

The Arabana people, water and developing cultural indicators for country

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Photo: Kati Thanda Lake Eyre (M Nursey-Bray)



Arabana Country. Artwork by Jody Warren, 2015.

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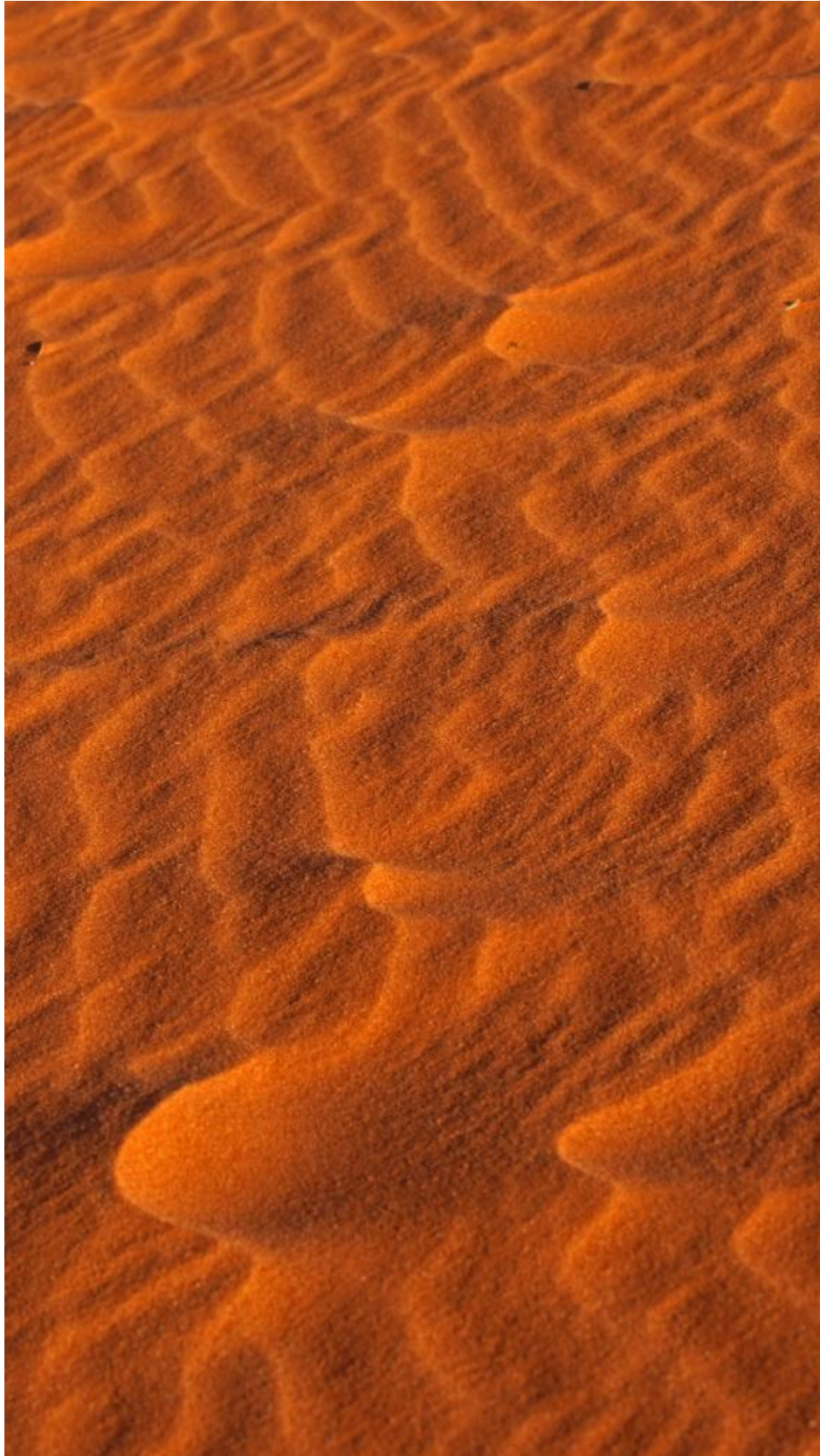
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EXECUTIVE SUMMARY

Water is of paramount importance to the Arabana people who live in the Kati Thanda-Lake Eyre region. Assessing the ongoing condition of aquatic ecosystems is an important part of management. Development of indicator frameworks that can incorporate both scientific and cultural values can ensure Indigenous involvement in management, but also facilitate ways in which local and traditional knowledge can be acknowledged as being of value.

This project aimed to identify and document the values and indicators for water systems held by the Arabana people with the view to developing ideas about how future assessments across the whole region may: (i) engage with and then, (ii) build a template for cultural indicators across the whole region.

This project was implemented using Indigenist and participant methodologies. Arabana people were employed as co-researchers. Three field trips and meetings were held to identify Arabana values for, and indicators about, water in their country.

Results indicate that Arabana people value water in multiple ways including for survival, culture and identity. Interestingly, Arabana people also valued water variability and its absence: historical, dry or degraded water sites were noted as significant.

Arabana people used a number of indicators or ‘signs’ to assess the ongoing condition of a site. This included flora, fauna, soil, knowledge, history, use, and pressure indicators. In many ways, the cultural indicators used by Arabana people have complementarity with scientific indicators and thus have potential to be built on and then implemented in conjunction with other indicator suites. A cultural indicator schemata is presented as is a co-engagement model for use in wider assessments with other Indigenous groups.

However, this research concludes that it is not possible to develop a generic template for integration of all indicators across the region and questions whether or not this is really necessary.

Ultimately, what is required is funding and investment into each Indigenous group across the Kati Thanda–Lake Eyre region to support each group to develop their own specific schemata (based potentially on the one we suggest here), and then allocation of funds to train and employ Indigenous people to implement them.

The knowledge set built over time in this manner, especially if grounded in the principles of co-existence rather than integration, will also facilitate the conditions for effective and adaptive management. It will be a true complement to scientific indicators and knowledge, while respecting and incorporating Indigenous people aspirations in the region.

1. Introduction

Water is of paramount importance to all people that live in the Kati Thanda Lake Eyre, Australia, but to the Arabana, it also holds immense cultural significance. Having lived in the region for thousands of years, Arabana people have developed their own methods to assess the ecological condition of their water sites in particular ways. This report presents the results of a collaborative project designed to develop a suite of cultural indicators for water sites in the Kati Thanda region. Based on field trips and a comprehensive desk top review, this report presents the ‘signs’ used by Arabana to assess condition, and discusses whether or not these can be used in more generic ways across the region to assist in broader river assessment processes. The report ends with some reflections on how the development of these indicators can be integrated with Western indicators in ongoing management.

This project reports on a sub project within a wider Goyder project that builds upon existing frameworks and research to analyse new and existing data to identify condition indicators and associated threshold values of water sites. The wider project will inform the assessment of environmental condition of Lake Eyre Basin (LEB) rivers as required under the LEB Intergovernmental Agreement (LEBIA) to which South Australia is a signatory. The recognition of cultural water and its potential links to economic productivity is a significant and emerging policy area in SA. The LEB Community Advisory Committee (CAC) and Scientific Advisory Panel (SAP) have both supported this policy direction and noted that Indigenous perspectives should be reflected in the assessments and monitoring activities under management plans for the LEB rivers and water sites.

Box 1: Aims of the Goyder Project:

To develop a set of indicators to assess the environmental condition of the aquatic ecosystems of the Lake Eyre Basin (LEB)

The project will:

- analyse both existing and new data to identify a suite of useful condition indicators and threshold values for the LEB, and
- identify potential methods/approaches for using the above to assess the environmental condition of LEB rivers [as required under the LEB Intergovernmental Agreement (LEBIA) to which South Australia is a signatory]
- Integration and analysis of existing and new ecological and spatial datasets to develop quantitative indicators of environmental condition (to monitor and assess and monitoring the condition of the LEB at various scales).

New datasets will include:

- flood inundation and other hydrological information
- population dynamics of aquatic biota (fish)
- **aboriginal perceptions and values.**
- nutrient status

Increasingly, the creation of and then incorporation of cultural indicators is advanced as one way to build Indigenous capacity and involvement into water management planning. In New Zealand, research has been undertaken on Māori cultural indicators, including the development of a Māori Cultural Health Index (Tipa and Teirney 2002, 2003). In Australia, researchers have found Indigenous perspectives are important to water management planning, but many challenges exist (Jackson and Barber 2013, Jackson and Altman 2009, Jackson 2005, 2006, 2011). Indigenous involvement in the development of cultural indicators is important because: (i) it fosters ongoing consultation with Indigenous groups; (ii) creates opportunities for documenting water issues at local scales; (iii) creates tangible means (via the indicators) by which other stakeholders can ‘see’ Indigenous aspirations; and (iv) has potential to be integrated into other (scientific) indicator management frameworks.

While worthy in intent, there remains many difficulties in achieving these aims, including a difficulty in conducting consultations and an incompatibility between world views around the values and management of water (Jackson and Langton 2012). As Gibbs (2010) notes, the embedded Eurocentrism inherent in most dominant water regimes in Australia can also marginalise Indigenous interests and their involvement in water resource management. Jackson (2006) adds that this creates a compartmentalisation of values which can mitigate against, rather than add to, effective water management. Various studies address this issue by suggesting the implementation of principles and guidelines for good practice in Indigenous engagement (Jackson et al. 2012, Bark et al. 2012) and by explicit incorporation and recognition of Indigenous values about water in management (Ioris 2013).

1.1. Project Aims

This particular study was a pilot study, working with the Arabana people of the Kati Thanda-Lake Eyre region, to identify aboriginal perceptions of indicators of environmental condition using both traditional and contemporary knowledge. The key aims were:

- To engage with the Arabana community to undertake a case study of indigenous condition perspectives on river health
- To identify Aboriginal condition indicators (including spatial attribution of indicators) and values associated with water
- To assess condition, identify threats, pressures and agree on indicators for measuring change
- To develop suggestions on ways to integrate Aboriginal and western science indicators of environmental health into assessments and reporting of Basin condition.
- To develop a means of engaging Indigenous peoples in the development of cultural indicators and provide some reflection on how to do this.

- To identify a strategy for future engagement with other Indigenous groups in the Kati Thanda – Lake Eyre region.

The report has been structured in the following way to present the research findings. First, it presents a background summary of the project context, followed by a description of the case study and the methodology. An analysis and documentation of the sites, values and cultural indicators, based on Arabana perspectives follows. The report ends with recommendations and reflections on the development, utility and application of cultural indicators in river assessment processes in the LEB rivers region.



2. Background

2.1. National Water Governance

A key element of national water governance in Australia is the National Water Initiative (NWI) of 2004, which was the first Commonwealth policy to try and incorporate Indigenous interests in relation to water. Subsequently, State and Federal governments have been trying to establish policy mechanisms for incorporating Indigenous values and interests in water allocation and other planning processes (Jackson and Barber 2013, 435). Despite the aims of the NWI, Tan and Jackson (2013) argue that the NWI has four features that restrict an expression of Indigenous interests as articulated within the policy including: (i) the low priority given to Indigenous needs in over-allocated catchments; (ii) state government pressures, which result in a lack of clear guidance on balancing competing priorities; (iii) procrastination while awaiting native title determinations; and (iv) consultations that do not result in equitable access to valuable economic resource rights. They further argue that Indigenous groups and policy makers both need to work together to overcome a number of additional challenges, such as the limited knowledge available about how to address Indigenous water requirements, a lack of Indigenous and government agency capacity and ways to resolve competing priorities.

In the context of Kati Thanda-Lake Eyre, the issue of how to address Indigenous water rights becomes even more complicated. Water in this region is variable in quantity (and quality) and the laws relating to its management occur across a number of jurisdictions as well as incorporating the requirements of the Lake Eyre Basin Intergovernmental Agreement (2000). Figures 1 - 4 below highlights the governance structure in the Kati Thanda -Lake Eyre region. Indigenous interests are represented via membership of the Community Advisory Committee.

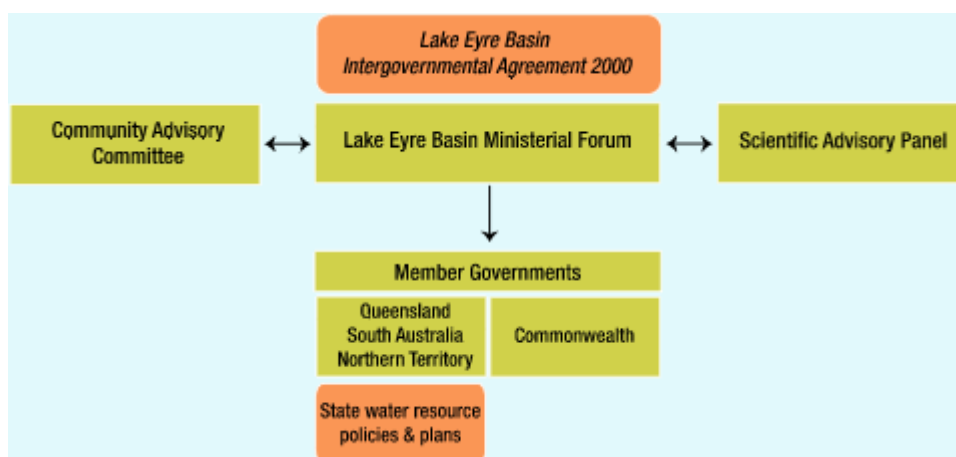


Figure 1: Governance structure of the Lake Eyre Basin (<http://archive.nwc.gov.au/home/water-governancearrangements-in-australia/cross-boundary-arrangements/lake-eyre-basin/lake-eyre-basin-ministerial-forum>)

The responsibility for individual State and Territory water governance is covered by various levels including NRM bodies. The figures below presents these management arrangements.

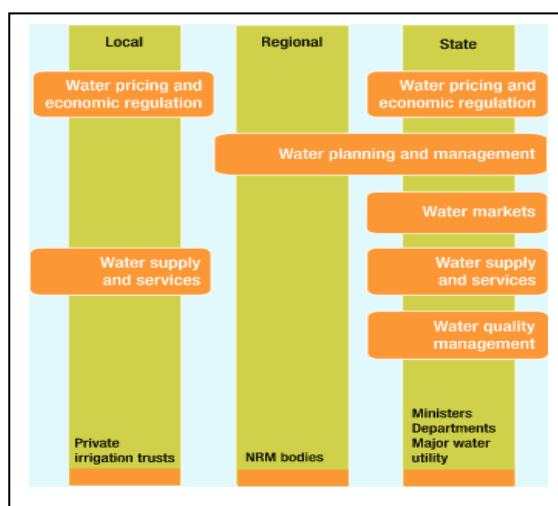


Figure 2: South Australia Water Governance

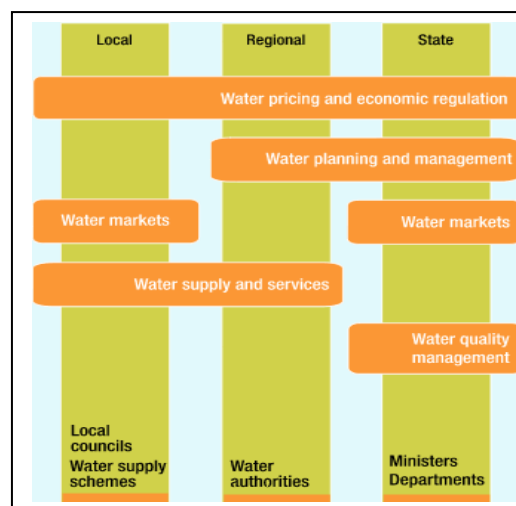


Figure 3: Queensland Water Governance

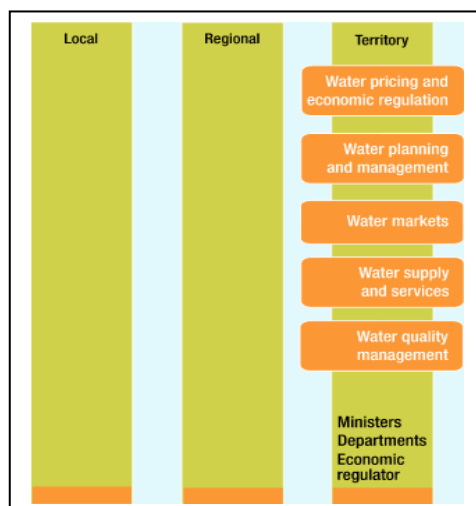


Figure 4: Northern Territory Water Governance

Water governance then, not only for this region, but overall, is a complex endeavour, and incorporating Indigenous rights and aspirations within them an ongoing challenge. This report reflects on one dimension or opportunity offered that has potential to recognise and build in Indigenous interests in water governance regimes; the development of cultural indicators.

