the people and communities in this site, who are learning to live

with the effects of climate change and less water, are likely to be the forefront of learning to be drier. This and the previous paper raise important issues about how to learn to balance water use equitably in the Basin, by taking account of other uses and users, including the environment, both upstream and downstream.

The fourth site paper, *Learning to be drier in dryland country* (Smith & Campbell 2009) is focused on the modes of learning and particular strategies which people in a 'dryland' site in the northern Wimmera and Southern Mallee use to gain information about living with less water. Unlike the other three sites that have direct access to water from permanent rivers, this dryland area has always had only limited water for stock and domestic purposes via channels, aside from seasonal and relatively low rainfall for 'broad acre' cropping. On 13 October 2009, *The Age* in Melbourne reported, on its front page, that the region will have its severe water restrictions relaxed from level 4 to level 1, courtesy of water savings from 'the nearly 9000-kilometre Wimmera-Mallee irrigation pipeline' (p.1).

Our common presuppositions

Our first, important and common presupposition is that adult, vocational and community education and training institutions and programs comprise only a small sub-set of all learning. In rural and regional areas, the proportion of adults (particularly older adults) who access such institutions and programs, in the small number of places that they exist, is known to be relatively low. Golding, Brown and Foley (2008) reviewed the breadth and importance of informal learning. They concluded that it was important to conduct and value research into adult and community learning in all its forms, well beyond those legitimised by neo-liberal discourses restricted to standardised and government-accredited 'formal' learning. Specifically, Golding Brown and Foley (2008: 52) pointed to the value of examining learning as it occurs 'in particular times, places, communities, relationships and situations'. They agreed with Colley,

Hodkinson and Malcolm (2000), that the task of policy and practice is not to see informal and formal attributes of learning as somehow separate.

All learning situations and sites examined in this *Learning to be drier* research were therefore anticipated to 'contain elements of in/formality that are interrelated in different ways in different learning situations' (Golding Brown & Foley 2008: 52). We anticipated that all members of communities in the four sites would be learning, lifelong and lifewide, through experience, by doing, through the media (including the internet), as well through their social, family, work and community networks. In effect, they learn by what they do, read, see and hear. What we did not know, and sought to examine, was how adults learned, made sense of, and adapted to the recent and significant changes towards becoming drier in the past decade. Our interest, therefore, went well beyond the so-called 'formal' education delivered and directed by institutions. In all four, relatively small rural communities in which we collected data, post-compulsory education and training institutions including technical and further education (TAFE) and adult and community education (ACE) had a limited presence.

Our interest in the four articles in this special volume is essentially about the modes of learning about living with less water in four highly water-dependent communities in the southern Murray-Darling Basin. We deliberately chose, in our method, not to make presuppositions about causality: about whether the most recent decade is indeed an unprecedented drought, climate change or a combination of both. Rather, we started with the undeniable reality that much of Australia's southern inland 'food bowl' is 'on its knees' and being forced to adapt to be significantly drier, as a consequence of a combination of historically low rainfall and runoff in the past decade, combined with a significantly over-allocated and diminishing water resource. Our interviews therefore sought to discover what a diverse range of adults

know, learn and understand about the phenomenon of drying, with researcher assumptions of causality aside, *in order to* theorize the learning that is occurring. In effect, we took a constructivist (Vygotsky in Kozulin 2003) and situated view of learning (Lave & Wenger 1991). We presupposed that there is no right way of learning, knowing about or understanding this phenomenon.

Our method presupposed that adult learning would and should take many forms beyond accredited education and vocational training, particularly in the community. We also assumed, in our site selection, that what people need to know and learn would vary with their location, particularly by their position in the catchment. We deliberately steered away from naming and privileging learning on the basis of its formality (informal, non-formal or formal learning). We acknowledge that our study was conducted in rapidly changing and tightly inter-related physical and community environments. Conceptually and practically, we anticipated that people and organisations were being forced, albeit in different ways, to quickly adjust their lifelong knowledge and assumptions about water with increasingly limited adaptive options. Most were likely to be struggling for solutions to local and regional water shortages, without necessarily understanding, acknowledging or accepting the risks, likelihood or consequences that this might not be a drought, and particularly that the drying might be causally related to climate change and global warming.

