

Carl-von Ossietzky-Universität Oldenburg & Rijksuniversiteit Groningen

Master of Science, Water & Coastal Management

Master Thesis

Purposes and Challenges of Cultural Mapping in Australia – Possibilities and Limitations of GIS Use

by
Christine Hoegg

September, 2010

Supervisors:
Dr. Terry van Dijk (Groningen)
Dr. Thomas Klenke (Oldenburg)

Christine Hoegg
Ehnenstraße 162
26121 Oldenburg
Germany
Phone: +49 441 83626
E-mail: christine_hoegg@yahoo.com

Student ID (Groningen): 1947044
Student ID (Oldenburg): 9821600

Table of Contents

Acknowledgement	3
List of Figures	4
List of Tables	6
List of Acronyms	7
1 Introduction	8
2 Methods	11
3 Cultural Mapping – Setting the Ground Rules	16
3.1 Western and Indigenous Maps	16
3.2 How Trustworthy is a Map or the Map Maker?	22
3.3 Holistic versus Non-holistic Concepts - Sea Country versus the Commons of the Sea	26
4 Cultural Mapping with GIS – Possibilities and Limitations	32
4.1 Availability, Logistics and Costs	32
4.2 GIS and TEK	35
4.3 Oral versus Written Knowledge	41
4.4 Fixing TEK to x- and y-Coordinates	43
4.5 Alteration, Distortion, Assimilation	45
4.6 Issues of Access and Privacy	48
5 Conclusion	51
Literature	55
Appendix A: Questionnaire Girringun	69
Appendix B: Questionnaire Cape Arid National Park	76
Appendix C: Questionnaire Alngith	82
Appendix D: Questionnaire Noongar	88
Appendix E: Questionnaire Jawoyn	93
Appendix F: Questionnaire Uluru – Kata Tjuta National Park	98
Appendix G: Interview with Troy Mallie	102
Appendix H: Guidebooks and Online Support	105
Appendix I: Non-plagiarism Statement	108

Acknowledgement

This master thesis would not have been possible without the help of the following Australian people and organizations, who invested a lot of time to answer my questions and provide me with information:

Rod Nielson and the Girringun

David Guilfoyle, Cat Morgan, the Nkooring, the Wudjari and the Ngadju

Mick Morrison and the Alngith

Brendan Moore and the Noongar

Ray Whear and the Jawoyn

Kerrie Bennison of Uluru – Kata Tjuta National Park

Troy Mallie of Cultural System Solutions

List of Figures

Fig. 1: Map of Australia with location of mapping projects contacted for information	12
Fig. 2: Marshall Islands stick chart	18
Fig. 3: Wooden coastal charts from Greenland	18
Fig. 4: Bedolina map	20
Fig. 5: Crocodile and fire dreaming, by Djamika Munungurr, 1985	21
Fig. 6: Caledon Bay, Northern Territory	21
Fig. 7: Gunda Muruwirri, saltwater bark painting by Mawalan II Marika	21
Fig. 8: Anuta Island shown with Google Maps ‘map’ function active	25
Fig. 9: Anuta Island shown with Google Maps ‘satellite’ function active	25
Fig. 10: Mental map of Anutans, with 2- to 3-mile radius of their island	25
Fig. 11: Historical boundaries of Australia, 1788 - present	27
Fig. 12: Tribal boundaries in Aboriginal Australia	27
Fig. 13: Native Title claims, 2009	28
Fig. 14: Native Title sea country claims, 2008	28
Fig. 15: Wellesley Islands sea claim area	31
Fig. 16: Remote areas across Australia	32
Fig. 17: Indigenous population distribution, 2006	32
Fig. 18: GIS productivity	34
Fig. 19: Yanyuwa concept of seasons	38
Fig. 20: Aerial view with angle used in oblique perspective	40
Fig. 21: Oblique perspective	40
Fig. 22: Animated frames simulate movement of summer sun	40
Fig. 23: Animated frames simulate movement of winter sun	40
Fig. 24: Animation frames simulate daily tidal cycle	40

Fig. 25: Map of Arnhem Bay, Arnhem Land, by Larrtjannga Ganambarr 47

Fig. 26: Map of Arnhem Bay, Arnhem Land 47

Fig. 27: Cultural heritage grid, Victorian Government 50

List of Tables

Table 1: Mapping techniques and tools	9
Table 2: Projects contacted with cultural mapping questionnaire	13
Table 3: English and Aboriginal terms	16
Table 4: Comparing TEK and Western science	36
Table 5: Possible advantages and disadvantages of cultural mapping with GIS	52

List of Acronyms

ATSIC	Aboriginal and Torres Strait Islander Commission
DEH	Department for Environment and Heritage
DEW	Department for Environment and Water Resources
DEWHA	Department of Environment, Water, Heritage and the Arts
GIS	Geographic Information System
GPS	Global Positioning System
IHP	Indigenous Heritage Program
ILUOP	Inuit Land Use and Occupancy Project
NAILSMA	North Australian Indigenous Land & Sea Management Alliance
NNTT	National Native Title Tribunal
ORIC	Office of Registrar of Indigenous Corporations
PGIS	Participatory Geographic Information System
PRA	Participatory Rural Appraisal
TEK	Traditional Ecological Knowledge
UN	United Nations

States of Australia

NSW	New South Wales
NT	Northern Territory
QLD	Queensland
SA	South Australia
TAS	Tasmania
VIC	Victoria
WA	Western Australia

1 Introduction

Cultural mapping has become an important tool to achieve a variety of different goals and purposes, mostly in land disputes, conservation and resource management or the protection of knowledge. Cultural mapping is often done by indigenous peoples. Cultural mapping is defined by the UNESCO as “a crucial tool and technique in preserving the world’s intangible and tangible cultural assets” and “involves a community identifying and documenting local cultural resources”. Tangible data includes landmarks, events, arts and crafts, whereas intangible knowledge encompasses memories, stories and values (UNESCO 2010). There are several different terms for cultural mapping in use today: indigenous mapping, ethnocartography, counter-mapping, non-Western mapping, power mapping, social mapping, remapping, participatory mapping, participatory land use mapping, participatory resource mapping, multimapping, community mapping, community-based mapping, self-demarcation or self-determination (Chapin et al. 2005, Chapin & Threlkeld 2001, Corbett et al. 2009, Herlihy & Knapp 2003, Rocheleau 2005, Wood & Krygier 2009a). For cultural mapping involving GIS, the terms can also vary (public participation GIS, community-integrated GIS, mobile interactive GIS), but the most commonly used is participatory GIS (PGIS) (Chapin et al. 2005).

This paper will focus on cultural mapping done by the indigenous people of Australia, namely Aborigines and Torres Strait Islanders. But since the Torres Strait Islanders consist of a rather small group in the far north of Queensland, most of my research will draw on Aborigines. The UN defines indigenous people as people that have continued connections to or live on their traditional lands (Corbett et al. 2009). In Australia, the term indigenous encompasses Aborigines and Torres Strait Islanders. In order to qualify as such, they have to be of Aboriginal or Torres Strait Islander descent, as well as identify as such and be accepted by their community (WTAPPT 2005). Although this paper will focus on cultural mapping done by indigenous people, I will use the term cultural mapping because most Aborigines in Australia title their projects as such and the focus is often on cultural and heritage issues. The term is furthermore used by the UNESCO and recognized as a tool to conserve cultural diversity (UNESCO 2010). I chose Australia as a focus for my thesis because it is a country where cultural mapping is kept “under wraps”. Academic literature on cultural mapping in Australia is rather thin, especially compared to the USA or Canada, or even South America (see Chapin et al. 2005, Corbett et al. 2009, Poole 2003), the exception being Mahood (2006) and Strang (2000).