2.2. Cultural Indicators

There are a number of imperatives for developing cultural water indicators. Firstly, they may act as an internal driver encouraging Indigenous peoples to undertake community based monitoring that may otherwise be undertaken by scientists or other third parties. They also provide opportunities to monitor condition in response to an issue or impact over time. A range of other benefits are described in Box 2 below.

Box 2: Benefits of Developing Cultural Indicators

- Articulate and increase understanding of cultural values and perspectives
- Identify and determine issues and areas of potential resource – and cultural/political – conflict
- Monitor changes and trends in the cultural health status of water bodies
- Identify and prioritise (culturally significant) areas for restoration and enhancement projects
- As a basis for cultural impact assessment and other Indigenous planning and policy
- As a basis to resource consent responsibilities and recommendations
- Help build Indigenous research capability
- Expand Indigenous knowledge and understanding (e.g. integrated knowledge systems)
- Expand science knowledge and understanding (e.g. integrated knowledge systems)
- Help build collaborative research with science agencies and researchers
- Help establish collaborative projects and partnerships that make a difference (in line with Indigenous needs, aspirations, goals)
- Generate new Indigenous research directions
- Inform Indigenous policy and planning
- Inform local government policy and planning (drawn from Fraser 2002, Reed 2005, Stuart- Hill et al. 2003, Dougill et al. 2006).

Importantly, if resourced properly, the use of cultural indicators can ensure that the community retains ownership and intellectual property rights over their information while allowing them a mechanism to record that information in a culturally appropriate way, rather than being subject to Western systems of recording. As discussed later, this ensures that information is not subsumed within existing scientific systems or data sets (i.e. GIS data sets) but co-exists in partnership or alongside these other data sets (Berkes 1999). It also means that 'attempts to translate and filter traditional ecological knowledge (TEK) through western cultural biases and standards' (Karnjala et al. 2004) do not compromise its integrity, as sometimes occurs (see Duerdon and Kuhm 1998).

Implementing indicator frameworks has additional challenges, such as recognising that in Indigenous contexts, a different suite of species may be considered important, as against those which science sees as significant. Further, accommodating different management objectives within existing jurisdictional and legislative water management can be problematic (Finn and Jackson 2011). Taking into account not only Indigenous world views and then Indigenous water values is an additional issue. Nonetheless, as outlined in Table 1,

there are a number of approaches emerging in this field, which highlight ongoing development, and then successful implementation of various cultural indicator frameworks.

Often this work focuses on community led/based indicator systems, and they are worth considering because some focus specifically on Indigenous involvement and TEK. The most recognised of these indicator systems is perhaps the work done by Gail Tipa in developing a Cultural Health Index for assessing water catchments in New Zealand, an approach which has since been applied and refined by other Māori groups. Table 1 below provides an international overview (based on a literature review) of some of the key approaches being currently trialled in this field.



Viewing a water site (Photo: M Nursey-Bray)

Table 1: Summary of types of cultural and social indicator frameworks¹

Model/Place	Model	Description
New Zealand Tangata whenua	Cultural Health Index (CHI) (Tipa and Tierney 2003, 2006)	Identifying and prioritising stream health problems, evaluating remedial actions aimed at restoring or enhancing stream health, and monitoring stream health of a site or the whole catchment. Use of the CHI in discussions with water managers and others involved in rivers and streams also provides a way of better understanding Māori perspectives and concerns about
Iwi/hapu groups from the Motueka Catchment	Cultural Health Index (CHI), New Zealand	These groups have adapted and developed the CHI in the Otago region and applied it at sites throughout the Motueka and Riwaka catchments. The Motueka cultural health index stratifies the landscape into Atua domains (a Māori cultural framework) such as Tangaroa, Tane Mahuta, Haumietiketike, Rongomatane, Tumatauenga and Tawhiri Matea. Attributes covering riverbank condition, riverbed composition, water clarity, water flow, water quality, channel shape, riparian vegetation, catchment vegetation, river modification/use, use of river margins and smell are scored from 1 (poor) to 5 (excellent), with the overall cultural stream health measure calculated as the average of these scores. An assessment of the mahinga kai status and traditional status of the site is also determined, along with a judgement of whether iwi would return to the site.
Dixon, L (2001) Tangata Whenua, New Zealand	The Ake Ake model	Perspectives are considered across five components: environmental, economic, cultural, social, and health and wellbeing. The model is produced in three steps:

¹ This list is an indicative one and aims to show the diversity of approaches available world wide in this area, however, it is acknowledged this is not an exhaustive list.

		<p>(i) Iwi learn about how the river people lived in the past – with reference to each of the five components.</p> <p>(ii) Iwi identify the present situation – with reference to each of the five components.</p> <p>(iii) Iwi draw what they want the future to look like for iwi in 50 years' time. Drawings should include representation of the five components.</p>
Sweden	Cultural Sustainability Indicators (Axelsson et al 2013)	Cultural Sustainability indicators applied across Sweden municipalities to create visual data maps reflecting these indicators, and hence regions of greatest cultural sustainability
Northern Territory Australia	Joint Management Indicators (Izurieta et al 2011, Stacey et al 2013)	A participatory monitoring and evaluation approach where partners agree equally on the identification of criteria and indicators to measure agreed management outcomes
Morelos, Mexico	Local Indicators (for conservation) Framework (Monroy-Otriz 2009)	A criteria/indicator approach involving locals, was used to identify plant species of importance for conservation and where local knowledge assisted in this process
World wide	Sustainability Indicators	<p>Various approaches that describe and identify means by which to assess sustainability of programs:</p> <p><i>Top down</i> including <u>Panarchy theory</u> and <u>adaptive management</u> (Gunderson and Holling 2002), <u>Orientation theory</u>, (Bossel 2001), <u>Pressure-State-Response</u> OECD 1993, <u>Framework for Evaluating sustainable land Management</u>, (Dumanski et al. 1991)</p> <p><i>Bottom up</i> including <u>soft systems analysis</u> (Checkland 1981), <u>Sustainable Livelihoods Index</u>, (Scoones 1998), <u>Classification Hierarchy</u> (Bellows 1995), <u>The Natural Step</u>, (TNS 2004)</p>
Kalahari Desert	Regional Sustainability Assessment Guide (Reed et al 20??)	Set of indicators developed due to different perceived priorities identified by different sets of locals living in the Kalahari region, but within 200 km of each other
World wide	Indicator Threshold Index/Framework e.g. Palmer-Drought Index	Effective way of helping community monitor changes over time

	(Reed et al 20??)	
Aboriginal Forest Planning Process Central interior British Colombia	Local level criteria and indicator frameworks (Karnjala et al 2004, Adam and Kneeshaw 2008)	Participatory decision making tool designed to enhance co-management of forest to develop local criteria and indicators of sustainable forest management
British Columbia, Canada	First Nations Marine environmental monitoring (Heaslip 2008)	Kwakwaka'wakw monitoring practices include the use of qualitative individual, community and population scale indicators and the integration of traditional knowledge as baseline data about the healthy condition of traditional food resources
Australian tropical river systems	Integrated indicators of ecological and socio-economic change (Jackson, Finn and Scheepers 2014)	Uses replacement cost method to establish baseline for assessing and monitoring the socio-economic impact of hydrological and ecological changes from water resource development. Included identification of subset of high value species which could be used as integrated indicators
New Zealand	Cultural Indicators of wetlands (Harmsworth 1999, 2002, 2006)	Documents a series of generic indicators by which the Tangata whenua assess wetland condition
New Zealand	State of Takiwa 'toolbox' (www.ngatahu.iwi.nz) ²	Tribal Environmental monitoring and reporting tool
New Zealand	Significance Assessment Method (Tipa 2003)	Technique where a series of steps ensure assessment to: (i) identify all attributes/values/criteria, (ii) discuss the significance of the attributes selected and (iii) review methods undertaken to determine future information requirements
New Zealand	KEIA-R Framework (Kaitiaki Environmental Impact Assessment and Reporting) (Dixon 2001)	Circular process involving (i) documentation of issues (ii) establishment of outcomes/needs/goals, (iii) development of methods and cultural indicators, (iv) undertaking of monitoring activities, (v) identify information and training needs, and (vi) future research opportunities.
New Zealand	Te Mauri Assessment tool (De Kepa Morgan 2014)	A decision making assessment tool template used additive scores and weightings across 4 dimensional aspects.

² Takiwa is the term for tribal area

3. Kati Thanda-Lake Eyre and The Arabana People

As a region, Kati Thanda-Lake Eyre is unique. It is Australia's largest salt lake, located 647 km north east of Adelaide in the state of South Australia. Its catchment includes areas in the states of Queensland, the Northern Territory, South Australia, and New South Wales. It is a drainage basin of over 1.2 million square kilometres and at 15.2 metres below sea level in its eastern perimeter, is Australia's lowest point. The Basin consists of two lakes: Lake Eyre North and Lake Eyre South and are connected by the Goyder Channel (Nursey-Bray 2013, Arid Lands NRM 2010).

The region experiences little rain, and floods on average only four times a century; although between 2006 and 2011 there have been many more rain events than usual. Named after the English explorer Edward John Eyre, the region is also the traditional land for the Arabana, Anangu Pitjantjatjara Yankunytjatjara and other Indigenous peoples who have inhabited the area for thousands of years. Today, there are about 57,000 people living in the basin working in pastoralism, tourism, mining and petroleum as well as township based work such as retail, education, medical and other services.

The Arabana people are an Indigenous group located within the centre of the Kati Thanda-Lake Eyre region. However, Arabana people also (due to colonisation) live across the entire continent, and live in Darwin, through to Adelaide respectively (see Figure 5 for details). Political leadership of the Arabana is vested within the Arabana Aboriginal Corporation's Board of Directors, most of whom live in Port Augusta, yet there are important loci of traditional leadership (based in Alice Springs) and social leadership (Darwin) which contribute to the contemporary Arabana identity.



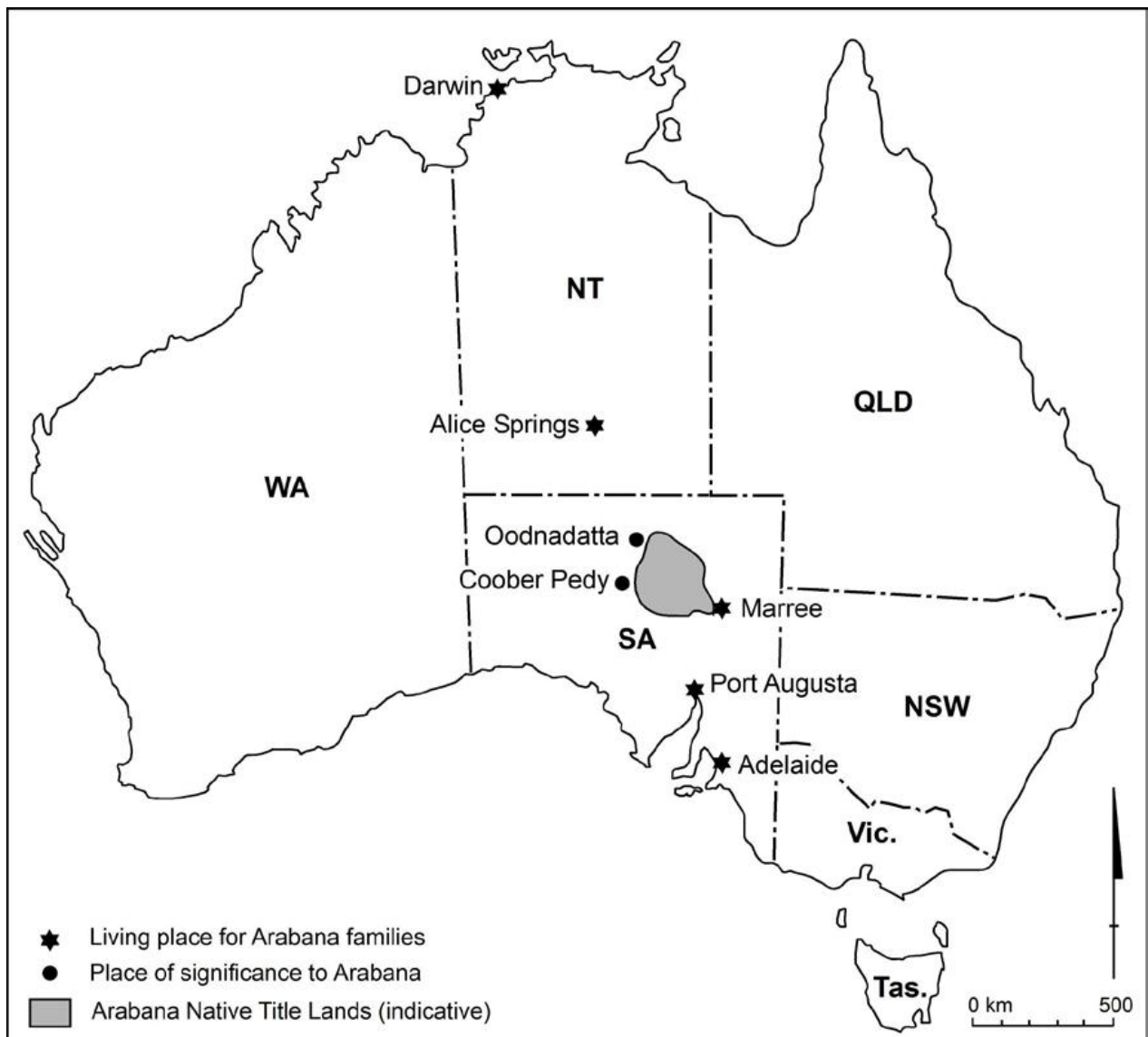


Figure 5: Arabana country and places Arabana people now live. (Reprinted with permission from Chris Crothers)