Finally and importantly, we made no *a priori* assumptions about causality with our informants. In our field research, we deliberately and consistently used the terms 'drier', 'dryness' and 'drying' to avoid presuppositions about causality. While there is no debate that the southern Basin had dried out, particularly in the past decade, there is debate about causality. At one extreme, the term 'drought', while descriptive of the situation being experienced, has connotations associated with a natural aberration. At the other extreme, terms such

as 'global warming' and 'climate change' presuppose warming and drying associated with human impact, a view that is not universally accepted in the Basin.

Methodology

Our case study approach

Our researchers and teams shared an interest in the learning taking place for adults in the four different sites. In our preliminary discussions we decided that a case study approach would be most appropriate, as our basic intention was to seek to describe and develop an understanding of the setting and the learning, rather than for the research to be an active agent in evaluating or changing anything. Stake (2000: 437) called this approach an *intrinsic case study*, as 'it is undertaken because, first and last, the researcher wants better understanding of this particular case'.

We developed case studies of each of the four settings, gathering data to describe the experiences of the stakeholders and illuminate the approaches to learning. The perspectives of a range of people were sought. The purpose of the research was two-fold. Firstly, we explored the structures, relationships and content of the experiences and the people involved. This entailed engagement of the interpretive categories of the social, educational and professional values, beliefs and attitudes of the main participants. Secondly, we wished to study, in particular, how the participants integrated their learning about water into their everyday life.

Since this represented an interpretive study that was 'bounded' in both time and space, we identified the case study as the most appropriate methodology for its capacity to accommodate the complexity of this situation, as it actively engages the changing dynamics of the settings and its social aspects (Campbell 2000: 80). Additionally, we recognized the validity and compatibility, in this project, of Stake's assertion (Bryman 2001: 55) that '[t]he utility of

case research to practitioners and policy makers is in its extension of experience'; and that case studies centre on '... research on a single case with a view to revealing important features about its nature'.

Each setting or site investigated was a 'bounded system' in a number of ways. From the physical perspective, it was located as a dedicated area and described by the specificity of the water production or use in the area and its position in the water Basin or catchment. One site, in the Alpine area of Victoria, mainly involved water harvesting. Two sites, in mid-river New South Wales and on the lower river in South Australia, involved irrigation where river flow was highly regulated and perennial. In the dryland site in north-western Victoria, local stream flow was minimal and ephemeral. Each site was also bounded in that we collected information over a specific period (April–July 2009)—a snapshot in time. The research methodology needed to be sensitive to the constraints and opportunities that presented within the research project. Stake (2000) discusses how researchers '... aim the inquiry toward understanding what is important about that case within its own world ...' and describes the development of the interpretations of issues and contexts as '*thick descriptions*' (Stake 2000: 439).

We have reflected on the data, providing our interpretation of the learning of the participants within the context of each individual site. Through this we seek to '... describe the cases in sufficient descriptive narrative so that readers can vicariously experience these happenings and draw conclusions' (Stake 2000: 439).

Limitations and ethical considerations

All four case study papers involve similar limitations. We were limited by a very modest research budget to four sites in different parts of the southern Murray-Darling Basin. All sites were pragmatically accessible to Victorian-based researchers. Recent national research had identified the southern Basin as already relatively dry and more

likely to be subject to future drying associated with predicted climate change. The number of people we were able to interview in each site, along with the number of interviewee categories we deliberately selected, was similarly limited by time and expense of transcription. It was not possible to randomise or objectively select interviewees within categories. Rather, the potential interviewees were identified, contacted and selected for interview on the basis of advice, typically by phone, internet or email, from a range of key informants, to try and cover a diverse range of water-dependent stakeholders and viewpoints.

Consistent with our research ethics approvals from both our universities, we are restricted in our reporting to ensure that individuals are not named or identified, so that their confidentiality is respected. In some cases, because we are reporting on data collected in very small communities, we have therefore been unable to identify some organisations, place names or informant roles.

Site selection and our interest in these sites

Our interest was in how adults learn in order to adapt to changes in water availability exacerbated by recent prolonged drought and postulated climate change (Prime Minister's Science, Engineering and Innovation Council-PMSEIC 2007), arguably related to global warming in four rural, inland communities in the southern Murray Darling Basin. We selected four discrete regions and communities (which we call sites) in three Australian states that we describe in our individual papers as Alpine (North–east, Victoria), Mid-River (Western Riverina, New South Wales), Lower River (Riverland, South Australia) and Dryland (Wimmera/Mallee, Victoria). All four sites shown in Figure 1 are in the southern portion of a Basin widely recognised as 'Australia's food-bowl' (PMSEIC 2007: 3). Communities in the lower and dryer parts of the Basin arguably 'have a lower capacity to adapt', and are therefore most 'at risk (PMSEIC 2007: 3).