Cultural mapping started out as a tool for land claims. European explorers, and later colonialists, marked and treated the land inhabited by indigenous peoples as uninhabited, a misconception that widely remains (Denniston 1994, Stone 1998). The first mapping projects by indigenous people were undertaken in Canada and Alaska in the 1960s

(Chapin & Threlkeld 2008, Corbett et al. 2009, Poole 2006, Rundstrom 2009, Wood & Krygier 2009a). They were prompted by attempts to seize yet unexploited resources and develop projects on Inuit land (Chapin et al. 2005, Corbett et al. 2009, Rundstrom 2009). The Canadian government assumed that the land was not used since First Nations did not practice agriculture (Chapin & Threlkeld 2008). Probably the most famous milestone was the *Inuit Land Use and Occupancy Project (ILUOP)* (Freemann 1976), compiled by Inuit in the Northern Territories to document evidence of land use (Brody 2002, Chapin & Threlkeld 2008, Poole 2003, Poole 2006, Rundstrom 2009). The ILUOP recorded past and current hunting, gathering, fishing and trapping patterns, campsites, places names and other cultural data of 33 indigenous communities (Chapin & Threlkeld 2008, Corbett et al. 2009, Wood & Krygier 2009a). The data collected over 30 years ago is still of great use today (Poole 2006). Maps based on this data were essential for the 1997 Canadian Supreme Court ruling that Aboriginal land rights exist (*Delgamuukw vs. British Columbia*) (Corbett et al. 2009, Tobias 2000) and the 1999 establishment of Nunavut territory, which subsequently led to the first indigenous self-government in the Americas in 2009 (Wood & Krygier 2009a).

In order to claim their lands and protect their rights against governments, loggers, miners or developers, indigenous people need clear defense lines that mark their boundaries (Stone 1998). And as Monmonier (1995, p. 105) points out: “*Maps make good witnesses. In lawsuits over boundaries and land ownership, maps can testify with authority and conviction*”. With the help of Western mapping techniques (see Table 1) indigenous people record their land management, histories, sacred and cultural sites, place names or other attributes in order to make their territories and culture visible (CIER 2010, Corbett et al. 2009). Oral demonstration, which is characteristic of indigenous cultures, is often not enough to convince the dominant society of indigenous land occupancy (Tobias 2000). Therefore, the tools of the governing power (e. g. GIS) have to be employed for indigenous mapping projects (Rundstrom 2009). Stone’s title of his article *Map or be Mapped* (1998) describes the essence of the dilemma very well.

Mapping techniques and tools	Explanation
Ephemeral mapping	drawing maps into the soil with stones or sticks
Sketch mapping	drawing maps from memory or observation, has no exact scale
Scale mapping	similar to sketch mapping, but with a consistent scale
3D modeling	making 3D relief models of accurate scale
Photomapping	for larger scale projects, using aerial photographs as base maps
GPS (Global Positioning System)	employing a satellite-based positioning system to make sketch, scale maps and 3D models more accurate
GIS (Geographic Information System)	database that allows to store, manage and analyze geo-referenced data

Table 1: Mapping techniques and tools (after Corbett et al. 2006)

Data collected through cultural mapping can be used for several other purposes as well. The map making can have political, cultural or social reasons (Chapin et al. 2005, Corbett et al. 2009, Mohamed & Ventura 2000, Poole 1995b, Rundstrom 2009):

- Recognition of traditional land rights and protection against dispossession
- Land-use management and natural resource management
- Communicating spatial and traditional knowledge to external agencies
- Creating public awareness
- Creating awareness for threats inside the community
- Strengthening community organization
- Reinforcing cultural identity and strengthening kinship
- Gathering and protecting traditional knowledge for future generations
- Unifying and consensus building
- Conflict resolution

Cultural mapping is not exclusive to indigenous societies. There are countless examples of non-indigenous mapping projects with just as many diverse objectives, quite often in urban areas, for example: water and sanitation mapping in Tanzania (Glöckler et al. 2004), mapping as a development tool for tourism projects in Scandinavia (Hultman 2007), mapping to reduce crime in South Africa (Liebermann & Coulson 2004), investigating social landscape patterns in Zanzibar, Tanzania (Fagerholm & Käyhkö 2009), monitoring of slums in Ethiopia (Lemma et al. 2006) or mapping to establish offshore rights over oil and gas deposits between East Timor and Australia (Nevins 2004).

Cultural mapping can cover land and water. But it is more widespread on land since mapping at sea can be difficult due to access as well as legal reasons. In Western ideology, the oceans belong to everybody or are national territory, and therefore cannot be private property (Russa & Zeller 2003). However, Aborigines do not distinguish between land and oceans. For them it is just their land, no matter if it consists of soil or water (NAILSMA 2008). Indigenous land rights have largely been dealt with and acknowledged in Australia. But indigenous rights in the oceans are still a contested area. The jurisdiction of the seas makes it difficult for indigenous people to follow their tradition of sea country management. Even if indigenous rights to the sea are granted, they often come with restraints compared to claims granted on land (Strelin 2009). But as such, cultural mapping is the ideal tool to further push for those rights or create a basis to convince other stakeholders of indigenous management practices in marine areas.

Today, the most commonly used tool to undertake cultural mapping projects is GIS (Geographic Information System). GIS offers a large number of possibilities for mapping projects, for example easier access to data or collecting and storing huge amounts

of data. At the same time, this technology can also have negative impacts, like the misuse or misinterpretation of data. This paper will look at the possibilities and limitations of GIS use for indigenous cultural mapping projects and deal with the following question: Is GIS an adequate tool for cultural mapping in Australia? The basis for most of these mapping projects is indigenous knowledge, also known as traditional ecological knowledge (TEK). TEK is very different from Western scientific knowledge. Therefore, the following questions need to be addressed: Is GIS a sensible tool for storing TEK, even though it was not specifically made for TEK, but for Western knowledge systems? Can GIS overcome these cross-cultural issues? Should TEK be put into a GIS at all? What are the advantages and disadvantages of collecting and storing TEK in a GIS? Do the positive aspects of GIS outweigh the negative? Do Aboriginal projects in Australia encounter those problems with GIS as well? If so, do they ignore them, circumvent them or solve them?

In order to answer these questions this paper will first look at Western and indigenous concepts of maps in order to illustrate the difficulties that arise from the simple fact of employing maps and mapping for indigenous purposes. To understand the problems that can arise when indigenous and Western ideologies collide, the paper will take a closer look at the concepts of sea country and the Western concept of the oceans and how cultural mapping can help further the dialogue to find solutions for those issues. The last part will focus on the advantages and disadvantages of employing GIS for cultural mapping of indigenous knowledge systems. It will look at difficulties that arise when trying to put TEK into a GIS. The paper will address how cultural mapping projects in Australia deal with transmitting TEK into Western technologies and present some approaches that try to solve those problems and give a possible outlook for the future development of GIS for cultural mapping of indigenous space and knowledge.

2 Methods

This data compiled in this paper is a combination of peer-reviewed articles, reports and management plans and information collected from questionnaires plus one interview. The management plans and reports used were published by government organizations, e. g. Australian Government Departments, NNTT (National Native Title Tribunal) and Aboriginal organizations, e. g. ATSIC (Aboriginal and Torres Strait Islander Commission), NAILSMA (North Australian Indigenous Land & Sea Management Alliance). I chose to send questionnaires to Aboriginal organizations because the literature on actual mapping projects in Australia is very thin. Additionally, it is usually only academics who publish articles, not indigenous people themselves. I hoped to get a slightly different view on the matter with the questionnaires than from the literature alone. The an-

swers I got back were used to fill in the gaps left by the literature, to complement or to confirm those findings. The questions were based on findings in the literature. The literature raised questions I wanted answered or pointed to something I wanted confirmation on from actual mapping projects.

I chose questionnaires so that organizations could do them at their own leisure or spread answering them over several days. Besides, the time difference between Germany and Australia could have made finding a date for an interview difficult. Nevertheless, I offered this option to every group as well, in case it would be more convenient for them. One person took me up on the offer. The questionnaires were sent to 26 Aboriginal organizations that are doing cultural mapping projects in Australia (see Fig. 1 and Table 2). Fig. 1 shows a map of Australia with the organizations I contacted. Yellow dots mark the six projects which returned my questionnaire. The map does not attempt to present a complete list of mapping projects in Australia. With one exception (# 13), it shows only projects that applied for funding from the Indigenous Heritage Program (IHP) and whose short descriptions identified them as possible cultural mapping projects.