4. Method

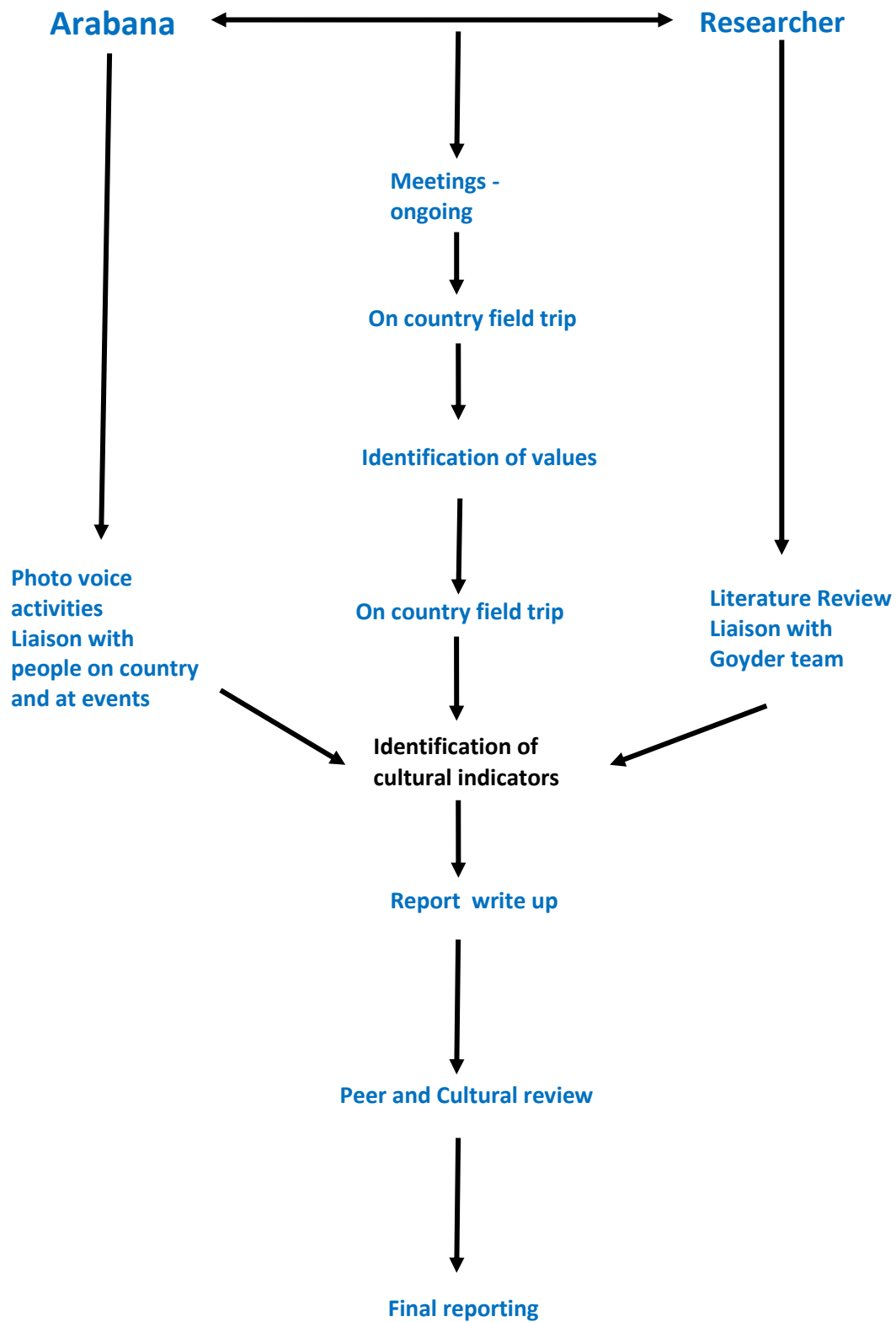
This project explicitly draws upon participatory methodologies that put Indigenous voice and action at the centre of the project and ensured that the research was collaborative at all stages. This action based, community based participatory research approach, drew on a range of literature discussing the dimensions of undertaking research with Indigenous peoples including (but not restricted to): Arbon (2008), Rigney (1999), Humphery (2000, 2001), Ivantiz (1999), Hughes (2000) Henderson et al. (2002), Hurley (2003), Jackson et al. (2012) and Smith (1999). It is consistent with current Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS 2000) research guidelines. In practice, a combination of participant observation, interviews and field work was used to gather information. Specifically, this approach drew on the notion of Indigenist research (Rigney 2009) and continues the research methodology that were jointly developed during a previous project on climate change adaptation (Nurse-Bray et al. 2013, 2015, Arbon and Rigney 2015).

Schensul, Schensul and Le Compte (1999, 91) define participant observation (PO) as 'the process of learning through exposure to or involvement in the day-to-day or routine activities of participants in the researcher setting.' It was used throughout this project when the researcher was spending time with Arabana people in more informal research contexts. The use of PO is appropriate in working with Indigenous communities as it enables researchers to check terms and activities with participants while in-situ, and to undertake day to day activities, via immersion in other people's lives (Gans 1999). This enables the researcher to observe events, places or others in ways that would not be appropriate or likely to be relayed in more formal interview/workshop type situations (Spradley 1980, Marshall and Rossman 1995). It thus allows researchers access to and insight into the participants own settings.

Figure 6 below highlights key facets of this approach in practice and embodies both theoretical intent to implement decolonist research principles, as well as find multiple ways to involve Arabana people equitably in the research process. For example, regular meetings were held throughout the project with the Chairman of the Arabana Association (Mr. Paul Tanner in the first half of the project and Mr. Aaron Stewart in the second). These meetings served to ensure that the leadership body were fully informed as to what was happening, when, where, how and why. The researcher also presented at two Directors meetings of the Arabana Aboriginal Corporation. Two field trips were conducted, one at the time of the Annual General Meeting in Marree for the Arabana Aboriginal Corporation (October 2014) and another in April 2015. Smaller meetings were held in Adelaide and Port Augusta with influential Arabana leaders over the year, and Arabana Professor, Veronica Arbon, assisted with documenting the views of Arabana people who lived in Darwin. Finally, both during a Rangelands Conference and on field trips to Marree, the researcher met with key elder Syd Strangways.

Guba and Lincoln's criteria were used to evaluate the project validity. These criteria are: (i) credibility, confidence in the 'truth' of the findings; (ii) transferability - showing that the findings have applicability in other contexts; (iii) dependability - showing that the findings are consistent and could be repeated; and (iv) confirmability, establishing degree of neutrality

Figure 6: Outline of Methodological Approach Taken



or the extent to which the findings of a study are shaped by the respondents and not researcher bias, motivation, or interest (Guba and Lincoln 1985). This took the form of an extended cultural review process which meant that this report was presented to the Arabana Board of Directors, as well as key individuals who reviewed the findings with the researcher, page-by-page, to ensure the cultural validity and accuracy of the themes and ideas represented in the text. This is consistent with a commitment to the democratisation of knowledge inherent in adopting Indigenist research principles (Funtowicz and Ravetz 1996), and with putting Indigenous people at the 'heart' of the project (Arbon and Rigney 2015).

Arabana people were also employed on a short-term basis to be cultural liaison and research officers. Arabana people helped in escorting the researcher to sites, and recording and providing information about water values and indicators. In this way, despite the short-term nature of the project and limited funding, Arabana people were able to be involved in discrete but productive ways. This process also allowed the researcher to involve Arabana to set some direction within the framework of the project overall.

Photovoice was also trialled. In this case a camera was given to two Arabana people (Sam Stewart and Jody Warren) to report on and record information about various water sites during the research period. Jody Warren also agreed to paint the original landscape artwork for the front cover which represents Arabana values and connection to water in the Kati Thanda-Lake Eyre region. Photovoice is a participatory action research method used to involve communities by getting them to photograph and verbally record their perception, and places. Originally a technique employed for health research, since 1994 it has evolved into a tool used to enhance community-based participatory research (CBPR) (Garziano, 2004). The advantage of photovoice is that the method facilitates the building of partnerships between the researcher and community but also, and importantly, amongst stakeholders and cultural groups, when the researcher is absent. Thus, Photovoice also creates equity within and during the research process and has been shown to uncover rich and descriptive information regarding the community and its members (Catalani and Minker, 2009).



Country near Finnis Springs (Photo: M Nursey-Bray)

For both the photovoice and field trips, the methods used to develop understanding of what indicators drew from Harmsworth's work with the Tangata whenua of the Motueka catchment, New Zealand, where he asked a series of questions. These questions were amended and were:

1. What indicators/signs did the Arabana use to identify changes in the state of their water sites?
2. Is the environment/site getting better or worse?
3. How do Arabana people measure and perceive changes in environmental health?
4. What indicators/signs, from an Arabana perspective, are used to assess, measure, and determine positive or negative change?
5. What suggestions did Arabana people have about the ongoing management of these sites?

The questions were answered on a site reporting sheet which was developed and completed for each site visited or discussed.

In terms of reporting on the actual detail about every site however, and presenting it within this report, there is some sensitivity around how Arabana information may be disseminated and used in the wider policy and governance domain. Hence in this context, while this project reports on the values, use, constructions of and indicators for water sites, it does not provide a detailed site register. This is consistent with the work undertaken by Rea et al. (2008) who also adopted a decolonist and Indigenist research approach in a cultural water values project with the Anmatyerr people of the Northern Territory. As she explains of their reporting:

'The aim was to give authority but not visibility to the extensive, rich and active Anmatyerr Law and knowledge about water in the same way other sectors command rights while maintaining privacy..... the research was therefore not to extract and document knowledge but to convey the properties of law and knowledge about the importance of kwaty for sustaining Anmatyerr culture in ways that other people could make sense of.' (Rea et al. 2008).

5. Cultural Values for Water

5.1. Introduction

A key output of this project was the documentation of water values in Arabana country. As Langton (2002) notes, there are many examples of early Indigenous association with water. For example, the Murray Darling region has been occupied for over 35 thousand years (Finn and Jackson 2011, Barber et al 2015,). Water sites have always been a source of food (Humphries 2007). Water also has a sacred quality (Jackson 2005) and a historical significance where water bodies traverse knowledge of country which is continuously reaffirmed and revitalised (Jackson 2005, Mooney and Tan 2012). For example, the Wagiman people of the Northern Territory stayed close to the river as they walked, fished and hunted game.

Barber and Jackson (2011, 32) in a case study of the Pilbara (where water resources are under increasing pressure from multiple uses) found that water is 'significant...as part of the creative legacy of the ancestral beings, as an elemental resource for life, as reflective and constitutive of group and individual identity by relating people across time and space and as a key focus of concerns about the ongoing effects of resource development'.

Nonetheless, while the incorporation of values is important it has 'tended to have been overlooked in a scientific process that leaves little room for different world views relating to nature' (Jackson 2008, 874). This often results in what Jackson terms a bipolar character in values determination, which creates either a reification of and also a case for excluding (via their separation from other values) Indigenous water values in water decision making. A study in the Daly River catchment area in the Northern Territory is a case that illustrates this point. During a 12 month planning exercise that sought to integrate Indigenous values into decisions about land use and water extraction the:

'Separate treatment of Indigenous and non-Indigenous social values compounded the reification of Aboriginal 'cultural values' which were perceived largely within the confines of a cultural heritage paradigm' (Jackson 2006, 19).

5.2. The Arabana: What is water?

Water is of great value and significance to the Arabana people and is central to their current and historical identity. Water is seen as essential to their survival in the region, representing a composite of values that is hugely socially and culturally significant. A key finding in this research is that Arabana do not compartmentalise or characterise different water systems according to their *source*, but rather by *site*. For example, despite consistent reiteration that this project was primarily focussed on *river* waters, Arabana people continued to talk about multiple kinds of water *sites*. It was often difficult to ascertain whether the Arabana were talking about river or spring based water as this is not a determining factor for them when establishing significance and values. As such, the term *water* itself needed some classification, before we could move on to develop an appreciation of the values around it. There was some debate between us all, when discussing water sites, until a mutual understanding of the term was achieved.

It is suggested in this research that this confusion stems from the fact that Arabana world views are underpinned by the notion of *country*, which reflects a seamless connection between people, land and waters, with each group being responsible for and holding knowledge for particular sites that are connected to a whole, so it is with water. Water is not split up into different aquatic ecosystems, or indeed legal jurisdictions, as is the case in Western scientific classification regimes, but understood as *one resource* (Kurtha) with *multiple sites* within the country. These types of sites are described and understood by the Arabana people as follows.

Mound Springs

Mound springs are common in Arabana country such as at Wabma-Gadayabu and elsewhere. Such springs do not just represent sites where Arabana people met and camped, but are also of great cultural significance as the loci of key dreaming stories. In Wabma-Gadayabu, these mound springs are the site of a battle (see inset for the story).

'For a long time the hunter dug, hunting the stranger snake. Didna bagana, long creek beds, are the digging paths of the hunter. He found the tunnel and at last the snake. He pulled it from the ground and killed it. Bithalina - the snake's writhings are the water movements in this spring (The Bubbler). The hunter prepared a large ground oven to prepare the snake. Dirga - the oven (Blanche Cup). After breaking it up to eat the hunter throw the snake's head away. Wabma-gadayabu - The Snakes Head (Hamilton Hill)' (DEWNR Interpretive Site Wabma - Gadayabu 2015)

Photo: Blanche Cup in foreground with Hamilton Hill at the back. M Nursey-Bray)



Catchments

Water is also referred to as 'catchments'. Initially this terminology will confuse Western scientists, because for the Arabana people the word means water that is literally 'caught' in soil indentations and pools. There may thus be thousands of little catchments in the region after a rain. During the first field trip for this project, there were not many of these catchments, but during the second, due to a recent rainfall, there were many.



Creeks and Waterholes

Water is also talked about in relation to ‘creeks’ (karla) or waterholes. These were quite often, but not always, connected to river sites. These features tended to be the most vegetated of the sites, as well as the most eroded. They tended to have trees around them and were, unlike many Arabana water sites quite visible from afar. They were larger in scale, and were the areas where Arabana people most often met and camped over longer periods of time. These were also the only sites where Arabana referred to fishing as an ongoing activity, and where species such as yellow belly and black brim were caught.



Popular water holes/creeks (Photo: M Nursey-Bray)



Constructed water sites

Water from man-made bores, pipes and wells also play a prominent role for Arabana people. It has been these constructed water sites that have been crucially important to how Arabana people relate to and visit their country today. For example, Finniss Springs, part of the land returned to Arabana as part of their native title determination, has recently had water returned to it via a dam, and it is in the process of negotiating receipt of water via a pipe diversion to Finniss from a BHP owned pipeline that crosses their country en-route to the Roxby Downs mine site.

The provision of water supply to Finniss in this way will facilitate returns to country by Arabana people, even if only to camp on holiday, and thus has enormous significance in progressing cultural re-vitalisation and ongoing identification with and connection to country. Other constructed water sites such as bores and wells also provide ongoing means for Arabana to access water on their country.



Well near Finniss Springs (Photo: M Nursey-Bray)

Soakages

Arabana people consistently referred to various sites as ‘soakages’ or finding a ‘soakage’. A soakage is an area where, by various signs, they will know that there is likely to be water underneath it. Arabana people recognised these various soakages by the colour of the soil, its viscosity, occasionally by the plants growing in and around it, and the extent to which the soil was ‘cracking’. These signs told Arabana people that water would be underneath, even though it was not visible to the naked eye. There are many areas where soakages exist, and they can be related to both spring and river systems. Arabana people relayed how knowledge of the soakages was one primary means by which they survived in the heat and when

travelling from place-to-place, whether traditionally, or more recently for railway and pastoral work.

Floodways

The Kati Thanda-Lake Eyre region is known to flood in times of rain. Floodways are one of the ways in which Arabana people characterise their water sites. Even when they do not have water, Arabana people know where to find them, (and avoid them!) at various times. As noted below, some cultural ceremony sites are in fact located near floodways. Arabana expressed concern about these sites because of climate change. Predicted increases in flood activity in their country could cause more erosion damaging the cultural values of the sites located near or adjacent to floodways..



Soakage and floodway, just north of Finnis (Photos: M Nursey-Bray)



Absent water

Part of how Arabana understand water is by its absence. In contemporary terms, this means that there are many sites that are understood as ‘water’ sites, but which at present have *no* water in them. There are two types of ‘absent’ sites – firstly, there are sites where living memory charts a change in water flow: ‘when I was growing up this used to flow over and gush down like waterfall, no more now...’ (Marree respondent 1 2015). The absence of water in these cases is usually attributed to current impacts such as mining or due to seasonal and climate variability.

The other type of ‘absent’ water sites are those regions which are culturally significant, but which are water sites from millennia past. For example, we were taken to ‘waterless’ sites which were areas that had numerous shell fossils and other fossils reflecting pre-existence of a marine environment. In these areas there were many cultural artefacts such as grinding stones, also indicating ‘long dure’ Arabana existence (Nursey-Bray et al. 2013). Hence, current important water sites for the Arabana also comprise of areas where water *was*, but is no longer, both in living and traditional memory.