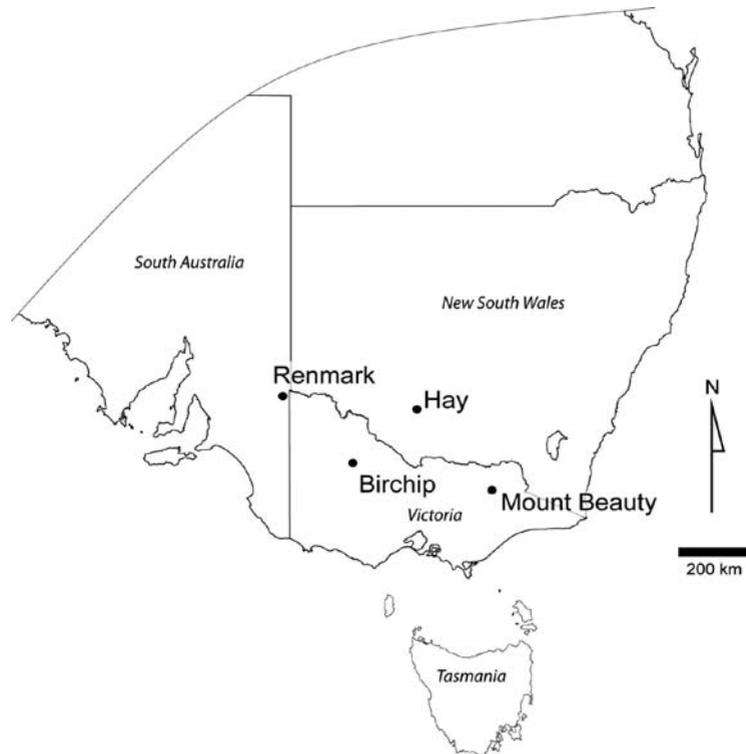


Figure 1 Sites in south-eastern Australia within the 'Learning to be drier' research

In each of these sites, shown in Figure 1 to be centred on the rural towns of Mount Beauty, Hay, Renmark and Birchip respectively (but inclusive, in each site, of several nearby populated localities), we anticipated that livelihoods and communities would be highly dependent on water in different forms for different purposes in different parts of the catchments. This dependency ranges from snow, rainfall, stream flow and water storage towards the top of the catchments, to rivers, irrigation channels, pipelines and groundwater aquifers in the lower and dryer riverine catchments, to highly seasonal rainfall in dryland cropping and grazing areas. In all parts of

the same catchments, there are significant environmental assets that are also dependent on the same limited water. The southern Murray-Darling Basin, according to some commentators, was 'virtually out of water' by 2008 (Young & McColl 2008: 9). They noted that ...

Many wetlands have already been closed and the level of Lake Alexandrina and Lake Albert [at the Murray Mouth] is already below sea level. ... It may not be possible to keep all environmental assets and all irrigation systems going. Parts may have to be abandoned or changed forever.

Our presupposition is that knowledge of how and what adults learn about deciding what to change, what to save and what to lose, is most likely to be found in these water and climate-sensitive communities. We regard learning about the management, conservation, use and availability of water, as the environment becomes drier and warmer in these water-sensitive contexts, as critically important and under-researched issues in inland, riverine Australian communities. These issues are also important for capital city and regional communities to learn about and from. Adelaide and large areas of South Australia (as far Kimba, several hundred kilometres west of the Murray, that it pipes its water from) already draws most of its (increasingly saline) water from the Murray-Darling Basin. Meantime, Melbourne is pinning some of its hopes on future water by tapping into the southern part of the same Basin, via a new (and controversial) 'north-south' pipeline. The plan is to take water from the already stressed Goulburn River, on the assumption of water savings through future, improved irrigation efficiencies. This new pipeline comes a year after the cities of Ballarat and Bendigo in regional Victoria were seen to be 'saved' by a similar 'Goldfields' pipeline.