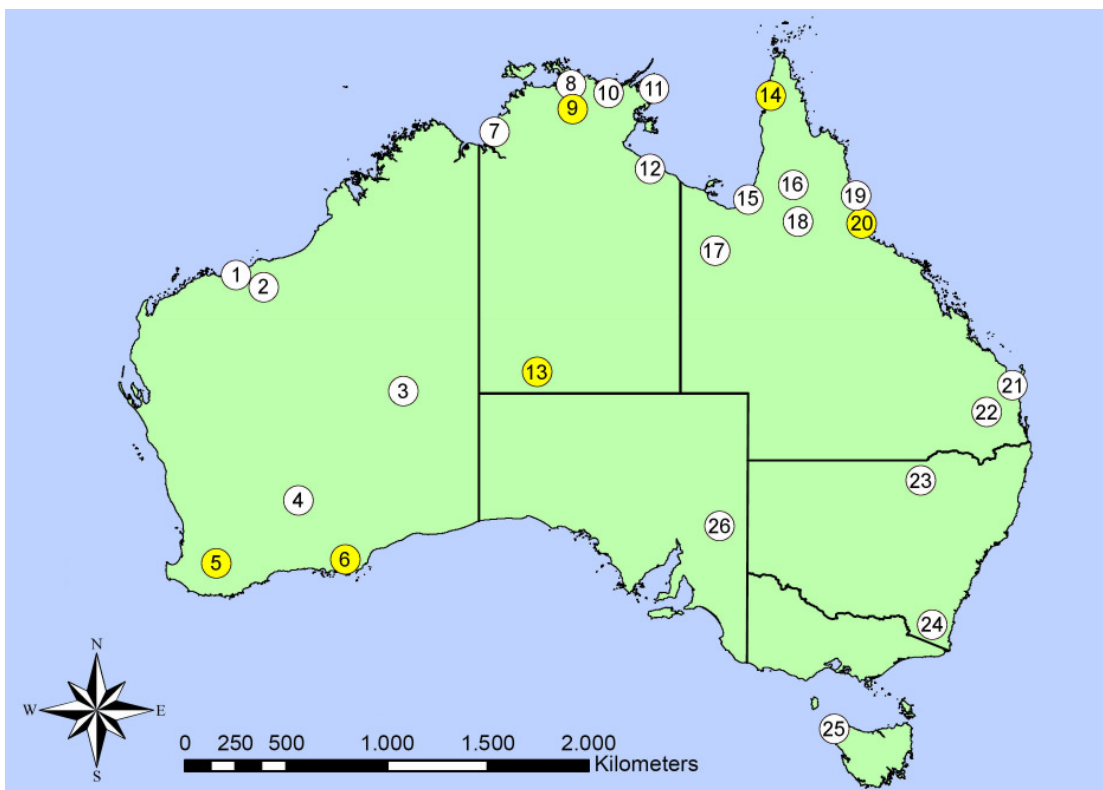


Fig. 1: Map of Australia with location of mapping projects contacted for information (own map, made with ArcGIS, data source: Geoscience Australia 2010)

	Project Title	Organization	State	Financial Year¹	Funding from IHP
1	Juluwarlu Cultural Mapping Book and DVD Project	Juluwarlu Aboriginal Corporation	WA	2009/10	\$91,000
2	Woodstock Abydos Site Identification Project	Yamatji Marlpa Aboriginal Corporation	WA	2010/10	\$97,000
3	Conserving the Ninu Dreaming track in the Ngaanyatjarra Lands	Ngaanyatjarra Council Aboriginal Corporation	WA	2009/10	\$100,000
4	Spinifex Heritage and Mapping Project	Pila Nguru Aboriginal Corporation	WA	2010/11	\$49,400
5	Sharing Noongar Heritage ³	South West Aboriginal Land and Sea Council Aboriginal Corporation	WA	2009/10	\$100,000
6	Cape Arid Cultural Heritage Assessment Project	National Trust of Australia & The Gabbie Kylie Foundation	WA	2009/10	\$70,550
7	Managing Cultural Heritage of the Thamarrurr Region	Thamarrurr Development Corporation	NT	2008/09	\$28,684
8	Indigenous Heritage (Kurulk and Kardbam)	Bawinanga Aboriginal Corporation	NT	2007/08	\$28,200
9	Jawoyn - Cultural Heritage ³	Jawoyn Association Aboriginal Corporation	NT	2010/11	\$100,000
10	Arafura Wetlands Cultural Heritage GIS Database	Murwangi Community Aboriginal Corporation	NT	2006/07	\$80,650
11	Dhimurru IPA Heritage Protection ³	Dhimurru Aboriginal Corporation	NT	2009/10	\$90,000
12	Heritage Priorities of the Barni Wardimantha Awara Yanyuwa	Mabunji Aboriginal Resource Association	NT	2007/08	\$50,000
13	Cultural Site Management System at Uluru - Kata Tjuta National Park ^{2, 3}	Parks Australia	NT	-	-
14	Alngith Cultural Heritage Project	Malaruch Aboriginal Corporation	QLD	2008/09	\$87,250
15	Kurtijar IHP 2006	Kurtijar Aboriginal Corporation	QLD	2006/07	\$4,000
16	Mapping and Recording of Indigenous Heritage Sites in the Northern Gulf of Carpentaria	Northern Gulf Resource Management Group	QLD	2009/10	\$97,000
17	Recording the Cultural Heritage of Stock Routes	Southern Gulf Catchments	QLD	2009/10	\$90,386
18	Cultural Heritage Site Mapping of Sandstone Country of the Northern Gulf of Carpentaria, Queensland	Northern Gulf Resource Management Group	QLD	2010/11	\$97,500
19	Strengthening Cultural Heritage Information Management in the Wet Tropics	Terrain NRM	QLD	2008/09	\$100,000
20	Girringun's Cultural Heritage	Girringun Aboriginal Cor-	QLD	2009/10	\$99,900

	Identification, Mapping and Management Project	poration			
21	Brunga Spirit (Badtjala people)	Desert Channels Queensland	QLD	2006/07	\$87,500
22	Identifying and Reconnecting with the Bunya Mountains	Burnett Mary Regional Group for NRM	QLD	2010/11	\$100,000
23	Walgett Aboriginal Heritage and Environment Identification	Dharriwaa Elders Group	NSW	2007/08	\$72,400
24	Bundian Way Survey	Eden Local Aboriginal Land Council	NSW	2010/11	\$99,700
25	Developing an Aboriginal Heritage and Land Management GIS ³	Tasmanian Aboriginal Land and Sea Council Aboriginal Corporation	TAS	2008/09	\$100,000
26	Ngadjuri Heritage Project	Ngadjuri Heritage Committee	SA	2010/11	\$99,500

1 Year of funding, if funding covers several years, the funding year shows the most recent year

2 Project not funded by IHP

3 Confirmed usage of GIS program from Cultural Systems Solutions for mapping

Table 2: Projects contacted with cultural mapping questionnaire

I selected the projects from the website of the IHP, a program that funds indigenous cultural and heritage projects. It is financed by the Australian Government and each project can receive funding up to A\$ 120,000 annually (DEWAH 2010). Not all the ones I contacted were specifically listed as cultural mapping projects. Sometimes the mapping is just part of a bigger project and the mapping aspect might not be clearly stated. I selected those projects that appeared to have a spatial component in connection with collecting cultural data.

When the contact details for the listed organizations were not available via a basic search of the internet, I looked for these organizations via the Office of Registrar of Indigenous Corporations (ORIC 2010). Due to time restraints I only considered organizations listed with an e-mail address, as the postal way would have taken too long. Interaction with indigenous groups can be difficult in Australia, if one is not part of an agency or the right research group from universities with established connections. Strict rules and guidelines apply when contacting indigenous communities in Australia and it often takes years to establish trust for a good working relationship between agencies. Therefore, I did not expect the return rate to be very high, but decided to try anyway as some Aboriginal organization seemed to want to share their culture and experiences with the public (publishing books or DVDs, doing exhibitions) (see for example Mahood 2006). I first tested the viability of this venture by sending out ten questionnaires. I made it clear in my cover letter that I was not interested in sensitive cultural data, as this might have been a major “deal-breaker” for my request, since this knowledge is kept mostly confidential. Several organizations were contacted twice in order to get a reply,

sometimes with shorter questionnaires, but this approach was not successful. Some e-mail addresses acquired through ORIC were found to be invalid.

The questionnaires contained between 25 and 35 questions, depending on the project. Most were open questions. Some had yes / no options for answers, where a positive answer asked for further clarification. The questions were supposed to act as guidelines to encourage detailed answers. Therefore they were kept rather general to apply to as many unique circumstances as possible as it was difficult to obtain more detailed information about some projects in advance. Almost all questions had room for further comments, in case the recipient of the questions deemed them necessary. Also, all recipients were told that they could add comments wherever they saw fit.