Example of old sea bed with fossils (Photos: M Nursey-Bray)

6. Values

In talking about these water sites it was clear that Arabana value water in diverse ways, and not just for its 'presence'. These values are underpinned by an appreciation of water in a historical continuum, from millennia past, to colonisation, to today.

6.1 Water is life

'Water is our life, need to think about keeping it, looking after it, the waterholes is where we all met back in the day, where the uncles went camping, hunting, we used them to wash in, swim in sometimes, now all over, its drying up...we need to find ways of keeping water in country' (Arabana respondent 2, Marree, 2015).

As this quote highlights, first and foremost, water represents life for the Arabana and as such is valued for cultural, livelihood and social reasons. Or as one respondent noted 'People can not live in or go back to *dead* country - and animals to, including all the environment, needs water' (Arabana respondent, Marree 2015).

Further, water, in attracting animals, and being the sites where bush tucker could be accessed, were areas that people met, gathered and harvested for and washed in. All sites have various stories attached to them and are thus an important source of cultural connection for the Arabana, to each other and to their country.



'Water all dried up now' (Photo: M Nursey-Bray)

6.2. Survival

Water was represented as being of importance and value simply for survival purposes. Humans need water to survive. The value of water for survival was represented on a continuum, where Arabana people talked about how people used water in traditional times, in the 'old days' (historical time), and how even today, knowing where water was, how to access it, how to manage and protect it is an ongoing worry and pre-occupation. This is unsurprising given the Kati Thanda- Lake Eyre region is one of high rainfall variability and is an extremely arid and extreme environment. Burke and Wills indeed, famously lost their lives in this region, and it is said, partly due to the fact they decried the local Indigenous knowledge about how to find water.

However, Arabana people also talk about how important water is for the survival of species, the plants and animals that are found in the region, particularly species of cultural significance such as the Perenti lizard and many other reptiles. Many Arabana talked about various plants and animals that are no longer found at various water sites. This again represents a discourse of absence, and how the lack of water or changes to its historical availability also affected the survival of habitats, ecosystems and species. In recent years, Arabana people also noted a change in the density of introduced species such as rabbits in these areas.

'Water means life for the animals, vegetation and if you wanted to live out on country: survival. One needs water. Also, if you wanted to regrow local vegetation you need water to get them going' (Arabana respondent 5, Darwin, 2015).

'As kids, if we could not get water to drink we used to use the salt bush - you know like the sheep - squeeze it out to get the water. Even though there must be moisture around for the saltbush to grow' (Arabana respondent 3, Darwin, 2015).

'Water is fundamental to existence of all things. Arabana depend on rain, springs, soakages and rock holes for water'. (Arabana respondent 11, Marree 2015).

'Water is like the sun - it is the essence of life. Water to the Arabana should be seen as critical to the country and is sustaining to that country. There must always be an abundant supply to Arabana lands as it is a giver of life to country and all that exists in it' (Arabana respondent 15, Alice Springs 2015).

6.3. Access - Site Knowledge

Knowledge about how to access water sites is an important and active value. Knowing where the sites are, how to access the water (i.e. via soakages), and being able to thus survive in their country today is important to the Arabana. Being able to remember and keep the stories for these sites is treasured and respected: 'We also swam and picnicked at the rock pools in Callana Station. There is rock art there as well.' (Arabana respondent 1, Darwin 2015)

Keeping this knowledge also means Arabana people can continue their traditions of visiting, and enjoying these sites as they have done for millennia. This was clearly evident in field trips where Arabana elders and parents showed Arabana youth and children sites they had not been to before and shared their knowledge about these sites – past and present.

What they looked like in the past, what kinds of changes they had experience, what types of flora and fauna to expect there were all discussed and relayed to the younger people present on the field trips. Knowledge about how to access water sites is a value that has been fractured historically by the relocation of Arabana from their land, as a result of colonisation.

Thus, part of ongoing cultural expression for the Arabana is ensuring ongoing access to their water sites so this knowledge continues. This knowledge represents a real skill because most water sites in Arabana country are invisible to other eyes. Being able to read the landscape so it is possible to find water takes time and requires the application of detailed observational capacity and great learning at local scales.

Having rights to access water was also raised often as an important value, as expressed in the following quotes:

'We worry about our water being pumped out for mines - we need water rights. We need to reconnect to country, water is central'. (Arabana respondent 3, Darwin 2015).

'The protection of water rights is paramount to Arabana country and her people. Because if there is no proper rights and management of regulatory protocols in place for the usage of water, particularly the great artesian basin - then we are lost. If water is sourced willy nilly by proponents for developments then this could have an adverse impact on the survival of Arabana country in its natural form' (Arabana respondent 10, Marree 2015).



'It's just over there'...Arabana see and know how to access water in this landscape
(Photo: M Nursey-Bray)

6.4. History

An interesting dimension of the Arabana relationship to water is the way it has shaped their history and drives current negotiations with other stakeholders such as the mining industry. The history of the Ghan railway or pastoralism in the region for instance, is for Arabana, an example of their recent historical interaction with water, and is marked by Arabana knowledge of where to find and access it. Field trips always comprised being taken to at least one railway siding, and the water sites nearby.

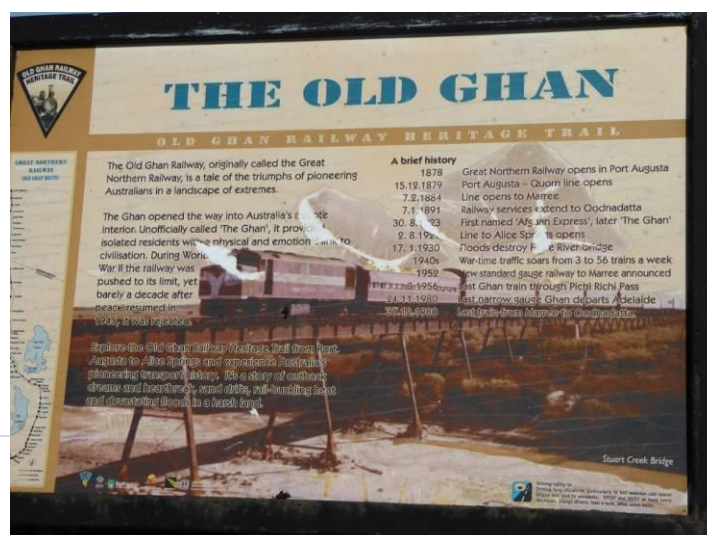
A lack of water resulted in the closure of Finnis Springs, a pastoral station, inclusive of a small mission on Arabana country. This resulted in many Arabana people having to move from their country to live elsewhere. As part of their Native Title Determination, Finnis Springs was returned to the Arabana in 2013 in the form of a ninety-nine year long lease and ongoing negotiation with mining companies has resulted in discussions for a pipeline to be installed in Finnis, giving Arabana access to water, enabling them to return to and start living on country again.

Sites around Finnis Yard, especially various springs, brought back fond memories of camping with families, and enjoying water sites on hot days. Water always becomes the springboard for discussion of other dimensions of culture, memory and familial history hence it is not only of historical value in itself, but a connector to many other expressions of Arabana identity.

'Conrad Springs was our swimming hole - we used to holiday there with Uncle Syd and Aunty Eve. The water hole had a sand bridge. The water was very deep on one side and shallow on the other. Dad nearly drowned there one time and had to be 'saved' (Arabana respondent 1, Darwin 2015).

'The Frome River was also a swimming place when or after it rained heavily.' (Arabana respondent 2, Darwin, 2015).

'We used to go out to the Bubbler - an important place where we could see the snake - to get wet in the water - the Bubbler was much stronger when we were kids in the 19040s. We also swam in a permanent waterhole on Muloorina Station as a part of the school' (Arabana respondent 3, Darwin, 2015).



6.5. Cultural Identity and Resilience

Arabana people consistently talked about a deep connection to their country, part of this connection derives from their intimate relationship with water. The Mound Springs in particular are foci of various cultural stories and hence identity, but overall, any waterhole or water site is significant as it represents a site that enables survival in a very difficult environment. A mound spring represents cultural and familial connection and also highlights how, as Arabana people moved across and over their lands, they were able to survive.

These sites now also represent the historical movements (for work and resulting from colonial dispersal) of Arabana people and reflective of their resilience in this period. For example, many Arabana men worked on the railway and on the pastoral stations, and are proud of the ways in which they could recognise soakages, and ensure that wherever it was they worked on country, they could still find water. The ways in which engagement with water sites has been transformed over time in line with the intense pressures on Arabana people caused by colonisation, also charts how Arabana people have adapted over time to the impact of colonisation, and the resilience and flexibility with which they faced this challenge to their culture.

'Our great grand mother belonged to a family of rainmakers - there are important stories of the Arabana around this matter,' (Arabana respondent 1, Darwin 2015).

'We know of stories where our old people would go out and catch fish 'yellow bellies' and others to eat,' (Arabana respondent 6, Marree 2015).

'There is also a story about fish that we connect it through our grandmother that goes up and across the Neales,' (Arabana respondent 2, Darwin 2015).

'All of this has to be protected as recognition of Native Titles is nothing without such matters around water resources being protected,' (Arabana respondent 4, Darwin 2015).

'All rivers and springs have sacred sites that relate to ancient stories. Arabana need funds to map out completely a full site mapping exercise' (Arabana respondent 8, Port Augusta 2015).



Revisiting water sites is a big part of how Arabana people stay connected to their country and important areas, enabling collection of information about each site(Photo: M Nursey-Bray)

6.6 Variability and change

This study confirmed Gibbs' (2010) finding that variability is part of how water is valued in this region. Arabana people often referred to the variability of and quantity of water, and how its very unpredictability heightened importance in their cosmological and empirical relation to the country. Very few, if any, water sites in Arabana country are consistent in their flow, quantity, presence, species assemblages or quality. Part of the connection Arabana people have with water is thus derived from charting this variability, moving from place to place on a regular basis so they always know what is happening in each site.

Today, this does not happen as often, and yet during field trips, Arabana people were always comparing the condition of the site in relation to what it used to be like or in to their last visit. Sites are hence never static areas, but complex composites of what they were and have become. However, the variability of the climatic and hydrological factors in the region mean that Arabana people often accept changes to sites as part of natural variability.



Example of a site which had recently had water and is typical of the variability experienced by the Arabana in relation to their sites (Photo: M Nursey-Bray)

6.7. Control

Implicit in many conversations with different Arabana people, was the ongoing lack of control people felt they had over the management of water in their country. *Having* control was valued. For example, on one of the field days, we visited a water site on Arabana land which had stray cattle, illegally using and trampling an important water hole. As part of their native title agreement, Arabana people are not permitted to run cattle themselves, yet they have limited control over stopping the trespass of these cows on their own property.

Table 2 sums up some of the worries about and ways in which Arabana people conceptualise and talk about water in the context of valuing control over their water sites. In many ways, this value is an evolving one and a good example of where Arabana are seeking ways to re-insert themselves into discussions about water management, so their access to and control over it can be reconfigured and their contribution and values about it acknowledged.



Camp Site in Finnis (Photo: M Nursey-Bray)

Access	'We're not getting the rain we did before. Lots of places grandfather could dig for soaks, could get them nearly everywhere. I think if we did that now wouldn't find it down there, quite easy them days, very lack of water now, don't get water now (William Creek Respondent)
Survival	'Costs fuel too to go out and get a roo – can't afford it - the rain cycle not happening any more. We haven't had rain for 7-8 months supposed to have summer rain and we didn't have it. A constant worry - where is it leading into? Where is it taking us? How will people survive without water when the tanks run out? Can't afford to buy in water here' (Oodnadatta respondent).
Mining	'Probably a lot more to do with the mining – the water they taking out - I have seen a little bit and hearing from Mum how much water was in Coward Springs in her day compared to what it is now'(Alice Springs respondent).
Tradition/history	'We could find water in soakages in old days – that's what we grew up on - nowadays hard to find water even in those soakages. That kept us alive then! What a marvellous job the old people done! We done hard yakka like the old people then, we started off with nothing. Everything done special way. Old people prepared for everything had to work in with the land, the weather, the climate and we had watering points, bores, water holes, the rain was far apart, so we'd go from spring to spring - happen no more, water going...' (Marree respondent).
Change	'We worry as we got mound springs up north and water levels dropping just like the bubbler that's a big worry and cos of that our water quality is not good either. We used to drink that water but no more. If you go to Dalhousie can't use that either. Bit further out it's pure spring water. You can drink it it's just beautiful. Water is a big thing in this arid area' (Oodnadatta respondent).
Change to vegetation	'In the last 25 years, like mobs of water are drying up earlier and quicker and vegetation around it is starting to die off- with the water dries quicker than it used to. Rainfall changed – we used to get mobs of good rains here – last good rain last year February then little rains after that, used to get a lot of rain around here' (Macumba Respondent). 'When we used to go to creek and get spring onions out, and used to eat all those berries, the wild tomato – you see them sometime now but used to be thick eh, and those poppas we used to step on them eh. No more. And the trees are not really shady now eh, they are starting to die off, mulla – mulgas going, used to be thick but no these here now you can look straight through them' (Marree respondent).

Table 2: Exemplary quotes reflecting concerns over control of/access to/changes in water on country

7. Cultural Indicators and the Arabana: the ‘signs’

Q:How can you tell when a site is in good condition?

A: When it is visited or cared for - cleaned. Stories are known. The smell and taste of water. Vegetation is healthy.... (Arabana respondent 1, Marree, 2015).

As described earlier, Arabana people are constantly visiting and assessing the conditions of their water sites although it is not possible anymore for all sites to be visited in any one year (a few of the sites we visited had not been accessed for years). Over time, Arabana people have developed a series of ways in which they assess the health of those sites by what they termed the ‘signs’ and which below for project consistency are called indicators. The idea of health here is important, again, unlike Western classification systems, cultural and ecological indicators are not separated but woven together.

However, from the range of indicators below, it is clear there is complementarity between how Arabana construct site health with how science assesses ecological condition.



Viewing a water site: young Arabana learn about the site by being brought to see them and learn about their value and history over time (Photo: M Nursey-Bray)

Cultural monitoring is based on long-term collective observation, is qualitative and subjective yet also offers fine scale detail about site condition. Based on the fieldwork and interviews with Arabana people, a range of indicators are presented below. While these indicators are specific to Arabana country they are presented as a framework for cultural assessment, which could be used LEB wide, but added to and amended as and according to each individual Aboriginal group within the basin.

7.1. Water Indicators

Water itself is an indicator for the Arabana. Given its variability, it is always of intense interest to Arabana as to how much has been present, and when the site in question had most recently experienced a rainfall event. The practice of observing how recent a water event had been was common practice every time we visited a site, and speaks to the importance of understanding variability in this region; the extent of time in between ‘drinks’ also told the Arabana what to expect in relation to species composition, number and presence.

Arabana people charted the presence of water via: its colour; the staining of the soil; and what the colour and extent of ‘wetness’ could reveal how long ago and what amount of water had been present. The amount of water present was very important. Arabana people used comparisons of site state from the last time they had seen it as a marker to understand its current health and continually reflected on the difference between the state of sites over time, rather than between physically comparative but geographically differentiated sites.

The colour of water was also an important part of interpreting the site. At one site the colour of the water was referred to as ‘the colour of a lovely cup of tea but without milk’. Water would be characterised according to its clarity or murkiness, and its colour, ranging from light blue to deep red. These signs also told the Arabana people about the condition and quality of the water. Levels of salinity were also used as an indicator, and were tested by taste, and also by observing the colour of the soil adjacent to the sites (i.e. white crust).

How and when the water moved was also an indicator. For example, the level of flow or alternatively stagnation were good hints for the Arabana people as to whether the site was healthy or not. In one instance, algae was present in the Bubbler, a key Arabana spring and cultural site, and this was seen as a sign that something was wrong with the site and indicated recent external disturbance to the site. This was especially upsetting, given the ‘bubble’ in the water is actually the sign of the presence of ancestors, so its diminishment, is deeply significant. In other sites, the lack of water flow, or lack of ‘staining’, showed that water had not been replenished or refreshed for some time.