Our interests included the many mechanisms for the 'learning to be drier' that occur related to water and its availability, through work as well as through community and family networks. We anticipate that this knowledge about learning will be critically important

to government policy makers, as well as to the many community stakeholders whose livelihoods are highly dependent on water, and subject to significant demographic and structural changes in the coming decades. The urgency of understanding this learning is emphasised by climate change research (PMSEIC 2007), that predicts changes likely to further affect atmospheric, evapo-transpiration, catchment, groundwater and community balance across the Basin. Like PMSEIC (2007: 5), we understand that discussions and research about climate change have multiple dimensions: *global; mitigation* to reduce sources of atmospheric emissions or increase absorption, as well as *adaptation* to changes in climate. The focus in our research in Basin communities already under severe stress, is on adaptation. While our interest in this suite of papers is in how adults learn to adapt, ‘live, ... do our business [and] protect and sustain our ecosystems’ in the Basin (PMSEIC 2007: 5), we acknowledged that parallel learning and urgent action needs to occur with global mitigation, since ‘global greenhouse emissions will continue to drive climate change across Australia for the foreseeable future’ (PMSEIC 2007: 11).

Context for the research

While Australia generally has a climate-sensitive economy (PMSEIC 2007: 2), our interest was in framing adult learning in the *southern* part of the Basin, where water and climate-dependent agriculture and associated ‘downstream’ industries is most intensive, and where population densities are highest. The best available, recent climate projections in the southern part of the Basin, based on a range of climate modelling and sources, are consistent (PMSEIC 2007; CSIRO 2007; Hennessy, Fawcett, Kirono et al. 2008). They suggest: significant annual warming; increased diurnal temperature range (more hot days, more warm nights, less frosts); less precipitation (rainfall runoffs, stream flow and snow); increased drought

occurrence and severity, and substantial increase in fire weather risk, including more frequent and severe bushfires. In brief, the CSIRO (2007: 4) predicts that the future climate in the ‘Lower Murray-Darling Catchment is likely to be warmer and drier [with increased] evaporation, heat waves, extreme winds and fire risk’, placing ‘human life, property and natural ecosystems at increased risk (CSIRO 2007: 5). Unsurprisingly, the CSIRO predictions are also of significantly less average annual stream flows for all of the main permanent river catchments we were researching (Lachlan and Murrumbidgee in the Hay Shire; upper Murray tributaries in the Victorian Alps; Murray-Darling Basin in Renmark).

The case for concern about drying

The data were collected in mid 2009 in the context of severe (and worsening) water shortages, associated with harsh and prolonged (1997–2009) ‘drought’ and predictions of climate changes, specifically in the decades ahead. The four sites selected for intensive study deliberately spanned three states (Victoria, South Australia and New South Wales) in the southern Basin, guided by CSIRO (2008) findings about where the relative level of surface water use is already very high, and where climate change is most affecting the reliability of water in the Murray-Darling Basin.

Our original research proposal coincided with the release of the *Water availability in the Murray-Darling Basin* (CSIRO) report in October 2008. This report revealed that by that date, two thirds of Australia was drought-declared and the livelihoods and futures of many farming families were being threatened by very small and diminishing water allocations over much of the southern Murray-Darling Basin in 2008/9, as the Basin total flow was reduced by 61 per cent (CSIRO 2008).

The *Climate change in Australia report* (CCA 2007) had already identified the definite severity, likely urgency and possible future risks

associated with the problem of drying in the Basin. The necessary learning and understanding from the typically complex, technical reports, that consistently point towards increase in atmospheric carbon, global warming and climate change as being implicated, have taken some time to be recognized. While the presenting problem is significantly less rainfall and river flows in the southern Basin over the past decade, many older residents remain sceptical that this is anything other than a protracted drought, based on their lifetime of experience of previous sequences of both severe and prolonged droughts and floods. It is easier to optimistically assume that things will return to normal, than to accept that the changes might be permanent, and particularly to accept, pessimistically, that things may get progressively worse. Mackinnon (2007: 86) concluded that while 'We have continued to build our cities and our agriculture with a vast cultural amnesia'. However:

... [o]ptimism is not enough to counter the relentless effects of drought and the failure of the River [Murray] to meet our needs. We forget our past at our peril: we mortgage our future to amnesia. (p.87)

Whatever members of the public or experts read, no one is able to compute *for themselves* the risks and probabilities of change coming out of the different and very sophisticated climate change models. The best anyone can do is read widely, understand the drying of the Basin as a complex problem with underlying uncertainties, and make a personal decision about the consequences of accepting the probability of different levels of future risk. As a consequence, the likely, though uncertain consequences of gradual climate change on the Basin have taken much longer to be understood, recognized or accepted. The possible causes (and solutions) have several possibilities, that depend on assumptions and confidence in the climate modelling, and that are used to extrapolate from recent observable changes to likely future risks.