The questionnaires started with more general questions in order to judge if the project fit the objective of the thesis, as this was sometimes hard to judge from the short project descriptions on the IHP website alone. Also, the more general questions helped putting the project into the overall context and provided valuable background information. Even though the focus of this paper is GIS use, I did not directly inquire about possible problems with GIS in order to receive more genuine answers. No system is perfect, especially if used on unique problems when the technologies are hardly ever designed for an individual purpose. Instead of asking outright “Were there any GIS-related problems?” I opted to ask more general questions, wanting to catch the most important problems rather than suggesting what I expected or wanted to hear. I only did this in the interview (Mallie 2010) when the problem of GIS and holistic views, which is featured very prominently in the literature, did not come up during the regular questions I had prepared. When I specifically asked about this issue the problem was confirmed, but it was clear that it was not the most pressing dilemma, as was often implied by the literature. If I had asked directly in a questionnaire, the person filling out the form might have been content with confirming the problem without mentioning other issues.

After sending out the first questionnaires and receiving the first ones back, I adjusted some questions slightly. I made a few questions even less specific and changed some wording. I put even more emphasis on using “inside” terms to demonstrate prior knowledge of Aboriginal culture and the topics addressed in order to avoid too basic answers or misunderstandings. Terms specific to Aboriginal culture include for example “sea country” (= the oceans) or “women’s / men’s business” (= gender specific knowledge, not to be divulged to the opposite sex). Various Aboriginal terms have become well used in official documents when addressing issues concerning Aboriginal people or Aboriginal lands. Some of the most commonly used terms are listed in Table 3. This list of terms also shows that Aboriginal concerns often focus on nature and heritage conservation as well as resource management.

English Term	Aboriginal Term
Best practice	right way
Biodiversity	rich country
Communication	talk talk / yarn / Murri bush telegraph
Community	the mob
Cultural Heritage	our business
Degraded catchment / land	sick water / sick country
Guideline	'which way' business
Law	lore
Memorandum of Understanding	goodwill paper
Natural Resource Management	caring for country
Protection	watching country

Table 3: English and Aboriginal terms (from WTAPPT 2005, p. 73)

The more information about the project was available in advance, through websites or reports, the more specific I could make the questions. For example, one organization supervising cultural mapping, Applied Archaeology Australia, focuses on archaeological relicts and information. The original questionnaire covered this topic only marginally and the additional information I gained while discussing my project with my contact person at the organization allowed me to adapt the questionnaire to these particular circumstances. Simply knowing the location of the project determined if questions concerning sea country needed to be included or left out.

Some of the contacts made by sending out the questionnaires recommended other people for me to contact, known as a snowball effect. Some contacted organizations proposed doing my questionnaire for a different project than I had suggested, either because it was more recent or an older project if the data was not complete yet.

3 Cultural Mapping – Setting the Ground Rules

3.1 Western and Indigenous Maps

The dominant culture generally sets the ground rules for cultural mapping. If minorities, i. e. indigenous people, want to achieve their goals, they have to convince the dominant society, i. e. Western society, that these goals are valid and important. The best way to do so is to employ methods and tools that are predominant in the country of operation. In the case of cultural mapping that is GIS. As indigenous people usually are in the minority by numbers, it is no surprise that it is hard for them to make their voices heard. Estimates put the worldwide number of indigenous people at about four to five percent of the world's population with approximately 250 million people (Beltrán 2000). Based on the last census data from 2001, Australia's indigenous population consists of 458,520, which is 2.4% of the total population (ABS 2003a). In addition, Australia's indigenous population was not granted citizenship until 1967 (NOO 2004a).

Using traditional indigenous mapping techniques to convey information to a non-indigenous society is not a solution. In the light of globalization, adaptation to Western cartographical methods is unavoidable, if indigenous peoples want to gain further autonomy (Bauer 2009, Pearce & Louis 2008). Even if these tools and technologies are not adequate for indigenous purposes, they are far more likely to achieve something than insisting on using traditional maps to convey data and problems to Western society, as they would most likely be written off as irrelevant or at best lead to misunderstandings. As diverse as cultures are, it should not come as a surprise that maps and mapping can be just as diverse. As Brody (2002, p. 45-46) points out: *“Oh yes, Indians made maps. You would not take any notice of them. You might say such maps are crazy. But maybe Indians would say that is what your maps are: the same thing. Different maps from different people – different ways.”*

Many Westerners see their maps as the only true maps and disregard maps that look different or maps they do not understand. This subjective perception of map and non-map - or right and wrong - efficiently illustrates the difficulties that are encountered when Western and indigenous cultures come together and make maps. In order to understand what kind of challenges indigenous people encounter when they want to map their knowledge with GIS, one has to understand the different cultural concepts first. Although mapping itself is not a Western concept, most mapping today centers on Western cartographic theory, from mapping definitions to mapping technologies like GIS. Mapping systems have developed independently all around the world. They are not developmental stages of one system, but systems in their own right. Mapping is a cultural process and the result of specific environmental and spatial needs. Therefore, different mapping cultures developed separately in different parts of the world (Pearce & Louis 2008, Sutton 1998, Wood & Krygier 2009b). But the dominance of Western mapping subdues other mapping concepts and continually refuses to acknowledge them as equal. The term ‘non-western mapping’, often used to describe indigenous mapping, illustrates the problem quite well, as the term has a negative ring to it because it supports the perception that mapping is primarily a European discipline (Pearce 2009). The problem is rooted in even the most basic issues, such as the definition of what is a map and what is not a map.

Even within Western society there are several different definitions for a map (Keski-Säntti et al. 2003, Wood & Krygier 2009b). Chapin (2006) allocates the difficulties to the fact that maps are a technical as well as a political product. The technical aspects come into play when drawing up and producing a map, the political aspects emerge when maps are put to use. One common definition for a map is “a representation of a part of earth’s surface” (Wood & Krygier 2009b, p. 340). This is a rather nature-related

description and leaves out most social and political aspects of a map. But most maps are used for orientation and way finding or political purposes (Wood & Krygier 2009b). But the criterion that makes it especially difficult for maps drawn by indigenous people to be accepted is the world's arrangement into longitudes and latitudes by laying a coordinate system over it and giving every location a specific x- and y-coordinate (Pearce 2009).

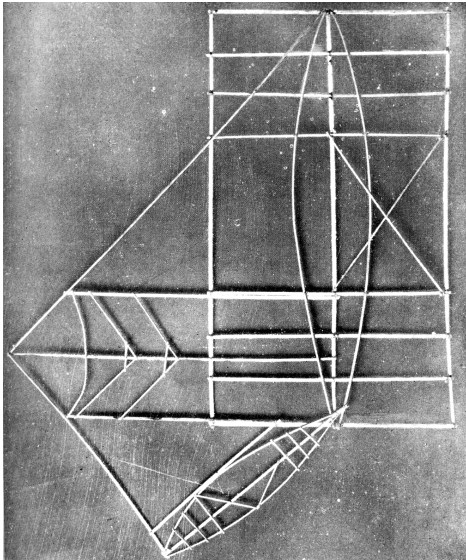


Fig. 2: Marshall Islands stick chart (Finney 1998, p. 482)

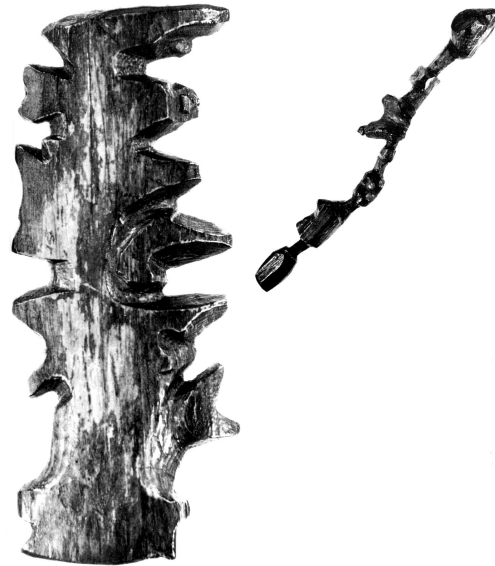


Fig. 3: Wooden coastal charts from Greenland (Lewis 1998, p. 169)

When looking at the objects shown in Fig. 2 and 3 one could easily mistake them for pieces of art, when in fact they are maps. They certainly do not make use of a coordinate system. But their makers used them successfully as navigational tools. Fig. 2 shows so called stick charts from the Marshall Islands. They consist of palm fronds tied together with cord. Islands are marked with shells or coral pieces. The arrangement and positions of the sticks mark waves and swells or rather currents, which were not known to the Islanders. The knowledge of using and making stick charts was a well guarded secret (Feinberg et al. 2003, Finney 1998, Thrower 2008, Turnbull 1993). Fig. 3 shows three-dimensional wooden coastal charts made by the Ammassaliks, an Inuit group from Greenland, which they carried with them in their kayaks. The contours depict the relief of the coastline in great detail, including angles of the cliffs (Chambers 2006, Lewis 1998, Rundstrom 1993, Turnbull 1993). Even knowing they are maps, without proper instruction, an outsider would not know how to navigate with them.