Whether or not the site was subject to flooding was also an indicator that Arabana people used to assess site condition. This would in-turn determine decisions about when and where to camp near such sites, and also culturally, which ceremonies to enact in certain places.



Example of algae (above) and colour used as signs by Arabana to assess site health
(Photo: M Nursey-Bray)





Example of soil 'wetness' by which Arabana assess quantity, timing and impact of water on various sites (Photo: M Nursey-Bray)

7.2. Faunal Indicators

Arabana people recognised or described the condition of their sites via the existence of various fauna. In particular, for the Arabana people, they are particularly focussed on the presence (or not) of birds, and various reptiles. Across Arabana country this includes the Perenti (although it is only found up in the northern part of their country), the kapiirri, a smaller goanna of southern areas, and many smaller lizards and geckos.

The finch (Katyapara) is of particular significance to the Arabana, and features as a symbol in representations of their culture. For Arabana people, the presence of finches represented not just ecological but cultural health of a water site. Other birds such as cockatoos, galahs, brolgas, willy wag tails (culturally a messenger bird) were also a good ‘sign’.

Other indicators related to the number of each species present, whether or not there were nests or eggs present, the degree and range of various scats evident, as well as the diversity of species found. These signs all tell the Arabana not only whether the site is in good condition, but also whether or not it has recently experienced water.



Nests and a small lizard found around water sites when on field trips (Photo: M Nursey-Bray)



The Perentie has cultural significance for the Arabana (Photo: Google Images)



This Lizard just missed getting run over (Photo: M Nursey-Bray)

The Willy Wag Tail is a messenger bird (Photo: M Nursey-Bray)



Example of a finch (Photo: Google Images)

7.3. Vegetative Indicators

Types of grass and other species of vegetation were used by Arabana not to primarily indicate site health, but rather to locate a site. Interestingly, vegetation indicates the *existence* of water, but not necessarily its *health*. For example, it was common to be on a field trip, and to look out and see ‘nothing’, but a few bushes only to find Arabana people pointing to a site ‘just over there’. A short walk always revealed water sites of various kinds behind the vegetation.

Vegetative assemblages tended to be characterised by having one or two trees, with various shrubs, mainly types of salt and blue bush, beneath them. There is very little ground cover in these sites. In some sites, small (and introduced) species are spread across the soakage areas. Arabana people harvested some of these for making tea/medicine and discussed how water sites were also sites of medicine trees that are of very high cultural important.

The presence of algae in small pools often signalled the site had not received water or flow for some time. Arabana people also judged and assessed the extent to which vegetation was trampled, and used this as an indication of site abuse by cattle.



Known as ‘Poppers’ – their abundance and flowering seasons tell Arabana about the health of the site and also climatic changes over time (Photo: M Nursey-Bray)



Examples of different plants and their characteristics e.g. flowering, and density tell Arabana how much water is there and how recently (Photo: Jody Warren)



7.4. Soil/Ground Indicators

The colour, condition, type and saturation of soil, as well as evidence of salinity and the extent of erosion are all further ways that Arabana people will read the signs of a site. For example, the presence of soakages, and whether or not they had water in them was signalled by the various size and shape of cracking in different soils. Wide cracking patterns with large cracks indicated drier sites than other smaller closer patterns.

Different soil colours tell Arabana people about the extent to which water had been absorbed and importantly how deep they might have to dig to access that resource. Deeper coloured stains indicated water was just below the surface and a lighter shade meant that some extra digging was required. Again, 'absence' of this indicator showed where a soakage or site had been a good water site and was no more. On a few occasions, Arabana people went to a site and found it had 'dried-up'.

Erosion was interpreted in many river water sites as being a positive sign/indicator. Where erosion was manifest and recent, this meant that water had been recently present. On the other-hand, where there was evidence of erosion in floodway sites, this was of concern as it may have implications for cultural site management. There is one site, traditionally a men's ceremony site, that was of particular concern where Arabana people, by observing the extent of erosion, could assess the level of damage to this area.

In many ways, these soil indicators are amongst the most important, for they ensure that Arabana people can read the country and access water underground that is not otherwise visible; a skill that is very important for survival in this region.



Salt crusts around various springs and water sites are signs indicating both salinity but also the fact the site is drying up. (Photo: M Nursey-Bray)

Examples of
different soil
cracking and colours
at different water
sites (Photo: M
Nursey-Bray)



7.5. Knowledge Indicators

Ongoing engagement with the Arabana people reveals a deep awareness of and application of experiential historical knowledge about country and what has happened to it. This adds another layer to traditional knowledge about country, and is used in many forms as a way by which Arabana people understand, refer to and assess the condition of their water sites.

For example, Arabana people do not just use what is visible to the naked eye to monitor the site condition of water sites on their country over time. Another way in which they judge site condition is via application of ongoing cultural/historical knowledge about that site and in turn their knowledge about the weather and climate events for that region. In their way, this can be described as what is in the ‘mind’s eye’.

This is often a collective knowledge map of incredible detail which is collectively disseminated amongst their people. For example, by communicating amongst themselves the recent history of rain events or other forms of water input/extraction Arabana people better understand and interpret why a site looks like it does. Constant family or cultural group visits to country over many years, builds collective understanding of where water sites are and their condition as does ongoing communication via Facebook.

Given the variability of water events in this region and the fact that when they occur they do not all occur in the same location, this is powerful knowledge. For example, one person may have recently spent time with a relative who is working on Anna Creek, in the northern part of Arabana Country who will relay weather and site information to another person. In-turn, when that person visits that site, he/she will then apply that knowledge to assist in understanding what have been the recent pressures and impacts on it. Similarly, communications about the extent and state of water extraction related to the mining industry is ongoing; discussed, noted and incorporated into current understandings of various water sites.

Finally, traditional ecological knowledge about sites, or series of sites and historical memories of generational use of those sites underpin Arabana assessment of water. Drawing on historical and traditional knowledge then about climate and water is an important part of the process Arabana people use to assess water sites and their condition.

An area of Arabana country and nearby water sites where cows are grazing
(Photo: M Nursey-Bray)





Sites like this railway sidings and creek nearby hold immense cultural significance to the Arabana (Photo: M Nursey-Bray)

7.6. Useability Indicators

When visiting water sites, it emerged that an important dimension of their relative health for the Arabana relates to its ‘useability’. Arabana country is located in the arid desert and thus water’s main characteristic or value is in its capacity to be used. In this sense, Arabana people assess whether the site has ‘drinkability’, whether it is useful for 'hydrating stock', or good for 'washing'. Taste is often used to determine levels of salinity, and useability.

Arabana also assess a water site as to its capacity to be used for camping, ceremony or family visits. Devonport Springs, Finnis Springs, Kurdimurka are all examples of very important sites. Historical knowledge is very important for this indicator and is assessed based on past use such as for the building of the old Ghan railway, for pastoralism or mining. Arabana people would often relay stories of their employment on the Ghan Railway or of experience working in Anna Creek or other pastoral stations across the region and the ways in which the water sites were used. The past or present use of the site in this sense will also inform Arabana assessment of a site.



Boiling the Billy at Kurdimurka (Photo: M Nursey-Bray)

7.8. Pressure Indicators

A key question for the Arabana, when out assessing current condition of water sites, is the extent to which that condition is a result of external pressures, characterised here as 'pressure' indicators. Identified pressures included climate change, mining, loss of traditional knowledge via loss of elders or people moving away from country and pastoralism.

When visiting sites, Arabana people reflect on how these pressures were visible to them as indicators of condition. For example, at some sites, Arabana people could see the signs of recent cattle movements. In one culturally important site, Arabana people discussed their concern that increasing and more intense flood waters, resulting from climate change would flood important men's sites and wash them away.

Time and again, mining was cited as a causal factor in the ongoing drying-up of streams and water holes:

'I think I am pretty certain the mining has affected our water – it was fine before, springs running and flowing all over the place, nowadays there is nothing and the pressure has gone as well – bubble another one we used to in the past we used to bubble so huge, the noise you could hear it from caward springs, where is that water?' (William Creek respondent).

Knowledge about the sites is also under threat as a result of Elders dying or being sick. Given there are only now a few Arabana individuals who can speak the language, and that many people now live away from these sites, ensuring ongoing stewardship of them, and maintenance of cultural knowledge is a valid and ongoing pressure indicator.

Finally, as demonstrated in previous work on climate change adaptation (Nurse-Bray et al. 2015), the Arabana people are very worried about and have observed significant changes to the climate over time.

These pressures provide contemporary platforms by which Arabana seek to understand and explain what is happening to their water sites today that threaten the values they hold for them. Every time Arabana people visit water sites, they observe these pressures. By applying these facets as indicators, Arabana people chart change in these systems over time, as well as identify or attribute their causes.



Cows are trampling water sites and many areas now hold wells/mining water infrastructure (above and below) (Photos: M Nursey-Bray)





Sites like this, now dried up are where Arabana families grew up: Arabana recall this site being 'overflowing like a waterfall in the old days' (Photo: M Nursey-Bray)



Sites like this, a traditional male ceremony site, are in danger of being washed away by floods (Photo: M Nursey-Bray)

8. Implications for assessment, Kati Thanda-Lake Eyre region.

The development of cultural indicators is a multiple stage process. These stages include: (i) development of project and trust relationships, role allocation; (ii) development of the cultural indicators; (iii) 'integration' of indicators with other types of indicators; (iv) implementation of monitoring systems using those indicators; and (v) evaluation of what those indicators reveal about site condition. This process implies a suite of skills and processes, not least the successful and appropriate involvement (not just engagement) of the relevant Indigenous group. The process also requires sensitive investigation of different knowledge systems and innovation in establishing ways to use that information productively alongside other types of knowledge systems.

Development and then application of cultural indicators is not a question of gathering Indigenous knowledge about sites, their location and characteristics, then incorporating and quantifying this information into existing Western classification systems. It is a process that will require additional investment and the ongoing involvement of the relevant Indigenous group in conducting their cultural monitoring, as they are the only ones: (a) likely to live in the region; and (b) to know it to the relevant extent.

This project while conducted over a relatively short period of time, nonetheless shows both the complexity and the utility of involving Indigenous groups into the development of water assessment processes. The development of and then implementation of cultural indicators as part of assessment processes will provide depth and detail that would not otherwise be achieved. There is scope to obtain fine scale data based on collective observation over time, and there is complementarity between scientific and cultural approaches to managing and assessing condition of country. However, whether or not, this means that it is possible to navigate a 'one model fits all' template is another question.

The discussion below provides some reflection on these questions and the implications of the findings from this project for: (i) future cultural engagement processes; (ii) development of indicator frameworks; and (iii) the potential for integration of a suite of indicators in future assessments. While the argument for integration is far from concrete, the case is made that this project yields strong potential for adaptive management, yielding insights into the importance of instigating rigorous processes of engagement and indicators development which could be applied anywhere, in any Indigenous context.

8.1. Implications for engagement

As outlined in the method section, this project was undertaken using decolonist and Indigenist research principles, that attempted, within the limitations of the project, to work with the Arabana people as co-researchers and acknowledged they are intellectual owners of cultural information about water sites in the region. As such, we developed a process of collaboration which builds on previous experience, but also helped build Arabana capacity to do the research and shared understanding about the nature and utility of that research. In working together, we also experienced some insights about how to conduct research in this area which are presented below.

In developing appropriate engagement in the first place, and in navigating knowledge exchange and transmission about sites, we found that language matters. For example, the terminology used about ‘indicators’ is confusing. As Turnhout et al. (2000) reinforce, even within the literature there is no clear definition of ecological indicators, so trying to define what we mean by cultural indicators is complicated. Current terminology refers to ‘indicators’, ‘criteria’, ‘parameters’, ‘quality’, etc. Moreover, ‘boundaries of science are not neutral anyway’ they are socially constructed and the result of boundary work (Gieryn 1995). Scientists have ‘truth claims’ (Jasanoff 1990) which can interfere with the promotion of integration and bridge building between boundaries in ways that can help translation of indicators to inform the science policy divide.

Indeed, it is not always the case, even when both parties are using the same terms, that the same thing is meant by them. In this case, proper engagement only started working once the researcher started to talk about ‘signs’ rather than indicators; understanding and ensuring language is not only appropriate but mutually understood is a crucial first step. In fact, development of mutual linguistic understandings can affect entire management regimes (see Nursey-Bray et al. 2010). To this end, this report has to as full an extent possible, tried to avoid Westernisation of terms, and hopefully been presented in such a way that is accessible to non-Western world views.

Another dimension of knowledge transmission, is that non Indigenous parties need to accept that not all knowledge will be provided for during cultural assessments nor in the development of indicators. Information about sites is not even available to all Indigenous owners of that country. This is because knowledge in Indigenous contexts is privileged, and access to it only through certain people and fora (Berkes 1999). The implication of this for field work and development of indicators is that knowledge about sites may have to be mediated and delivered through certain people and places irrespective of their scientific value or interest. Ongoing involvement of Indigenous peoples is crucial in the development of cultural indicators, especially as it is not possible or appropriate to have the same indicators for different groups.

Similarly, it is important to develop and build on existing knowledge protocols. Indigenous peoples are always very sensitive about intellectual appropriation of their knowledge. In applying and using cultural indicators, there would need to be clear conventions and

agreements in place about how that knowledge is used, why it is needed, and what benefit will accrue to Indigenous peoples that are involved.

Further, in each case, assessing sites will always be a sensitive negotiation. In the case of this work, it was decided not to deliver precise detail regarding each individual site although through the work of Sam Stuart and his father Deane Stuart, there does exist a GPS repository of Arabana sites. This is partly a function of the time given for this project, and also the reality that weather and timing meant fieldwork was limited to certain areas. Nonetheless, in all cases it is always important to ensure that the people being consulted are the appropriate individuals able to speak for country and can take you to particular sites. In various contexts, some sites may be gender based. This means only a male or female researcher can access it. In this project, the first field trip was led by Arabana men and the second by Arabana women. As a result, quite different information was obtained and different sites within the region visited, making the information richer in detail and perspective.

Making sure there is time and investment to access sites and involve the right people properly will yield much deeper outcomes over time. Acknowledging the time and effort Indigenous peoples invest in this process is thus as important as trying to work out how much 'institutional researcher' time should be costed (Jackson and Douglas 2015). What will the Indigenous group get out of it and why should they participate is an important question requiring an answer at all times. Will there be funds allocated to employing traditional owners to visit sites to help monitor it and develop indicators? What fora and means of participation will be available to Indigenous peoples to be part of the discussion about how to integrate the different assessments and indicator frameworks? Researchers are not expected to offer their time for nothing, so this is an important dimension to consider in future consultations on indicators across the region.



A pretty catchment in southern Arabana country (Photo: M Nursey-Bray)

In sum, the process of applying cultural indicators in assessments is about embedding processes for thinking about engagement for the purposes of: (i) relationship building; (ii) for development of indicators; and (iii) ongoing monitoring over time. Further, in this particular context, and looking to the development of cultural indicators relevant to other groups, the development of and understanding about Arabana values and indicators for water cannot be used as a surrogate for all Indigenous peoples of the Kati-Thanda-Lake Eyre region. In each case, an individual consultation needs to be undertaken. The use of any type of generic application can create a number of challenges in that indicators chosen may not be applicable across all regions (Reed et al. 2006).

However, while it is not possible to determine a generic approach for each group, it is possible to develop some key steps and processes for engagement which can be usefully applied across all peoples of the Kati Thanda region. Karnjala et al. (2004), in a review of the literature, suggest a range of principles that could be embedded in ongoing research processes which emphasise meaningfully involving Aboriginal people as participants in the decision making process. This include committing to the protection of sensitive and confidential information, drawing upon the strengths of both western and aboriginal world views to management approaches, and being adaptable to a diversity of cultures, ecosystems and resource management situations.