It is important to note despite our concern, that we are not wanting to contribute to what Hulme (2007: 5) calls the 'contemporary discourse of fear about future climate change' or global warming as global catastrophe. We wish to avoid blaming people in the Basin for not seeing this change coming and to anticipate its cascading, 'downstream' effects. In some ways, both irrigators and wetlands in the areas we have studied are somewhat analogous to 'canaries in the mine' in terms of their direct sensitivity to changed climatic, stream flow and water environments. Like Hulme (2007: 13), we acknowledge that three trends have combined to heighten public recognition of the likelihood of anthropogenic (human-induced) global climate change: 'a material change in environmental conditions, a heightened ecological consciousness affecting public values, and the growing institution managerialism of capitalist economies'.

We also acknowledge that for the first time in history, climate and catchment scientists have been able to analyse data and create complex, multivariate 'models' to make pronouncements and predictions about the likely climatic future, decades ahead, based on an increasing recognition of global connectedness, 'complete with uncertainty ranges, tipping points and probabilities' (Hulme 2007: 13). This has been achieved by joining a series of previously unconnected 'dots', to a point that there is now recognition of a likely 'link', for example, between carbon emissions in faraway nations like China, and the amount of water available to Adelaide from the lower Murray River. In this sense, as Boia (2005, cited in Hulme 2007: 13) put it, 'battles over climate change occur as much in the cultural and individual imagination as in the atmospheric spaces in which physical climates are formed.'

Riding out the drought or adjusting to the risk?

The most optimistic scenario is that the southern Murray-Darling Basin is experiencing a natural but severe, temporary departure

from stable, long-term, average weather conditions (particularly rainfall and temperature): in effect that we have a series of unusually protracted droughts. Governments in Australia had tended, until very recently, to provide 'drought relief' (as with flood relief) in the form of financial assistance, to tide farmers over the very dry times seen to be associated with normal and recurrent droughts (and floods). In more recent times, financial support has been for 'exceptional circumstances' (widely referred to as EC¹), again on the assumption that these are exceptionally dry departures from the long-term norms. The Productivity Commission (2008), in its recent review, concluded that the existing EC 'trigger' of a one in 20–25 year event 'based on historical records ... is not appropriate under a changing climate' (p.1).

In the case of both previous drought declarations and Exceptional Circumstances (EC) cases, the government has previously accepted the risk. However it is now likely to shift the EC 'goalposts', as exceptionally hot years and exceptionally low rainfall years are now occurring twice as often and over twice the area in all regions. Very recently, there has been a move by governments towards reframing the problem and shifting the risks to water users. Part of this shift towards water users 'bearing the risk', incorporated within the mid-river paper title (Golding & Angwin 2009), has involved renaming 'drought relief' workers and programs as 'rural adjustment' workers. This new term, 'rural adjustment', recognizes the perceived value to governments of encouraging farmers to accept the risk and adjust to future climatic likelihood or possibilities, by restructuring, retraining and reskilling, and for some, getting out of the industry and relocating.

Scepticism about climate change (and particularly the wisdom of a global Emissions Trading Scheme [ETS] to address it were front page,

political issues in late 2009, with the approaching Copenhagen round of talks. Nevertheless some state governments, and the national government in Australia were committed to build understandings of climate change, as well as to develop the appropriate technologies Australia would need for a less carbon and rainfall-dependent future. It was therefore considered timely to undertake strategic research to identify what role adult learning plays in preparing and adjusting workers and enterprises in the regions and towns most directly affected, for the likelihood or reality of the changing situation and its associated risks.

Method

Research Questions

We framed our research around three broad research questions.