These wooden and stick maps also show that maps are not exclusively found on paper. Although in the English language 'map' is mostly used to describe an object printed on paper, maps can be found on a variety of materials: paper, parchment, cloth, wood, metal and stone. The words 'map' and 'chart' originate from the Latin terms for 'cloth' (*mappa*) and 'paper' (*carta*) and therefore describe materials used for drawing maps on

(Thrower 2008). But this perception that maps have to be drawn on tangible objects again excludes numerous indigenous maps, as drawn maps are not the only form of cartography. Indigenous mapping purposes, symbols, scales and materials may differ from Western mapping practices, but as long as they have spatial content they can be classified as maps. (Thrower 2008). Performance cartography like rituals, dancing, songs and poetry also contain spatial knowledge. Indians in South America and Vikings used rhymes to remember their travel routes. For the Inuit songs acted as travel itineraries with the help of *inuksuit* (markers made of piled stones) along the way (Klinghoffer 2006). Australian Aborigines did not produce lasting copies of maps before the arrival of the Europeans. In Aboriginal mapping, the painted design, pattern or sign is not lost if the medium on which it is painted perishes or is destroyed. The design or patterns are permanent as they can be reproduced on any medium at any time. Only the design matters, regardless if it is drawn on a wall, bark, a boat or the skin of a boy during a ceremony. Sutton (1998, p. 363) cites the concept Aborigines have of their maps: “*We don’t need a paper map – we’ve got our maps in our heads.*”

The focus of indigenous maps often lies on the process rather than the end product. Even if maps are created during the process, e. g. maps drawn in the sand, they are often not intended to last or even deliberately destroyed after they have fulfilled their purpose (Pearce 2009, Sutton 1998). Very few map definitions account for these performative aspects of cartography, like Wood and Krieger’s (2009b, p. 340) definition of maps as “tangible and intangible objects that locate environmental and human features”. As Sutton (1998, p. 364) points out: “*The very word ‘maps’ carries its own cultural baggage. There is no direct translation for such a word into Aboriginal languages. The conditions under which Aboriginal topographic representations become cartographic are those in which they become of interest to a global audience of geographers and historians of cartography.*”

Basset (1998) points out that as long as Western map definitions prevail the field of cartography will continue to refuse acknowledging mapping traditions that do not resemble Cartesian maps. Rainstorm (1991) notes that without these different perspectives on maps the cartographical history will never be complete. But despite the *History of Cartography Project*, started by Harley and Woodward, with a special volume on non-Western mapping (Woodward & Lewis 1998) and other contributions that added to the field of cartography, the debate over what is a map and what is not continues (Pearce 2009).

Furthermore, with the development of European maps, especially mathematical accuracy and the development of the coordinate system, the map definition became more and more restricting over time. Before the technology for accurate mapping existed,

maps were more like guidelines, not meant for precision. In the Middle Ages, nobody expected them to be precise enough to rely on them for detailed navigation (Klinghoffer 2006). Even older European maps are often criticized for not being a map, because the purpose is usually unknown, cannot be proven or is merged with other functions, e. g. religious or spiritual ones (Smith 1982, Wood & Krygier 2009b). The oldest surviving and uncontested map is from ancient Babylonia (circa 600 BC). The oldest likely maps are the rock carvings of Bedolina (2,000-1,500 BC) (Fig. 4) and the wall painting of Çatal Hüyük (circa 6,200 BC) (Smith 1982, Turner 1993). A more recent discovery produced another possible map in the cave of Abauntz, Spain, which is over 13,000 years old (Utrilla et al. 2009).



Fig. 4: Bedolina map (Smith 1982, p. 14)

The same problem arises for indigenous maps, as the purpose that would qualify indigenous art as maps is often disguised behind unknown sign systems and cultural context that would need to be explained before one could adequately judge if something is a map or not. Fig. 5 shows a *dhulay* (paper bark painting) of the Gumatj clan homelands in north-east Arnhem Land, Northern Territory, and Fig. 6 a conventional Western map of the same area. In Fig. 5, the parts of the crocodile (an ancestral being) represent parts of the land. The crocodile's rear legs represent the coastline (marked green). Where the tail is attached to the body is the river mouth. When the graphic elements of a painting match with actual landscape contents, the *dhulay* is considered a map. With a little imagination even someone not too versed in this particular Aboriginal culture can recognize a map. But to understand the deeper meanings and read all the information contained in it, even for this painting one has to know something about the stories, songs and dances of the land. The background pattern (*mittji*) is the 'fire dreaming', a design owned by the Gumatj. The irregular diamonds signify flickering flames, where each color has a specific meaning as well. The pattern on the crocodile's back symbolizes

murky water, which represents dangerous territory. The *dhulanj* is used for teaching children about their surroundings and the dangers of the waters (Watson & the Yolngu 1993).

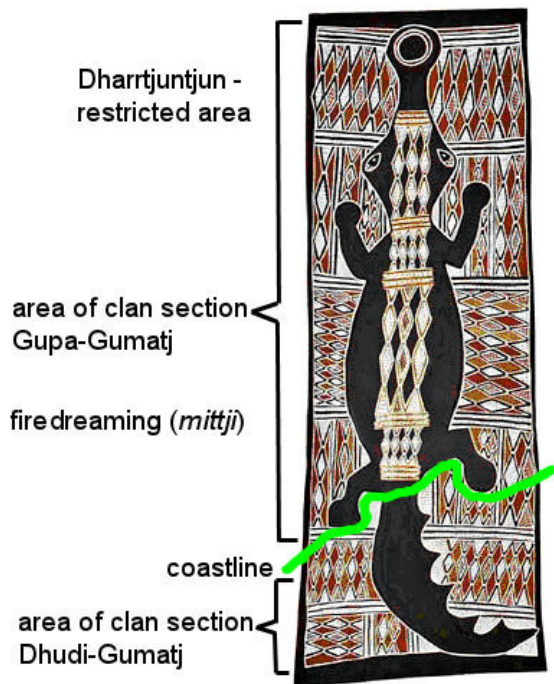


Fig. 5: Crocodile and fire dreaming, by Djamika Munungurr, 1985 (Watson & the Yolngu 1993, altered)

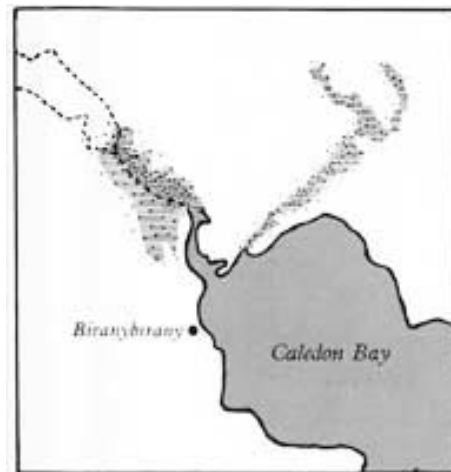


Fig. 6: Caledon Bay, Northern Territory (Watson & the Yolngu 1993)

In Fig. 7 the spatial connections are harder to decipher for the uninitiated. The painting is part of a saltwater bark painting collection that maps several hundreds of kilometers of coastal areas of north-east Arnhem Land. The paintings describe the traditional connections between saltwater people and their sea country. Some of those paintings were accepted as evidence in Federal Court to support Native Title claims over 510 square kilometers of sea in the Blue Mud Bay region, Arnhem Land, in 2005 (ANMM 2010b). Fig. 7 shows Muruwirri, a sacred rock in the Dhambaliya Channel. The painting was drawn by Mawalan II Marika of the Yolngu. The channel itself is considered sacred by some clans. It is said to be influenced by the Djambawal (thunderman) and Daymirri (the ancestral whale). It shows the sacred rock, Muruwirri, with bird droppings on top. The two



Fig. 7: Gunda Muruwirri, salt-water bark painting by Mawalan II Marika (ANMM 2010a)

king brown snakes point to a freshwater spring that wells out from the ocean floor. These features all exist in the channel. The sacred Aboriginal design with which the painting was produced contains even more information than the untrained eye can see. It is a collection of stories and ecosystem information, including conservation practices. But only people initiated in this knowledge can read it. When looking at a Western map of the area he had painted, Mawalan II Marika commented, "*It's really hard, I look at it and I can't even find it [the place and the story]. These maps don't match.*" (Papayannis & Mallarach 2009, p. 35).