Based on the literature and outcomes from this research we propose a staged approach to develop cultural indicators for LEB assessments as suggested below.



Chairman Aaron Stuart contemplating business at the Arabana AGM 2014
(Photo: M Nursey-Bray)

Table 3: Suggested Staged Co-Engagement Process for development of cultural indicators

Stage	Steps	Comment
One: Establishment Phase	<ol style="list-style-type: none"> 1. Identify cultural group and researchers 2. Establish who are the key people are in each instance 3. Meet to agree on terms of engagement with each other, including goals, level of resourcing, timelines and protocols about knowledge use, access, dissemination, publication, ownership and storage 4. Develop plan of action/methodologies and role of each party 5. Identify cultural mentor/s to work more closely with researchers 	<p>This is one of the most important stages of developing an approach that is truly collaborative.</p> <p>It may take a lot of time proportionally to the time you have, but it is worth doing</p> <p>It is important to be clear and honest up front as to the parameters of the project, the extent to which you can collaborate and how you can do that equitably within the budget constraints and deadlines</p>
Stage 2: Development	<p>Undertake the data collection</p> <p>This can be done via: -</p> <ul style="list-style-type: none"> - Field trips out on country - Semi structured interviews - Photovoice - Oral Histories - Focus groups - Workshops <p>This phase can also include training in research methods or cultural issues</p>	<p>Where possible as much of this work needs to be facilitated and in some cases by individuals within that cultural group, in conjunction with researcher.</p> <p>As such training in specific methods will help build capacity, mutual trust and offer the potential for cultural partners to undertake ongoing cultural monitoring/assessments into the future</p>
Stage 3: Assessing Results	<ul style="list-style-type: none"> - Analyse information collected - Work together to develop agreed suite of cultural indicators - Share key findings and structure of report/outputs to cultural and research groups - Make sure that output reflects cultural views and indicators are appropriate by instituting cultural as well as scientific review process - Make agreements about which knowledge can be public and which remains protected 	<p>This stage is also one of the most important, as it will reinforce researcher commitment to co-research principles, and ensure that at all stages of the research, that Indigenous peoples are involved as co-owners and participants in the research process.</p> <p>Cultural Review of the document as well as the information will ensure a democratisation of process that that does not just rely on academic peer review</p>
Stage 4: Follow up	<ul style="list-style-type: none"> - Find ways to keep connection with the each other. These may include: - development of collaborative ways to disseminate project outputs to wider publics (art 	<p>Indigenous peoples too often are used as subjects of research, and this is the stage when ‘benefits’ for researchers will accrue, in the form of publications, invitations to</p>

	<p>exhibition, flyers, on country trip)</p> <ul style="list-style-type: none"> - develop joint funding applications to get ongoing cultural monitoring -work together to co-present at conferences - develop co-authorship of publications 	<p>speak at conferences and future grants.</p> <p>Indigenous peoples need to be involved in this stage also, again reinforcing commitment to co-research principles.</p>
Ongoing	<ul style="list-style-type: none"> - Ongoing meetings/discussions with all key parties - Ongoing cultural documentation/literature reviews 	



Arabana Country: Artwork by Jody Warren

8.2. Implications for development of cultural indicators

Ensuring effective engagement is the first step in building cultural indicator frameworks as it provides the groundwork and good-will needed to progress documentation of the indicators. The next step is the development of the cultural indicators for that cultural group. In this case, analysis of the ways in which the Arabana people typify the ‘signs’ or indicators by which they assess water sites, suggests some key elements and insights for consideration in the development of any cultural indicators framework for the Kati Thanda –Lake Eyre region as a whole.

Firstly, indicators of condition for the Arabana are not simply current expressions of condition, but also comprise or occur on a historical continuum. Sites that may appear waterless for example, may be understood as water sites, and an historical indicator is not necessarily visible. However, sites can also be an expression of collective memory, traditional values and also anticipated future use. They are also physical manifestations of the changes wrought and inflicted upon Indigenous peoples by colonisation.

There is a clear relationship between the values ascribed to water and the signs Arabana people use to assess site condition. For example, the history of a site is an important value to the Arabana. Thus, an important sign of its condition is the level of historical knowledge about that site. We found that sites with specific cultural value reinforced Arabana identity were assessed as cultural indicators, including level of stories about that site, and whether people had visited or used it in the recent or traditional past.

Leading on from this we also found that Arabana people when assessing sites, tended to prioritise one indicator over another. Hence, in a site known to have significant cultural value, that indicator was used over and above others to ascertain site health. For example, if the site was known to be habitat for a certain finch, then it was the sighting of that finch that carried greater weight, even if there were many other birds present. Or if it was conventionally a site used for obtaining water for drinking, then the useability and quantity of the water was assessed as the primary indicator over and above others, such as vegetation or wildlife present. This doesn’t mean that other indicators weren’t used at the same time, but that particular indicators were given priority over others in assessing individual sites.

Further, the Arabana world view that constructs ecological domains as ‘country’, an integrated seamless whole means that the scientific differentiation of habitats (i.e. aquatic versus arid ecosystems), let alone between types of water systems (river, creek), is not complementary to Indigenous ways of seeing and doing (Howitt 2001). As described earlier, Arabana have many conceptualisations of water sites all of which are *in country* which mean that it is hard to create or have discussions about cultural indicators for water as a separate element, or *just for the river systems*. In effect, Arabana do not differentiate between them, and thus do not conceive of water management for the river systems *only*; management is understood as being country based, and therefore applies across all water types, uses and systems.

Nonetheless, in many ways, there is complementarity between how Arabana characterise the indicators for country and Western scientific ones. This is primarily via their application or differentiation of condition of water, soil, vegetation and fauna which offer opportunities to value add to each other's knowledge. This complementarity and potential to build an overall indicator system that provides local and regional, scientific and cultural, and precise and yet historical information is developed further in Table 4 . This shows that the differences in approach enable an overall deeper information base to be developed. Also, it shows that information using both approaches can be collected at local to catchment-wide scales, combine top down and bottom up approaches and ensures ongoing cost effective assessment over time. Involving local groups moreover means that ongoing knowledge, which has been held often for millennia can be usefully incorporated in respectful ways.

Characteristics of scientific Indicators	Characteristics of cultural Indicators
Robust and objective	Qualitative and subjective
Uses methods and equipment that are well tested and reviewed.	Cultural methods rely on collective skills/knowledge held by cultural group
Requires a high degree of professional expertise and experience	Based to a high degree on acquiring in-depth knowledge of a local environment
Measures precise changes to river and stream health over time	Require a high degree of consistency in the assessment in order to measure and detect long-term changes to an environment.
Relatively costly	Cost effective
Often over wider whole catchments	Often very site specific
Top down	Bottom up

Table 4: Differences between scientific and cultural indicators

However, this does not mean that it is possible to create generic templates or indicators that will work across all cultural groups and ecosystems across the LEB. In reality, given the diversity inherent in knowledge systems, it is unlikely that a ‘one size fits all’ template for cultural indicators to apply across all Indigenous groups in the region can be designed. It may be possible to apply a process such as we have built in this project that will facilitate integration of knowledge and build capacity within LEBRA processes. Table 5 below presents a suggested Cultural Water Indicators Schemata that can be used across all groups to develop detailed information sets, that could also, if worked through with scientific indicators build a robust understanding of the condition of water systems in the Kati Thanda-Lake Eyre region.

Table 5: Cultural Water Indicators Schemata, Kati Thanda-Lake Eyre

Indicator	Criteria	Description	Ranking
Water	<ul style="list-style-type: none"> -What type of water body it is -Whether it is present or absent -Quantity -Quality -Flow -Colour -Taste -Known variability of site -Location - History of water -Other 	This section to be filled in as and according to the site and each group recording it.	To be determined but could be 1 – 5 where 5 is excellent and 1 is very poor condition
Flora	<ul style="list-style-type: none"> -Number of species -Type of species -Whether species is in flower -Density of leaf on the plant/bush -Existence//proportion of introduced to endemic species -Other 		
Fauna	<ul style="list-style-type: none"> -Number of species -Type of species -Presence of eggs -Presence of scats -Evidence of movement (i.e. prints, trodden vegetation) -Presence of smells -Cultural importance of species -History of presence of that species -Other 		
Soil	<ul style="list-style-type: none"> -Colour of soil -Colour of soil due to saturation -Extent of ‘water stain’ -Extent and type of cracking -Other 		
Knowledge	<ul style="list-style-type: none"> -Level of existing 		

	<p>traditional knowledge about that site</p> <ul style="list-style-type: none"> -Level of historical knowledge about that site -History of that site -Use of that site -Observed/known changes to that site -History of various indicators at that site -Other 		
Use	<ul style="list-style-type: none"> -Pastoral -Mining -Tourism -Cultural -Camping -Family times -Aspirational -Other 		
Pressure	<ul style="list-style-type: none"> -Climate change -Extraction -Pastoralism -Generational use -Resources -Loss of traditional knowledge -Loss of Elders - Disconnection of youth -Other 		
Other	<ul style="list-style-type: none"> -To be determined by group 		

9. Integration?: Finding ‘cultural fit’ in LEB Governance: the future of cultural condition assessment

Indigenous peoples have been managing complex problems within their territories for much longer than western society and they still hold valuable knowledge for dealing with complex societal problems (Turner et al. 2000, Posey, 2001). Such management approaches are less about producing high quality specialised knowledge that can be used to solve a ‘problem’, and more about bringing different knowledge systems and people together to improve a complex situation (Folke et al. 2005).

One aim of this project overall was to work on how to integrate various types of indicators to develop a broad assessment regime for the LEB rivers and other water sites; this section provides some reflection on whether or not this is possible. There are a number of factors that need to be taken into consideration when working out how to develop points of convergence between scientific and Aboriginal indicators for the region.

The focus on indicators itself could be argued to be based on false logic. It is hard to construct the perfect indicator, whether scientific or not, thus investing too much energy in trying to create one, or a set of indicators, in order to achieve ‘integration’ could be an inadequate response to the problem. Moreover, there is a danger in differentiating between cultural and other types of indicators, in that their application instantly demarcates and separates Indigenous involvement in other areas of interest. It also immediately positions the whole process of assessing condition within a Western epistemological frame. Separating cultural values and indicators then can marginalise Indigenous knowledge systems, and reduce them by incorporating them into what are essentially reductionist approaches to management (Davis 2006).

Understanding or interrogating the logic of monitoring is one of the first questions to consider: what is the point of developing cultural indicators? Is it to conduct ongoing cultural monitoring and evaluation of sites? Is it to achieve integration of Western and cultural indicators about sites and develop a baseline of information and ongoing opportunities of knowledge integration? Is integration understood as gathering Indigenous knowledge to add to Western repositories of knowledge? Or is it the building of spaces where knowledge can be pooled or shared, an opportunity inherent in future work in this area.

Secondly, the co-existence of both paradigms can create a management tension caused by the fact that each knowledge system operates in practice in entirely different ways, again highlighting that trying to integrate them may not be possible (Hoverman and Ayre 2012). In this context, it is important to recognise some of the differences and contours of each knowledge system: knowledge is not an accepted ‘truth’ but is in fact constituted differently in different cultural contexts. Western knowledge systems tend to be linear, sequential, and follow scientific principles, whereas Indigenous people’s knowledge systems are more circular and different knowledge systems operate concurrently and feedback within a community in various ways (Sillitoe et al. 2001, Croal and Darou 2002).

In the Western world, while access to knowledge is in reality mediated by power and resource constraints, it is theoretically 'open' to access by all and science is a 'common pool' resource (Ostrom 1990). Yet in an Aboriginal context, knowledge is distributed, held and maintained by different members of society and strictly adheres to various delineations which prescribe specific responsibilities in relation to that knowledge.

Another important difference between the two domains is the local nature of Indigenous knowledge and the global nature of Western scientific knowledge. This has obvious implications for integration of indicator frameworks. While the local emphasis is important to obtain community involvement and support in management, the prominence and dominance of Western science plays a crucial role, especially in the realm of obtaining funds and ongoing support. Too often, the community link to place along with the 'temporal and spatial elements of knowledge generation' lacks translation into policy and needs building into any management regimes (Adams 2004, 38), especially relevant to this case study as the Arabana live across such a wide spatial realm. It is also clear from this study, that current and historical knowledge held by Indigenous peoples needs acknowledging – what Barber et al. (2015) coin 'working knowledge' and which reflects the evolution of Indigenous knowledge systems today to include other types of knowledge as they live on and care for country..

'Integration' also implies the adopting or incorporation of Indigenous knowledge into current jurisdictional and institutional arrangements, but they may simply, not fit. This is partly due to the reality that Indigenous conceptions of country do not compartmentalise functions of management in the way that occurs under common law today. Key to respecting different knowledge domains is the embracing of the notion of country, which in Indigenous Australia is the term used to designate cultural affiliation to, responsibilities for and knowledge and use about an area of land (and waters if appropriate) to which a specific cultural group will belong. There is an indivisibility about country, where Indigenous peoples are themselves connected to it, are part of it, and there is also a seamless connection between all the elements of country.

(Photo: M Nursey-Bray)



It is important to note that essentially all the indicators described above reflect Arabana ways of understanding, and seeing whether country is healthy or not, not whether or not water sites are healthy. Given the variability of and aridness of the region, water is especially significant but it is only part of the whole. Focussing on water per se can assist in developing cultural awareness of the wider understanding and recognition of Aboriginal lores and knowledge systems enshrined within understanding of country and caring for it (Rea and Messner 2008). Other Aboriginal concepts such as Garma which describes the meeting of saltwater with freshwater, and highlights the potential for integrating knowledge systems and cultures (Yunupingu 1991, 1993).

Another complicating factor affecting how integration may be achieved relates to the different ways in which Indigenous peoples construct and assert their own governance systems. This is important given Indigenous peoples are not just claiming the right to exercise their own customary regimes, but asserting their right to be part of contemporary environmental governance structures. This is a complicated challenge and one overlain with the ongoing legacy of colonisation and Indigenous actions to reassert sovereignty and rights the world over.

Indigenous governance, is defined as ‘the evolving processes, relationships, institutions and structures by which a group of people or, community, organise themselves collectively to achieve the things that matter to them’ (Hunt and Smith 2006). In an Arabana context this describes: who has authority over what; agreed rules to ensure authority is exercised properly; how decisions are enforced; how individuals and groups negotiate rights and interests with others; and which arrangements will best enable them to achieve their goals. Analysis of international studies identifies four features that indicate strong and effective Indigenous governance: (1) power; (2) ownership and access to resources; (3) effective governing institutions and accountability; and (4) legitimacy and cultural match (Nurse-Bray and Jacobson 2014).

Another issue that affects Indigenous governance systems is the challenge presented by being able to ‘speak’ for country. This is particularly challenging when brought into Western governance institutions, such as membership of a reference or advisory committee. Indigenous peoples often worry about whether they are the right person to be speaking about the issue for that bit of country, and are often expected to be able to transmit knowledge in ways that would be conventionally acceptable and expected in Westerns frames of reference but not within an Aboriginal cultural frame. As such, it is likely that development of LEB wide cultural indicator frameworks will need to acknowledge how customary governance regimes operate, and work with them in order to ensure the best fit between scientific and cultural aspirations with a close eye on power.

Further, the fact that Indigenous governance systems are quite different has implications when considering how to meet aspirations for sustainable livelihoods and water justice: ‘local systems of resource governance need to be well understood’ (Jackson and Barber 2013, 436). In the ongoing development and then implementation of condition assessments and monitoring using or integrating cultural indicators, the notion of socially just conservation

needs better exploration. The Kati Thanda-Lake Eyre region is known as an area of exceptional cultural and environmental value. Yet Aboriginal groups in the region, remain the

most socio-economically disadvantaged in Australia (Beer 2013). They also still experience the impacts of colonisation; the pattern of Arabana settlement across the nation is a case in point, meaning many Arabana still and necessarily live away from their country with limited (economically) opportunities for visiting it.