1. How and what do adults learn, formally and informally, in response to changes in water availability in four Australian non-metropolitan communities in the Murray Darling Basin?
2. How is this learning experienced and responded to by different stakeholders (from the perspectives of education & training organisations, water authorities & land managers, farming and other enterprises, community organisations and individuals)?
3. How are these stakeholders learning to respond in ways that are sustainable in the four different water environments where the level of surface water use is already relatively high?

Site selection

After a comprehensive literature review of water-related learning issues, particularly in the southern Murray-Darling Basin, several towns were selected in each of four regions that were identified as being highly dependent on surface water in different ways.

1 The current exceptional circumstances (EC) standard is of a one in 20–25 year event (Productivity Commission 2008, p.1).

- An *alpine* area in Victoria, highly dependent on snow and melt water for water harvesting, agriculture and forestry, hydroelectric power, snow skiing and nature-based tourism.
- A *mid-river* site in the Western Riverina in New South Wales, dependent on irrigation from the west-flowing Murrumbidgee and Lachlan rivers and aquifers for broad acre crops, including rice and cotton as well as vegetable crops.
- A *lower river* site in the Riverland in South Australia, mainly dependent on irrigation water from the lower Murray (and also Darling River), mainly for horticulture.
- A *dryland* area of the northern Wimmera and Southern Mallee in Victoria, highly dependent on local rainfall, other than the limited stock and domestic channel/pipeline systems, for cropping and sheep farming.

Some characteristics of these selected sites, previously identified in Figure 1, are summarised in Table 1.

Table 1: *Some characteristics of the four sites*

Sites & Teams	River Catchments	States	Regions	Main Towns (ARIA+)	Climate predictions
Alpine Foley & Grace	Kiewa & Ovens	Victoria	Alpine/ North East	Mt Beauty (2.44) & Bright	Warmer Drier
Mid-river Golding & Angwin	Murrumbidgee & Lachlan	NSW	Western Riverina	Hay (5.49) & Booligal	Warmer Drier
Lower river Brown & Schulz	Murray & Darling	South Australia	Riverland	Renmark (4.18)	Warmer Drier
Dryland Smith & Campbell	Richardson	Victoria	Wimmera/ Mallee	Birchip (4.87) & Donald	Warmer Drier

ARIA+ = Accessibility Remoteness Index of Australia; higher values indicate increased remoteness and decreased accessibility to services.

Site visits and interviews

The main purpose of the first, reconnaissance visit to each site, was that the two-person teams should come away having made contact

with the key water-related stakeholders in the categories referred to in Research Question 2 (above). Also, they should have gleaned a comprehensive overview of the main sources, uses and users of water in the site; of where the water that is consumed is collected, and which government and other organisations were primarily responsible for its management, storage and distribution. The intention was to confidently return to the site several weeks later and conduct audio-taped, focus group interviews: with post-compulsory education and training organisations; water authorities and public land managers; farmers; businesses directly or indirectly dependent on water as well as community organisations.

University research ethics approval was obtained for the interviews on the return visit. These audio-taped, focus group interviews varied in length between approximately fifteen minutes and one hour each. They resulted in a total of approximately 22 hours of digital recordings across four sites from 37 fully transcribed interviews, amounting to 442 pages of transcript data from a total of approximately 150 informants. In addition, several telephone interviews were undertaken with participants who were unavailable. Some other on-site reconnaissance and interviews included note taking but no audio-recording.

The interview questions focused on: what informants already knew about water origins, use and availability; how they learned about changes in water use and availability as well as how informants and their organisations were adapting to these changes. In the case of those providing education services, a question was asked about how their course offerings had changed. The interviewees were specifically asked about:

- where their water comes from
- the demand and usage of water in the area
- the water availability in this area

- how they found out about changes over the past five years to water usage and availability
- how they were adapting to changes in water usage and availability
- to give advice as to how learning to adapt to these changes might be improved.

Literature review

A relatively small amount of research has been undertaken in this specific research field to date, as identified in the literature examined and cited in our review below. This is surprising, given that Australians are ‘Living on the driest inhabited continent on earth’ (Potter & McKenzie 2007: 1), and arguably subject to either ‘the worst drought in a thousand years’ as part of a ‘natural cycle’, ‘a sign of global warming’ (p.1), or a combination of both. It is all the more surprising, given that ‘[n]inety-five per cent of the river length of the Murray-Darling Basin is degraded’ (Gell 2007: 23), and that ‘water removal, largely for an economically significant irrigation industry, now uses up to 90 per cent of the river’s divertible flow’ (p.23).