Besides the coordinate system, there is one other essential difference between Western and non-Western mapping, namely the joining of spiritual or religious space with physical, political or cultural space. This technique was also employed in medieval Europe until the 16th century, when any sacred aspects were eliminated from the map. Even when non-Western societies were introduced to these concepts they did not necessarily take them up. Maps devoid of spiritual aspects are for example considered inaccurate and incomplete in many Asian societies, in parts of Africa, or in Australian Aboriginal culture. In Australia, Aboriginal bark maps join topographical features with spiritual ones, which can include aerial as well as subterranean perspectives from the point of view of the ancestors ('shifting viewpoints') (Pearce 2009). When using GIS to map indigenous landscapes, adding coordinates to the data is an essential part and cannot be avoided. It can have consequences though. This will be addressed in chapter four. Leaving out the spiritual aspects is, however, mostly unacceptable for indigenous people as spirituality is irrevocably intertwined with other parts of TEK. This often causes problems for putting TEK into GIS as well as having Western society acknowledge such maps.

3.2 How trustworthy is a map or the map maker?

As mentioned before, people employing different mapping systems often distrust systems that are unlike their own. This can lead to the misconception that other cultures are incapable of understanding other mapping systems. Some might even classify them as inferior concepts. Adler (1910, in Basset 1998, p. 24) made the following statement concerning African maps: "*We are the more surprised that the Negroes do not draw well considering the delicate wood and metal carvings of which they are capable. ... This lack of cartographic abilities leads us to impute that they have less intelligence than they have sharp eyesight, hearing, and a sense of smell.*" Even though this offensive statement is a hundred years old, Louis (2004, p. 12) is upset that not much has changed since then: "*As an Indigenous Hawaiian cartographer, I am internally rebellious and angered by the disregard and disrespect Western science has shown toward*

Indigenous epistemological traditions, categorizing it as a lower form of intelligence.” Even Chambers (2006, p. 3), an advocate of cultural mapping and indigenous rights, admits to having fallen prey to making such a blunder in his earlier days of cultural mapping: “In 1974, I spent two hot days in a South Indian village trying and failing to make a map to show all the wells. In late 1989, during the second PRA [Participatory Rural Appraisal] event in India in Kistagiri village in Andhra Pradesh, when Sam Joseph invited farmers to make their own map they plotted all their wells with much animated crosschecking and correction, and then indicated which were in good condition, and which were bad or dry. They did the plotting in just 25 minutes!”

Despite the fact that many maps drawn by early European explorers were based on indigenous knowledge and indigenous maps many scholars still have reservations about acknowledging the mapping skills of indigenous peoples today. As the originals have long been lost and only the European versions have been published, seldom acknowledging the indigenous contributions they were based on (Thrower 2008). Explorers, from Columbus to Lewis and Clark, relied on indigenous guides and maps. This knowledge was then incorporated in European maps and often served to dispossess the very people that had provided the spatial information in the first place (Bryan 2009, Herlihy & Knapp 2003, Rundstrom 1991). In North America, early explorers especially came to value Inuit mapping for its accuracy. Their usage became common and was often pivotal for the success of expeditions. During his second Northwest Passage journey, William Parry found the crucial passage through Fury and Hecla Strait due to an Inuit map. The mapping of Frobisher Bay, Baffin Island, during Charles Francis Hall’s expedition between 1860 and 1862 was completely done by an Inuk named Koojesse. He mapped the coastline and the depths of inlets more accurately and in less time than Hall could have done it. Knud Rasmussen repeatedly commented on the precise Inuit maps and their usefulness, as well as the Inuit’s ability to produce them with unknown instruments (Rundstrom 1990).

But a healthy skepticism about maps, their makers, their motives, what they portray and why is always a prudent course of action. Maps are habitually claimed to be objective, scientific and precise. Due to mapping being an established and distinguished science, maps’ representations of the world are usually accepted unquestioningly (Winlow 2009). Only since the 1980s and early 1990s have geographers and cartographers started to look more critically at maps. For the first time, attention was called to the fact that maps are the product of social and political processes and therefore neither objective nor unbiased but subject to the dominating powers and their agenda (Crampton & Krygier 2005, Del Casino Jr. & Hanna 2005, Goodchild 2009, Wood & Krygier 2009a). Publications like the first volume of Harley and Woodward’s *History of Cartography* project

(1987), Harley's *Deconstructing the Map* (1989), Wood's *The Power of Maps* (1992), Turnbull's *Maps are Territories* (1993) or Monmonier's *Drawing the Line - Tales of Maps and Cartocontroversy* (1995) marked the beginning of 'critical cartography'.

Harley established maps as "cultural text" (1989, p. 7), where abstraction has been brought to a very high level. They always have an author, usually with a patron behind them, and a purpose. Without a purpose there would be no map. The author or patron wants to achieve an agenda by producing a map. Therefore, maps are never neutral. The agenda is manifested through map content and design. Harley (1989) emphasizes the internal and external power of maps. Internal power is employed through the use of a predetermined set of signs to represent landscape. Signs can draw attention to or repress certain features, therefore giving them a hierarchy in importance (see also Wood 1992). The external power refers to the institution that commissions the map, e. g. usually the government, the monarchy or the church. For these organizations the main purposes they need maps for have always been maintaining power and strengthening and expanding territories (e. g. imperialism) (Harley 1989). The agenda shapes and determines the content of a map. By omitting certain features or emphasizing others reality becomes distorted. In spite of that, maps try to make us believe – intentionally or unintentionally – that they represent reality. Consequently, even though a map never is reality, it can influence our image of reality and "create a different reality" (Harley 1989, p. 14). One has to keep in mind that the cartographer is always superimposing the map with his own impressions of the world. He may seem objective but his own upbringing, culture and political views influence how he sees the world and therefore how he reproduces this vision. Maps are always biased. Every map has an agenda (Klinghoffer 2006).

Western maps are perceived to be accurate because they use GPS nowadays, but that is no guarantee for accuracy or correct mapping. In 1989, long before GPS and GIS were widespread, Harley pointed out that with the continuous progress in mapping technology the map was to be believed to be ever more precise. The knowledge, equipment and technology with which mapping is undertaken, does not necessarily mean, that the map is more "honest" than in the past. The same misconceptions and means of power abuse apply no matter how precise mapping has become. Indigenous people are often intimidated by official maps, as they are assumed to be exact (see Walker 2001). For a marine mapping project of the Miskito Reef Mapping Project in Nicaragua, British Admiralty and US Defence Mapping Agency charts were examined for their accuracy. The reefs and cays were mislocated or did not even exist in reality. The chart depths were too deep and location names were in English, not in use by the local communities, or badly spelled Miskito and Spanish names. A Miskito captain compared the charts to a birth certificate with the wrong name on it (Nietschmann 1995).

These discrepancies often seem to concern marine areas. As Wood & Krygier (2009a) point out that while mapping on land has progressed greatly over the last decades the oceans are mostly still left blank. Anuta Island, Solomon Islands, is a very good example of this. Looking the island up in Google Maps ($11^{\circ}36'39''\text{S}$, $169^{\circ}51'01''\text{E}$) with the ‘map’ function turned on, draws a complete blank (Fig. 8), or rather a complete blue. Only when switching to the ‘satellite’ function, the island becomes visible (Fig. 9) (Google Maps 2010). Comparing the satellite image with the mental map of the Anutans (Fig. 10) increases the information content again. The mental map of the Anutans is rich in information and formed through direct experience and experience passed down from others. Locations carry more than just the names shown in Fig. 10. People can recollect very detailed descriptions about these places, including their resource potential or history (e. g. the first person to fish there) (Feinberg et al. 2003). Somebody using the Google Maps would think that there is nothing there, when in reality there is a whole island populated by people.