Progressing conservation objectives and regimes in the context of this disadvantage provides an ethical imperative to involve Aboriginal groups by building capacity and addressing social justice and inequalities. As Jackson and Barber (2013, 438) note:

'Cultural or symbolic forms of injustice are rooted in social patterns of representation, interpretation and communication and include being subjected to patterns of representation held by a majority culture, non-recognition and disrespect'.

In this context, the development of a collaboratively implemented indicator framework which brings in both Western scientific and cultural perspectives will assist in building socially just conservation across the region. Such a framework can build on the complementary nature of indicator domains as previously identified, simultaneously enabling an overview of condition that combines breadth with detail, and provides a historical context for ongoing observation of sites. Such a framework also provides an opportunity to build in and maintain community involvement in looking after sites and systems. Indeed, 'applying both Indigenous and research based knowledge to a contemporary problem will affirm the importance of Indigenous perspectives and epistemologies' (Finn and Jackson 2011 1242). Work undertaken in New Zealand, as highlighted in Box 3 below demonstrates that working with both approaches has merit, and provides mutual advantages in operation. The complementarity between and potential co-existence of scientific and cultural indicator frames is clear.

Box 3: Summary of Motueka Project

'We conclude that the use of scientific approaches and culturally based monitoring and indicators provide a wealth of knowledge to better understand river and stream health and the changing state of freshwater ecosystem health. The two approaches can be regarded as complementary and reflect two different knowledge systems and perspectives. It is important to continue using monitoring approaches side by side to provide a more complete holistic understanding of human values, uses, perceptions and attitudes. These values (priorities and preferences) are transformed into differing environmental aspirations, policy, standards and guidelines which dictate resource use and management and can illustrate reasons for conflict. They therefore provide an indication through assessment, to human values, perception, belief which is shown in behaviour when issues arise during resource management conflict. This research shows that it is very important that scientific monitoring approaches and indicators are not just compared to cultural approaches and indicators to show weaknesses and fallacies, but used side by side to illustrate different perspectives and articulate differing sets of values and human desires.... The scientific indicators were more objective and directly measured at each site, while the cultural indicators were largely qualitative and relied on consistent iwi training and shared cultural knowledge' (Young et al. 2006, 29).

The notion of co-existence perhaps is a better 'fit' and provides a way in which to conceive how cultural and scientific indicator frameworks may work together. Co-existence, as defined by Howitt et al. (2013) is 'sharing space in more just, equitable, and sustainable ways' As such, Indigenous interests and values about country can co-exist alongside, rather than being integrated within other rights and interests which implies a recognition that both parties are equal and that each knowledge system is legitimate and valid.

Commitment to co-existence implies working on ways in which both parties retain autonomy and control over how knowledge is used, disseminated and presented (Jackson and Palmer 2015).. As Arbon (pers comm) notes, there is no need to always 'integrate' but to seek ways in which Indigenous and non-Indigenous peoples can build bridges between and to each other. This concept is applied in practice by the Anmatyerrtyerry in the Northern Territory. In trying to develop cultural water provisions and livelihood opportunities they didn't try to work out how they could fit within non-Indigenous processes for managing water but rather sought to create new inter-cultural arrangements, that 'respect different knowledge and Laws at the same time as noting the common ground between them' (Rea and Messner 2008). By working together and attempting to understand each other's cultural domains, a productive space for discussion and progression was formed.

In the context of water management in the Kati Thanda-Lake Eyre region, taking a collaborative adaptive systems (CAM) approach to management has merit, and captures some of the essence of the principles of co-existence in practice (Bark et al. 2012). In adaptive management, the focus is not on seeking the answers but on trying to make sense of the situation, trigger interaction between knowledge systems, and to seek modes of co-existence in management that nonetheless harness the essential dynamism within and between each system (Byg and Salick 2009).

Adaptive management then can be a means of engaging with complex, uncertain, changing issues that are nonetheless interconnected and require a flexible approach to decision making (Gunderson 1999). Collaborative adaptive management can also provide a means by which some integration of interest or approaches or even knowledge can be achieved because it picks up on the strengths of two approaches: (i) adaptive management and (ii) collaboration. Thus it has the potential to link scientific and community aspects of natural resource management and monitoring which is critical to successful collaborative adaptive management (Scarlett 2013).

Ultimately, in order to achieve long term and sustainable cultural and other monitoring programs, future initiatives must be implemented and invested in, to ensure longevity and enhanced socio-ecological management. Two dimensions worth discussing are funding for Indigenous rangers to institute ongoing cultural monitoring on their country across their water sites and to ensure that such monitoring builds community capacity. Further, investigations into building capacity in other ways should be considered. For example, building on the funded work conducted by rangers could be the development of a LEB wide Indigenous volunteer collective that conduct ongoing cultural monitoring of indicators over time.

As Rea et al. (2008) note, 'Having Anmatyerrtyerry identify and convey what is important (values) and how to protect this (provisions) is fundamental, but ongoing participation and

employment thereafter is equally important. Cultural provisions will need managing just as water provisions to other users are constantly managed.'

The reality is, that to enable rigorous, and detailed monitoring of water resources across time and scale, and in order to access and integrate cultural knowledge in any way that is useful, future indicator programs must involve and employ Indigenous people. Ayre and Mackenzie (2013) highlight how water planning processes have struggled to engage with Indigenous knowledge in management and show how the role of knowledge is contingent on Indigenous participation in water planning:

'water planning processes must contain the possibility of an explicit approach to mutual recognition and consequent translation of the conceptual and pragmatic bases of water management and planning in both Western and Indigenous domains' (Ayre and MacKenzie 2013, 753).

Indigenous peoples are the harbingers, and custodians of that knowledge and country, and are often best placed to actively manage it over time; not just for cultural but also ecological values. Indigenous people's are most often living in or visiting those regions, and hence may also play an active role, once trained, in undertaking assessments for cultural and ecological condition.



(Photo: M Nursey-Bray)

10. Ways Forward

This study has shown that for the Arabana, their concept of country means that it is hard to create cultural indicators for water per se, and beyond that, just for the river systems. In effect, Arabana do not differentiate between these elements and thus do not conceive of water management for the river systems only. Management is understood as being country based, and therefore applies across all water types, uses and systems. Further, understanding of individual site condition is embedded in a continuum of historical experience. Appreciation of what happens to water sites over time and space, and the impact of colonisation and historical dispersal plays a very direct role in how Arabana understand and speak about water in their country today.

Nonetheless, the nature of and ways in which Arabana assessed condition and the indicators they used are strongly correlative with scientific indicators and hence form a useful basis for an integrated indicator framework. Doing so will require specific processes, as suggested both in the co-engagement research framework and the cultural indicator schemata, which can be applied to progress development of effective cultural indicators that can be applied in conjunction with scientific indicators to further our understanding of the condition of aquatic ecosystems in the Kati Thanda-Lake Eyre region.

Collaborative adaptive management (CAM) is suggested as an appropriate model within which both cultural and scientific knowledge about the region can co-exist, without being subsumed one into the other. It is also a model that in enabling cultural and scientific approaches to assessment to occur side-by-side, brings the strengths of each to the process overall. CAM also facilitates reflection and embeds flexibility in practice thus ensuring that adaptation to assessments can be made over time, based on lessons learned. Finally, CAM is a model that offers opportunities for stakeholder and community participation.

Importantly, Arabana people ultimately emphasised that involvement in and resourcing for them to be active participants in water management on their country is a vital next step. An implication of this for the Kati Thanda- Lake Eyre Rivers Basin Assessment is that in order to obtain ongoing value out of incorporating cultural indicators into management, or finding ‘cultural fit’ in LEB governance structures, the future must include Indigenous involvement in condition monitoring using cultural indicators, and this needs to be properly resourced.

Otherwise, the determination of cultural indicators runs the risk of becoming yet another way in which Indigenous interests, by being demarcated into a special ‘cultural zone’ will be separated from all other parts of water systems management. A result that ultimately is fundamentally oppositional to the holistic and integrated world view conveyed by the term ‘caring for country’.

Recommendations

1. That resources are invested in developing understanding of cultural indicators for all Indigenous groups in the Kati Thanda Lake Eyre Basin
2. That Aboriginal groups in the Basin are trained and resourced to undertake ongoing cultural monitoring across all the different Aboriginal countries.
3. That a workshop on integration or co-existence is funded, using the frameworks suggested herein as a starting point, and involving Western scientists and Aboriginal groups in the region to discuss points of convergence between cultural and scientific indicator frameworks.



11. References

- Adam, M.C. and Kneeshaw, D. 2008. Local level criteria and indicator frameworks: A tool used to assess aboriginal forest ecosystem values, *Forest Ecology and Management*, 255:2024-2037.
- AIATSIS. 2000. *Guidelines for Ethical Research in Indigenous Studies*. The Australian Institute of Aboriginal and Torres Strait Islander Studies, May 2000 http://www.aiatsis.gov.au/__data/assets/pdf_file/2290/ethics_guidelines.pdf
- Arbon, V 2008. *Arlathirnda ngurkarnda ityirnda: being-knowing-doing: de-colonising indigenous tertiary education*, Post Pressed, Teneriffe, Qld..
- Arbon, V and Rigney, L 2015. Indigenous at the heart: Indigenous research in a climate change project, *AlterNative* 10 (2): 478 – 492.
- Axelsson, R., P. Angelstam, E. Degerman, S. Teitelbaum, K. Andersson, M. Elbakidze, and M.K. Drotz. 2013. Social and cultural sustainability: Criteria, indicators, verifier variables for measurement and maps for visualization to support planning, *AMBIO*. doi:[10.1007/s13280-012-0376-0](https://doi.org/10.1007/s13280-012-0376-0).
- Ayre, M., Mackenzie, L. 2013. 'Unwritten, unsaid, just known': The role of Indigenous knowledge(s) in water planning in Australia, *Local Environment*, 18 (7) DOI: 10.1080/13549839.2012.665864
- Barber, M. and Jackson, S.2011. Indigenous people, water values and resource development pressures in the Pilbara region of north-west Australia, *Australian Aboriginal Studies* 2: 32-49.
- Barber, M., Jackson, S., Shellberg, J. and Sinnamon, V. 2014. Working Knowledge: Characterising collective indigenous, scientific, and local knowledge about the ecology, hydrology and geomorphology of Oriners Station, Cape York, Australia, *The Rangeland Journal* 36: 53-66.
- Barber, M., Jackson, S., Dambacher, J.M. and M. Finn 2015. The persistence of subsistence: qualitative social-ecological modelling of indigenous aquatic hunting and gathering in tropical Australia, *Ecology and Society* 20 (1): 60. [online] URL:<http://www.ecologyandsociety.org/vol20/iss1/art60>
- Bark, R. Garrick, D., Robinson, C. and Jackson, S.2012. Adaptive basin governance and the prospects for meeting Indigenous water claims, *Environmental Science and Policy* 19-20: 169-177.
- Bark, R., Barber, M., Jackson, S., McLean, K., Pollino, C.A. and Moggridge. B. 2015. Operationalising the ecosystem services approach in water planning: a case

study of indigenous cultural values from the Murray-Darling Basin, Australia, *International Journal of Biodiversity Science, Ecosystem Services and Management*.

- Bayley, I. 1999. Review of how Indigenous people managed for water in desert regions of Australia, *Journal of Royal Society of Western Australia*, 82:17-25.
- Beer, A, Tually, S, Kroehn, M and Law, J, 2013. *Australia's Country Towns 2050: What Will a Climate Adapted Settlement Pattern Look Like?*, Preliminary Report. National Climate Change Adaptation Research Facility, Adelaide: Centre for Housing, Urban and Regional Planning, University of Adelaide.
- Bellows B. C. 1995. *Principles and practices for implementing participatory and inter-sectoral assessments of indicators of sustainability: outputs from the workshop sessions*, SANREM CRSP Conference on Indicators of Sustainability, SANREM CRSP Research Report 1/95: 243–68.
- Berkes, F. 1999. *Sacred Ecology—Traditional Ecological Knowledge and Resource Management*, Taylor and Francis,
- Bossel H. 2001. Assessing viability and sustainability: a systems-based approach for deriving comprehensive indicator sets, *Conservation Ecology*, 5 (2) :12 p. DOI : [10.1079/9780851997315.0247](https://doi.org/10.1079/9780851997315.0247)
- Byg, A and Salick, J. 2009. Local perspectives on a global phenomenon – climate change in eastern Tibetan villages, *Global Environmental Change*, 19 (2): 156–166.
- Cataloni, C, Minkler, M. 2010. Photovoice: a review of literature in health and public health, *Health Education and Behavior*, 37 (3): 424-451.
- Checkland, P. 1981. *Systems thinking, systems practice*, Wiley.
- Croal, P., Darou, W. 2002. Canadian first nations' experiences with international development. In: Sillitoe, P., Bicker, A., Pottier, J. (Eds.), *Participating in Development: Approaches to Indigenous Knowledge*. Routledge, London, pp. 82–107.
- Davis, M. 2006. Bridging the gap or crossing a bridge? Indigenous knowledge and the language of law and policy. Pages 145-163 in W. V. Reid, F. Berkes, T. J. Wilbanks, and D. Capistrano, editors. *Bridging scales and knowledge systems: concepts and applications in ecosystem assessment*. Island Press, Washington, D.C., USA.
- De Kepa B. M. 2014. *Mauri Piki, Mauri Tu, Mauri Ora: The integration of traditional ecological knowledge and systems thinking techniques to create the Mauri Model*, 99th ESA Annual Convention 2014
- Dixon, Lorraine 2001. Cultural Indicators:
<http://archive.riversymposium.com/index.php?element=B3C+Dixon.pdf>

- Dougill, A.J., Reed, M.S., Fraser, E.D.G., Hubacek, K., Prell, C., Stagl, S.T., Stringer, L.C., Holden, J. 2006. Learning from doing participatory rural research: Lessons from the Peak District National Park, *Journal of Agricultural Economics* 57, (2): 259–275
- Duerden, F., Kuhn, R.G., 1998. Scale, context, and application of traditional knowledge of the Canadian north. Polar Record ecologists and local communities learn from each other, *Ecological Applications* 18: 1253-1269.
- Dumanski, J., H. Eswaran and Latham. M. 1991. A proposal for an international framework for evaluating sustainable land management. In: *Evaluation for Sustainable Land Management in the Developing World*, Vol 2, J. Dumanski, E. Pushparajah, M. Latham, R. Myers and Collin R. Elliot (Eds.). Technical papers. Bangkok, Thailand: International Board for Soil Research and Management, 1991. IBSRAM Proceedings no. 12 (2): 25-48.
- Finn, M and Jackson, S. 2011. Protecting Indigenous values in water management: a challenge to conventional environmental flow assessments, *Ecosystems* 14(8): 1232-1248.
- Folke, C, Hann, T, Olsson and Norberg, J. 2005. Adaptive governance of social ecological systems', *Annual Review of Environmental Resources*, 30 (1): 441-73.
- Fraser, E. 2002. Urban ecology in Bangkok, Thailand: community participation, urban agriculture and forestry, *Environments* 30: 37-49
- Funtowicz S, and Ravetz JR. 1993. Science for the Post-Normal Age, *Futures*, 25:735-755.
- Gans, H. J. 1999. Participant observation in the era of 'ethnography.' *Journal of Contemporary Ethnography*, 28(5): 540-548.
- Gibbs. M. 2010. 'A beautiful soaking rain' : Environmental value and water beyond Eurocentrism, *Environmental and Planning D: Society and Place*, 28: 363 – 78.
- Gieryn, T. F. 1995. Boundaries of science. In S. Jasanoff, G. E. Petersen Markle, J. C. Petersen, and T. Pinch (Eds.), *Handbook of science and technology studies* (pp. 393–444). London: Sage.
- Gilchrist, G, Mallory, M and Flemming, M. 2005. Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds, *Ecology and Society*, 10 (1): 20, <<http://www.ecologyandsociety.org/vol10/iss1/art20/>>.
- Guba, E and Lincoln, YS. 1981. *Effective Evaluation*, Jossey-Bass Publishers, San Fransisco.
- Harmsworth, GR. 2002. *Coordinated Monitoring of New Zealand Wetlands, Phase Two, Goal 2: Māori environmental performance indicators for wetland condition and*

trend. Report prepared for Lincoln University. Landcare Research, Palmerston North. 66 p.