With some exceptions, there is a lack of significant and critical, scholarly engagement with the issues that are the subject of our research questions as they relate to the way Australian communities are learning about changes in drying. McKay (2007: 96) identifies that while ‘community-driven solutions to water scarcity’ are desirable, because of entrenched ‘individual freedoms’ and a lack of a shared ethic of resource management in past water management policies, many rural communities have not been ‘accustomed to thinking in a catchment context’ (p.96). McKay (2007: 101) identifies the need for the community ‘to understand the delicate balance of the water environment’, and a particular need for ‘community education’, though without citation or evidence. Somerville’s (2007) research into ‘place literacies’ comes closest to some of the theoretical and methodological underpinnings in our own series of place-based

narratives, which we have collected very recently and *in situ*, in rapidly changing ecosocial circumstances. Somerville (2007: 153) asks what she regards as urgent questions: ‘How can places teach us about water?’ and ‘How can we incorporate the pedagogical possibilities ... to ensure the protection of people and ecosystems?’ Somerville proposes a new ‘critical place pedagogy’ framework for learning in the Murray-Darling Basin that:

... is necessarily embodied and local; our relationship to place is communicated in stories and other representations; place learning involves a contact zone of contested place stories. This new theory of place literacy brings into question the epistemologies and ontologies of print literacy and proposes different pedagogies of place literacy learning.

Traditional learning about climate change

There is evidence that Indigenous people in Australia and elsewhere (eg Gyampoh, Amisah, Idinoba & Nkem 2009, from Ghana; Somerville 2007, from Australia) have learned to solve problems to do with climate change and variability in areas dependent on rain-fed rivers, through experience and knowledge passed on orally from generation to generation. While Indigenous Australians have previously adapted to and coped with climate change involving both significant wetting and drying in relatively recent geological time frames in their 60,000 plus years in Australia, what has changed is that we are now dealing with a ‘climate of our own making’ (CSIRO 2007: 1), that is being transformed in ways that are arguably more rapid and unprecedented than throughout much of human history.

We also tend to forget we are living in recently and radically changed water catchments. While non-Indigenous occupation in Australia in the Basin under study is less than 200 years, this time frame has been sufficient in these ‘climate-sensitive’ agricultural areas (Bass & Ramasamy 2008) to develop some ‘rules of thumb’ about the likely duration and intensity of floods and droughts, much of which has

been transferred to the current generations in somewhat similar ways. While the most recent decade of drying and warming, as measured by rainfall and extreme temperatures, is longer and more severe than most older residents can remember, some people we interviewed drew attention to photographs indicative of river levels lower (or higher) than those recently recorded. What these photographs show are rivers before they were dammed by reservoirs and weirs, that were deliberately put in to hold back floodwaters and to provide water for agriculture during dry times of peak water use, usually during summer.

Learning to adapt in climate-sensitive locations

Peter Holmgren's Foreword in Bass and Ramasamy's (2008: iii) findings about necessary, community-based adaptations to climate change in Bangladesh appear to be highly relevant to the southern Murray-Darling Basin. Holmgren notes the '... imperative to identify and institutionalise mechanisms that enable the most vulnerable farmers and local communities to cope with climate change impacts'. He stresses that 'Awareness raising and capacity building processes are urgently needed at all levels that will support long-term learning processes', and that 'Decentralized programs seem most appropriate to remote local adaptation within the framework of coherent national policies'. In addition, he argues that '... immediate action is needed to manage existing and future risks within the framework of broader understanding on the most likely impacts of climate change.'

Young and McColl (2008: 3) would suggest that such adaptation and actions to minimize the negative consequences in Australia is some way off, since a coherent national water and climate change policy is not yet in place. They argue that 'The causes of the Murray-Darling Basin's problems stem from a flawed [water] allocation regime', and that the way to 'fix the Basin's problems' is to 'put a new system in place that is designed to cope with whatever climatic conditions the future brings.' (p.4). This would involve replacing 'the current [water]

entitlement and allocation regime with a robust one that can be confidently explained as one that will work—no matter what climatic future arrives', as well as implementing 'the resultant change in a just and fair manner' (p.4).