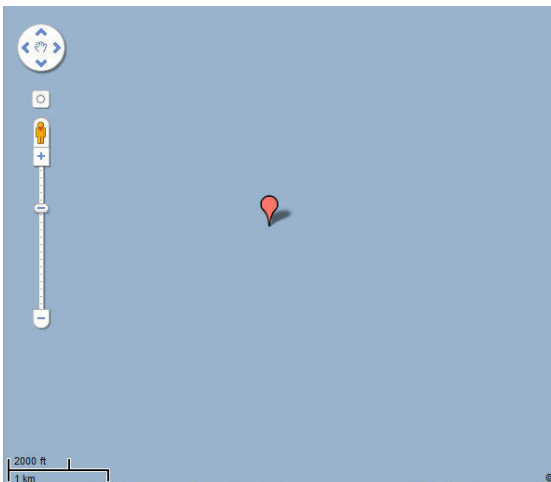


Fig. 8: Anuta Island shown with Google Maps ‘map’ function active (Google Maps 2010)



Fig. 9: Anuta Island shown with Google Maps ‘satellite’ function active (Google Maps 2010)

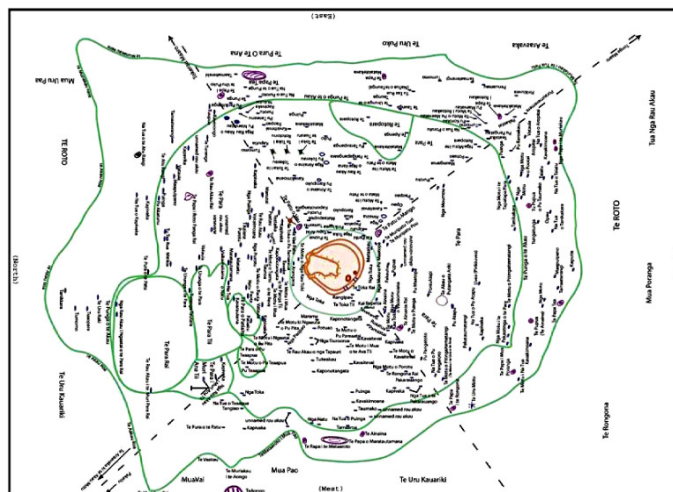


Fig. 10: Mental map of Anutans, with 2- to 3-mile radius of their island (Feinberg et al. 2003, p. 248)

No matter who produces the map, the observer should always keep in mind the intention of the map maker as this will determine what will ultimately be seen on the finished map. The map maker on the other hand always has to keep in mind who the observer will be, so that the data can be presented in a way that will be accepted. Only then will the information contained in the map be acknowledged as the truth. This is especially important for issues where the ideologies of the observer, in this case Western society, and the map maker, i. e. indigenous people, differ the most, such as over the concepts of the oceans.

3.3 Holistic versus Non-holistic Concepts - Sea Country versus the Commons of the Sea

Sea country, as Aborigines call the oceans, illustrates another conceptual conflict that challenges traditional rights and might be a very good opportunity to employ cultural mapping as a tool for obtaining more rights in the future. The oceans have long been considered empty and one-dimensional by the Western world. They were only mapped to help with navigation (Steinberg 2001). Aborigines do not distinguish between land and water. They see it as an artificial division and hold fast to their concept of traditional sea rights (Crowley 2003, Muller 2008b, NAILSMA 2008). Many Aborigines along the Australian coast have very strong connections to the surrounding waters, they consider themselves as maritime people or “saltwater people” (Sharp 2002). They depend on marine resources, are skilled navigators and fishers (Mulrennan & Scott 2000). When it comes to respecting Aboriginal rights to sea areas the Australian government is highly reluctant to grant the same rights that they grant on land (NOO 2004a).

Captain Cook declared Australia *terra nullius*, implying that the land belonged to no-one before colonialization and denying Aboriginal land tenure systems (Nurse-Bray 2003). *Terra nullius* paved the way for private property division when the British started to settle on the new continent in 1788. Analogically, the seas have been termed *mare nullius*, but since sea space cannot be private property it cannot belong to anyone, neither to Aborigines nor to non-indigenous people (AIATSIS 2006, Mulrennan & Scott 2000, Russa & Zeller 2003). Since the Magna Carta of 1215 the oceans have been considered subject to public rights such as innocent passage and fishing (Levy 1999). Before that, coastal waters were regarded as the property of the local coastal communities (Robinson & Mercer 2000). Even though Aborigines arrived on the Australian continent about 60,000 years ago (Sutton 1998) and Europeans only at the end of the 18th century, the continent was deemed uninhabited and randomly allocated between new settlers. When the first British fleet arrived, they brought with them the cadastral grid. They slowly made it visible in the form of wire fences. This probably made Aborigines aware

of their dispossession for the first time. Even though Aborigines had their own grid, scarred trees and other markers, it was as good as invisible to the settlers and could be easily ignored (Byrne 2003). Fig. 11 shows the random drawing up and redrawing of boundaries by Europeans, while Fig. 12 shows Aboriginal tribal boundaries.

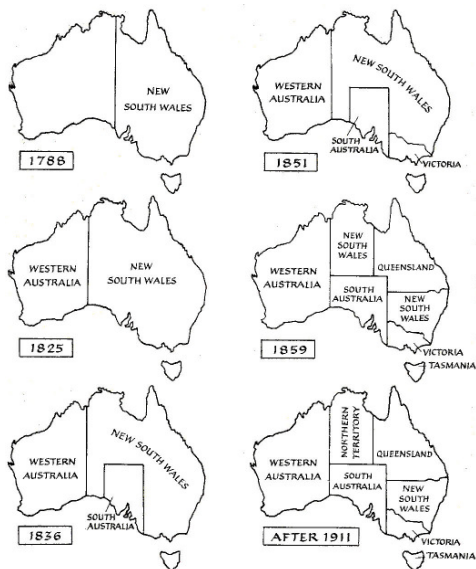


Fig. 11: Historical boundaries of Australia, 1788 to present (Hughes 1987, p. xxvi)

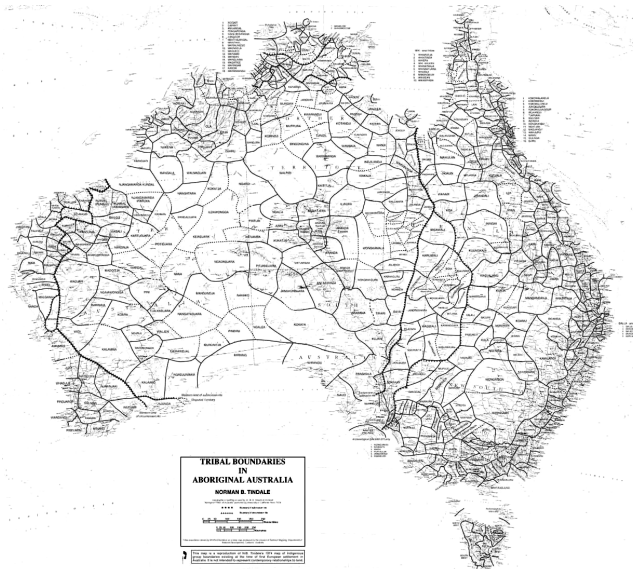


Fig. 12: Tribal boundaries in Aboriginal Australia (Tindale 1974)

Mabo v Queensland [No. 2] (1992) overthrew the concept of *terra nullius*. The High Court ruled that the previous annexation by Britain had not extinguished “Native Title”, determining that two parallel land tenure systems existed, the customary Aboriginal land tenure and the Australian cadastral system (Brazenor et al. 1999). Native Title rights are the acknowledgement by Australian law that indigenous people have traditional rights to land and resources which have existed long before European settlement. Holders of Native Title have the right to practice their laws and customs. These often include living on their traditional country, access to areas for cultural purposes, hunting and gathering food. The specific implementation can differ from community to community. Native Title is subject to extinguishment if other interests have been validated (NNTTa 2010). The Mabo decision only considered land rights (above the high water mark), not rights to the sea. The original claim, made in the Supreme Court of Queensland, did include rights to foreshore and fringing reefs, but those were dismissed by the court. Claims to areas outside the three nautical mile line had been withdrawn early on due to legal advice to avoid adding the Commonwealth as a defendant (Mulrennan & Scott 2000, Robinson & Mercer 2000). Today, about 20 percent of Australia is owned by Aborigines (Fig. 13) (DEWAH 2009). Until 1998 alone, the NNTT received 776 Native Title applications of which 140 included seaward extensions (Robinson & Mercer 2000). Fig. 14 shows the Native Title claims over sea country as of 2008.