- Harmsworth, GR. 2003. *Motueka Tangata Whenua Resource Management Group: Research, Issues, Management and Monitoring in Te Tau Ihu*. Landcare Research Contract Report 0203/34/016, 87 p.
- Harmsworth GR. and Tipa, G. 2006. *Māori Environmental Monitoring in New Zealand: Progress, concepts, and future direction*. 29 pp.
- Harmsworth, GR. 2008. Māori participation, *ICM*, 1, January 2008, Catchment connections. <http://icm.landcareresearch.co.nz/about/newsletter/>
- Harmsworth , GR., RG Young , D Walker , JE Clapcott and James, T. 2011. Linkages between cultural and scientific indicators of river and stream health, New Zealand *Journal of Marine and Freshwater Research*, 45:3, 423-436, DOI: 10.1080/00288330.2011.570767
- Heaslip, R. 2008. Monitoring salmon aquaculture waste: The contribution of First Nations' rights, knowledge and practices in British Columbia, Canada. *Marine Policy*, 32 (6): 988 – 996.
- Hoverman, S and Ayre, M. 2012. Methods and approaches to support Indigenous water planning: An example from the Tiwi Islands, Northern Territory, Australia, *Journal of Hydrology*, 474, 12: 47–56
- Howitt, R. 2001. *Rethinking Resource Management: justice, sustainability and indigenous peoples*. London, Routledge
- Howitt, R., G. Lunkapis, Suchet-Pearson, S. and Miller, F. 2013. New geographies of coexistence: Reconsidering cultural interfaces in resource and environmental governance. *Asia Pacific Viewpoint* 54 (2): 123-125.
- Hughes, I. 2000. Garma: Indigenous knowledge for reconciliation and community action, *Participatory Action Research World Congress*, Ballarat, September 2000, <<http://www2.fhs.usyd.edu.au/arow//arar/014.htm>>, Sydney, NSW: Faculty of Health Sciences, Cumberland Campus, University of Sydney – Action research E-reports - no.14, 2000.
- Humphery, K. 2000. *Indigenous health and 'western research'*, Melbourne: VicHealth Koori Health Research and Community Development Unit, <http://www.cshs.unimelb.edu.au/koori/docs/DP_KimHumpheryFINAL.pdf>.
- Humphery, K. 2001. 'Dirty questions: Indigenous health and 'western research'', *Australian and New Zealand Journal of Public Health*, vol. 25, no. 3, pp. 197-202.

- Hunt J and Smith DE. 2006. *Building Indigenous community governance in Australia: Preliminary research findings*. Working Paper No. 31/2006. Centre For Aboriginal Economic Policy Research, Australian National University.
- Ioris, A.R. 2013. The Value of Water Values: Departing from Geography towards an Interdisciplinary Debate, *Geografiska Annaler: Series B, Human Geography*, 95(4), 323-337.
- Ivanitz, M. 1999. Culture, ethics and participatory methodology in cross-cultural research, *Australian Aboriginal Studies*, 2: 46-58.
- Izurieta, A., B. Sithole, N. Stacey, H. Hunter-Xenie, B. Campbell, P. Donohoe, J. Brown, and L. Wilson. 2011. Developing indicators for monitoring and evaluating joint management effectiveness in protected areas in the Northern Territory, Australia. *Ecology and Society* 16(3): 9. <http://dx.doi.org/10.5751/ES-04274-160309>
- Jackson, S. 2005. Indigenous values and water resource management: a case study from the Northern Territory, *Australasian Journal of Environmental Management* 12(3): 136-146.
- Jackson, S. 2006. Compartmentalising culture: the articulation and consideration of Indigenous values in water resource management, *Australian Geographer* 37(1): 19-32.
- Jackson, S. 2008. Recognition of Indigenous interests in Australian water resource management, with particular reference to environmental flow assessment, *Geography Compass (Environment and Society)* 2(3): 874-898.
- Jackson, S. and J. Altman, J. 2009. Indigenous rights and water policy: perspectives from tropical northern Australia, *Australian Indigenous Law Review* 13(1): 27-48
- Jackson, S. and M. Langton 2012. Trends in the recognition of indigenous water needs in Australian water reform: the limitations of 'cultural' entitlements in achieving water equity, *Journal of Water Law* 22(2/3):109-123.
- Jackson, S., Finn, M and P. Featherston 2012. Aquatic resource use by Indigenous Australians in two tropical river catchments: the Fitzroy River and Daly River, *Human Ecology* 40(6): 893-908 DOI 10.1007/s10745-012-9518-z.
- Jackson, S., Tan, P, Mooney, C., Hoverman, S. and White, I. 2012. Principles and guidelines for good practice in Indigenous engagement in water planning, *Journal of Hydrology* 474:57-65. <http://dx.doi.org/10.1016/j.jhydrol.2011.12.015>.
- Jackson, S. and M. Barber 2013. Indigenous water values and resource governance in Australia's Northern Territory: current progress and ongoing challenges for social justice in water planning, *Planning Theory and Practice* 14(4):435-454.

- Jackson, S., Douglas, M.M., Kennard, M.J., Pusey, B.J., Huddleston, J., Harney, B., Liddy, L., Liddy, M., Liddy, R., Sullivan, E., Huddleston, B., Banderson, M. and Allsop, Q. 2014. 'We like to listen to stories about fish': Integrating indigenous ecological and scientific knowledge to inform environmental flow assessments, *Ecology and Society* 19 (1): 43.
- Jackson, S., Finn, M. and K. Scheepers 2014. The use of replacement cost method to assess and manage the impacts of water resource development on Australian indigenous customary economies, *Journal of Environmental Management* 135: 100-09.
- Jackson, S. E. and Douglas, M. 2015. Indigenous engagement in tropical river research in Australia: The TRaCK Program, *The International Indigenous Policy Journal* 6(2): Retrieved from: <http://ir.lib.uwo.ca/iipj/vol6/iss2/3>
- Jackson, S. and L. Palmer 2015. Reconceptualising ecosystems services: Possibilities for cultivating and valuing the ethics and practices of care, *Progress in Human Geography* 39(2) 122–145
- Jasanoff, S., 2000. *The idiom of co-production. In: States of Knowledge: The Co-production of Science and the Social Order*. Routledge, London 1–13.
- Karnjala, M.K. et al., 2004. Criteria and Indicators for Sustainable Forest Planning: a framework for recording Aboriginal resource and social values, *Forest Policy and Economics*, 6: 95-110.
- Langton, M. 2002. Freshwater. In *Background briefing papers: Indigenous rights to waters* (ed.) Lingiari Foundation), pp. 43–64. Lingiari Foundation: Broome.
- Lincoln, Y. S. and Guba, E G. 1985. *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Marshall, A. and Batten, S. 2004. Researching across cultures: issues of ethics and power [17 paragraphs]. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* [On-line Journal], 5(3), Art.39.
- Marshall, C. and Rossman, G. 1995. *Designing qualitative research*. Newbury Park, CA: Sage.
- Mooney, C. and Tan. P. 2012. South Australia's River Murray. Social and Cultural Values in Water Planning, *Journal of Hydrology*, 474: 29 – 37.
- Monroy-Ortíz, C.; García-Moya, E.; Romero-Manzanares, A.; Sánchez-Quintanar, C.; Luna-Cavazos, M.; Uscanga-Mortera, E.; González-Romero, V. and Flores-Guido, J.S. 2009. Participative generation of local indicators for conservation in Morelos, México. *International Journal of Sustainable Development and World Ecology*, 16 (6): 381-391, ISSN 1350-4509.

- National Water Commission. 2004. *Intergovernmental Agreement on a National Water Initiative*. Between the Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Northern Territory.
- Nursey-Bray, M, Marsh, H and Ross, H. 2010. Uncommon Platforms: Developing Common Discourse Understandings in Environmental Decision-Making, *Society and Natural Resources*, 23: 4, 366 - 382.
- Nursey-Bray, M. 2013. Arid Lands, arid management? Community engagement, communities of practice and environmental governance in the Lake Eyre, paper for memorium edition for Les Heathcote for the *South Australian Geographical Journal*, 111: 56 - 74.
- Nursey-Bray, M, Fergie, D, Arbon, V, Rigney, L, Palmer, R, Tibby, J, Harvey, N, Hackworth, L 2013 Community Based Adaptation to Climate Change: The Arabana, National Climate Change Adaptation Research Facility, Gold Coast, pp. 133. ISBN: 978-1-925039-63-4. See : <http://www.nccarf.edu.au/publications/community-based-adaptation-arabana>
- Nursey-Bray, M and Jacobson, C. 2014. 'Which Way?': The contribution of Indigenous marine governance, *Australian Journal of Maritime and Ocean Affairs*, 6 (1): 27 - 40.
- Nursey-Bray, M., Fergie, D., Arbon, V., Rigney, LI., Palmer, R., Tibby, J., Harvey, N., Hackworth, L., and Stuart, A. 2015. Indigenous Adaptation to Climate Change: The Arabana, for Palutikof, J., Boulter, S., Barnett, J., and Rissik, D. *Practical studies in climate change adaptation*, Wiley Press,
- OECD. 1993. *Environmental Indicators, Development, measurement and use*, Paris, France
- Olsson P, Folke, C and Berkes, F. 2004. Adaptive co-management for building resilience in social-ecological systems, *Environmental Management*, 34 (1): 75- 60.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press. Philadelphia, PA.
- Posey, D. A. 2001. Cultural landscapes. In C. R. Elevitch (Ed.), *The Overstory Book: Cultivating Connections with Trees* (2 ed., pp. 17–19). Holualoa, Hawaii: Permanent Agriculture Resources. ISBN 0-9702544-3-1
- Rea N. and the Anmatyerr Water Project Team. 2008. *Provision for Cultural Values in Water Management: The Anmatyerr Story*. Land and Water Australia Final Report, February 2008.

- Reed, M., E. D. G. Fraser, S. Morse, and Dougill, A.J. 2005. Integrating methods for developing sustainability indicators to facilitate learning and action, *Ecology and Society* 10(1):r3. [online] URL: <http://www.ecologyandsociety.org/vol10/iss1/resp3/>
- Reed, M.S. 2005. Participatory Rangeland Monitoring and Management in the Kalahari, Botswana. PhD Thesis, School of Earth and Environment, University of Leeds. Available:: <http://www.env.leeds.ac.uk/~mreed/PhDabstract.html>.
- Reed MS, Dougill AJ, Baker TR. 2008. Participatory indicator development: what can ecologists and local communities learn from each other, *Ecological Applications* 18: 1253-1269.
- Rigney LI. 1999. Internationalisation of An Indigenous Anti-Colonial cultural critique of research methodologies: A guide to Indigenist research methodology and its principles, *Journal of Native American Studies*, 14: 109-122.
- Rigney, L 2011. Can the settler state settle with whom it colonises? Reasons for hope and priorities for action, in Maddison S and Brigg M, (eds), *Unsettling the settler research methodologies: a guide to Indigenist research methodology and its principles*, *Wicazo Sa Review*, 14 (2): 109.
- Ross H, Grant C, Robinson CJ, Izurieta A, Smyth D and Rist P. 2009. Co-management and Indigenous Protected Areas in Australia: Achievements and Ways Forward, *AJEM*, 16: 242.
- Roux DJ, Rogers KH, Biggs HC, Ashton PJ, Sergeant A 2006. Bridging the science - management divide: moving from unidirectional knowledge transfer to knowledge interface and sharing. *Ecology and Society* 11: 4.
- Scarlett, L. 2013. Collaborative adaptive management: challenges and opportunities. *Ecology and Society* 18(3):26. <http://dx.doi.org/10.5751/ES-05762-180326>
- Schensul, Stephen L.; Schensul, Jean J. and LeCompte, Margaret D. 1999. *Essential ethnographic methods: observations, interviews, and questionnaires* (Book 2 in Ethnographer's Toolkit). Walnut Creek, CA: AltaMira Press.
- Scoones, I. 1998. *Sustainable Rural Livelihoods: A Framework for Analysis*, Institute of Development Studies, London, UK.
- Sillitoe, P, Bicker, A and Pottier, J. (eds) 2001. *Participating in Development. Approaches to Indigenous Knowledge*, Routledge, London and New York, pp. 108-139.
- Smith, LT. 1999. *Decolonizing methodologies: research and indigenous peoples*, University of Otago Press, and Zed Books, Dunedin, NZ.

- Spradley, James P. 1980. *Participant observation*. New York: Holt, Rinehart and Winston.
- Stacey, N., A. Izurieta, and S. T. Garnett. 2013. Collaborative measurement of performance of jointly managed protected areas in northern Australia. *Ecology and Society* 18(1): 19. <http://dx.doi.org/10.5751/ES-05273-180119>
- Stuart-Hill, G., Ward, D., Munali, B., Tagg, J. 2003. *The event book system: a community-based natural resource monitoring system from Namibia*. Working draft, Natural Resource Working Group, NACSO, Windhoek, Namibia.
- Tan, P. and Jackson, S. 2013. Impossible Dreaming - does Australia's water law and policy fulfil Indigenous aspirations? *Environment and Planning Law Journal* 30: 132-149. Cite
- Tipa, G. 1999. *Taieri River Case Study*. Technical Paper No. 58. Ministry for the Environment, Wellington. Māori Indicators Case Study, Technical Paper No. 58. 75 p + maps and appendices. Ministry for the Environment, Wellington.
- Tipa, G., Teirney, L. 2002. *Mauri and Mahinga kai Indicators Project: Developing the Cultural Health Index*. Unpublished report. Tipa and Associates, Dunedin.
- Tipa, G., Teirney, L. 2003. *A Cultural Health Index for Streams and Waterways: Indicators for Recognising and Expressing Māori Values*. ME475. Ministry for the Environment, Wellington, 72 p. <http://www.mfe.govt.nz/publications/water/cultural-health-index-jun03/cultural-health-indexjun03.pdf>
- Tipa, G. Tierney, L. 2006. *A Cultural Health Index for streams and waterways: A tool for nationwide use*. ME710, April 2006. Ministry for the Environment, Wellington.
- TNS. 2004. *The Natural Step*, Canada.
- Turner, NJ, Ignace, MB and Ignace, R 2000. Traditional ecological knowledge and wisdom of aboriginal peoples in British Columbia, *Ecological Applications*, 10 (5):1275-1287.
- Turnhout, E., Waterton, C., Neves, K. and Buizer, M., 2012. Rethinking biodiversity: From goods and services to 'living with'. *Conservation Letters*, 6 (3): 154-161.
- Young RG, Quartermann AJ, Eyles RF, Smith RA, Bowden WB 2005. Water quality and thermal regime of the Motueka River: influences of land cover, geology and position in the catchment. *New Zealand Journal of Marine and Freshwater Research* 39: 803- 825.
- Young, R.; Harmsworth, G.; Walker, D.; James, T. 2008. *Linkages between cultural and scientific indicators of river and stream health*. Motueka Integrated Catchment Management (Motueka ICM) Programme Report. November 2008. 39 p.

- Yunupingu, B. (1991). A plan for Ganma research. In *Aboriginal pedagogy: Aboriginal teachers speak out* (pp. 98-106). Deakin: Deakin University Press.
- Yunupingu, M. (1993). Yothu Yindi: Finding balance. In *Voices from the land. Boyer Lecture Series*. Sydney: Australian Broadcasting Corporation.