McKay (2007: 91) noted that:

The regulation of land and water use in each Australian state was founded on a legal implementation in the 1880s of a licence system for the allocation of water. The underlying principle of this regulation was unimpeded use for economic growth.

After a century of largely unregulated surface and groundwater water use, most areas of the Basin are 'are approaching—or are beyond—sustainable extraction limits' (McKay 2007: 95). Young and MColl (2008: 5) point to the urgent need for attention 'in the southern Murray River System'. As a result of 'the pattern of climatic events and water allocation decisions over the last two decades, they observed, at the time of writing in 2008, that 'the southern system was virtually out of water and that a number of environmental assets may have to be abandoned, or accepted as changed forever'. They also identified a need for recognition of interconnectivity to manage the 'entire system, surface and groundwater ... as a single interconnected system', rather than, as at present, '... granting two or more people the opportunity to take the same water in the same year but at two or more different places ...' (p.5).

Smit, Burton, Klein and Wandel (2000: 223) identify an 'anatomy of adaptation to climate change and variability' based upon three questions: 'Adapt to what?', 'Who or what adapts?' and 'How does adaptation occur?' In each of our study sites we anticipated that people we interviewed would answer each of these questions in somewhat different ways, depending very much on their answer to the first question. As Tol, Fankhauser and Smith (1998: 109) identified, in terms of adaptation to climate change,

... people will neither be dumb nor brilliant at adapting. They are likely to see the need for change, but may be constrained in their ability to adapt or in their comprehension of the permanence and direction of change.

The academic literature on adaptation to climate change and related concepts, as Berkhout, Hertinis and Gann (2006: 135) observed, is substantial, drawing on theoretical 'frames, methods and taxonomies borrowed from a range of disciplines including conservation ecology, welfare economics, and hazards and risk research'. Berkhout et al. (p.136) set out a framework for analysing adaptation, taking the perspective of the organisation based around the 'learning cycle' seen to occur within organisations based on case study interviews (in house building and water utilities companies in the United Kingdom). This 'circular' learning cycle is effectively based on learning by experience. It assumes an external signal is recognized and interpreted by an organisation, that 'experimentation and search' leads to 'knowledge articulation and codification' and to feedback and iteration. While Berkhout et al. (2006) found that '*direct* signals of climate change experienced in business activities and performance were rare and tended to be hard to interpret' (p.146), they anticipated that more direct climate feedbacks occurred in climate-sensitive sectors like agriculture.

Berkhout et al. (2006) identified four modes of likely adaptation (p.148): commercial, technological, financial as well as 'information and monitoring'. They also identified four alternative adaptation strategies (p.151): 'Wait and see', 'Risk assessment and options appraisal', 'Bearing and managing risks' and 'Sharing and shifting risks'. We anticipated all four modes of adaptation and adaptation strategies in our site-specific studies that follow, depending on whether informants perceived they were dealing with drought, the early signs of climate change, or both.

Looking ahead to the narrative themes in the papers that follow

This introductory paper deliberately sought not to draw early conclusions. Rather it sought to 'look ahead' to some of the underlying narratives we have heard, and in effect chosen to write about, from the many possible narratives. While each of the four team papers includes its own important and different site-specific conclusions from somewhat different theoretical perspectives, we have left the 'looking back' and drawing together to our joint *Wicked Learning: looking back on learning to be drier* in our final, collaborative paper (Golding, Brown, Foley, Smith et al. 2009).

The four case studies that follow rely deliberately and heavily on interviewee voice in narratives to tell their stories about drying as a learning phenomenon. The narratives seek to powerfully illustrate how adults in the basin learn to adapt and accommodate to live with less water, and how most long-term residents attempt to avoid breaking the intimate connection between the farm and rural town as their place of work, as a residence and as a family tradition. The narratives are also about the 'drought industry' and climate change advice; about whether the learning strategies and pedagogies of advisers are appropriate for farmers and local learning organisations to learn and teach from. While each study starts with a simple, physical pen pictures of the sites it leads to more complex and different narratives about the social changes associated with being dryer in each site. They provide evidence of how people, families, businesses and organisations across the Basin learn to cope with the changes, including the insidious nature of prolonged (and perhaps worsening) dryness. They incorporate narrative themes about learning to change (including learning about the likelihood and risks of climate change). Finally and importantly, they explore intricacy and interconnectedness between climate, water dependency and learning.

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