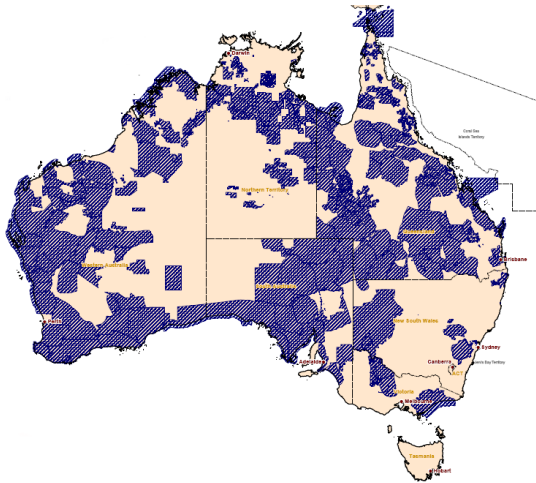


Fig. 13: Native Title claims, 2009 (NNTT 2010b, altered)



Fig. 14: Native Title sea country claims, 2008 (NAILSMA 2008, p. 15, altered)

Compared to the recognition of Aboriginal land rights, legal recognition for traditional sea rights have been much more difficult and slow going (Muller 2008b). The government is reluctant to share marine management with other stakeholders. Aborigines have been trying for decades to be included in the decision and managing processes of the marine environment. For them sea country is much more complex and important than in Western culture, where it is usually merely seen as a big blue that provides resources. Aborigines from the Northern Territory explain their connections to sea country like this: *“For Yolngu, sea country is very important culturally. When we sit, when we think, when we sing and when we dream, we have visions about sea country. Yolngu sing about the winds coming in from the ocean. The sacred sites from the Dreaming stories are there, too. We sing some animals from the sea, which are sacred to us, passed down from one generation to the next. Yolngu have sacred sites in sea country because stories are tied up with that land underneath it. That’s why we paint and we explain those drawings and paintings. It is not a painting; it is a map, a map of the Dreaming and sea creatures and sacred sites. There are many stories behind it. Dhawu, or stories, are very important to Yolngu”* (Papayannis & Mallarach 2009, p. 34).

One of the most important court decisions concerning the sea was the *Croker Island* decision (*Commonwealth v Ymirr 2001*). Croker Island is situated at the north-west tip of Arnhem Land, Northern Territory. The Native Title claim, lodged in 1994, included land and sea areas. Land claim was granted over the islands themselves. The offshore areas, which cover about 2,000 square kilometers and are mostly situated within the coastal waters (within three nautical miles), were a much more complicated matter. The Northern Territory, the Commonwealth of Australia and the Northern Territory Fishing Industry Council opposed the claim over offshore areas (Levy 1999). In 1998, the Federal Court granted the claim over Croker Island sea country, but it restricted the rights to

personal and non-commercial activities like hunting, fishing for subsistence and protection of sacred sites. Aborigines cannot hinder private or commercial vessels from entering their sea country. Commercial fishermen, mining and pearling companies were still allowed to operate in these areas (Mulrennan & Scott 2000). This is one of the main issues where Aboriginal law collides with Australian law. Mary Yarmirr provided the following testimony: “*Your common law says that the sea belongs to the Crown, but my law says that this belongs to my sea country. We do not trespass into another clan’s estate without asking permission*” (Sharp 2002, p. 149). Under traditional law, Aborigines can prohibit other clans from entering their sea country, whereas Australian common law guarantees the right to navigate and fish in territorial waters as they are common property. Additionally, international law guarantees the right to innocent passage. The federal court determined that gaining permission to enter Aboriginal sea country only applies to other Aboriginal people and therefore private and fishing vessels cannot be subjected to these traditional restrictions (Levy 1999, NOO 2004b). The decision was appealed, but in 2001, the High Court upheld the decision of non-exclusive Native Title claims at sea (Strelin 2009).

The Australian decisions concerning indigenous fishing rights contrast those from Canada and New Zealand. Already in 1990 (*Sparrow* case), the Canadian Supreme Court found that indigenous people have inextinguishable rights to fish for food that take precedence over other users’ rights. This ruling paved the way for increased involvement in the fishing industry (Notzke 1995, Prince 2003). The Maori in New Zealand have also negotiated joint ownerships in the fishing industry and have been granted more than one fifth of New Zealand’s fishing quotas (Bess 2001, Levy 1999). In Australia, the Blue Mud Bay decision (July 2008) finally gave the Yolngu exclusive rights to sea country up to the low tide mark. This means that Northern Territory fishing licenses do not apply to 80% of the coast line anymore and anybody wanting to enter Yolngu sea country needs a permit to do so (Muller 2008b, NAILSMA 2008). Canada and New Zealand still have more rights, as they get preferential rights in commercial fishing as well. More and more stakeholders are agreeing to share management responsibilities with Australian Aborigines, but discussing a share in economical benefits is not on the agenda yet (FAT & WMAC 2004). Huge amounts of money are involved in the Australian fishing industry. The commercial fishing industry operating out of Cairns, Queensland, consisting of over 800 ships, is worth about AUS \$200 million. Recreational fishing in the Great Barrier Reef is probably worth around AUS \$122 million (WTAPPT 2005).

This is one of the reasons why more and more Aboriginal groups publish their own sea country management plans (see for example Bradley & Yanyuwa Families 2007,

CLCAC 2006, Dhimurru 2006, FAT & WMAC 2004, Ngarrindjeri Tendi 2007). Most sea country plans give an outline of how Aborigines see their sea country and how they would like to manage it. When it comes to sea country, Aborigines are dependent on the good-will of the fishing and other industries to accommodate their needs and make voluntary agreements over managing their sea country (CLCAC 2006). The plans are an invitation to develop relationships with other stakeholders having an interest in Aboriginal sea country (fishing industry, tourism, recreational fishing, and mining companies). *“We need your good will, support and advice and hope our Sea Country Plan guides our future co-existence with greater equality than in the past. Our country needs us all working together, understanding its needs and limitations, not just what it can provide in the short term. Without this there is no healthy and sustainable future for any of us”* (FAT & WMAC 2004, p. 5). Several groups place emphasis on cultural mapping as part of their development strategies (Bradley & Yanyuwa Families 2007, Dhimurru 2006, Dhimurru 2008, FAT & WMAC 2004). Together with several environmental organizations, Dhimurru, the Aboriginal corporation presenting Yolngu interests, plans to map Dhambaliya Channel, including the seabed, for possible conservation as part of the Dhimurru Sea Country Plan (Dhimurru 2006).

Other discrepancies include the arbitrary drawing lines of Western jurisdictional areas. In 2004, the Federal Court granted Native Title over the Wellesley Islands area, Queensland. The claimants cited spiritual connection to their sea country “since time immemorial” (CLCAC 2006, p. 4). During the hearings for the Wellesley Islands claim, the elders explained that sea country extends as far as the eye can see. The court limited the extend of sea country to five nautical miles (from the high water mark) from inhabited islands and half a nautical mile from the mainland and uninhabited islands. This caused a “hole” in the area, where no Native Title is recognized, but completely surrounded by Native Title sea country (Fig. 15). *“These artificial legal distances are not consistent with our cultural understanding of our Sea Country and do not make sensible management boundaries. For the purpose of good management, therefore, this Sea Country Plan has been developed to apply to the whole of the original claim area”* (CLCAC 2006, p. 15). For Aborigines the extent of their sea country can vary. For some it includes all areas where they go hunting. Others extend to all places for which Aborigines have names or to places inhabited by ancestral beings (NOO 2004b). For the Yolngu, sea country can extend to the horizon or even beyond (Muller 2008b).

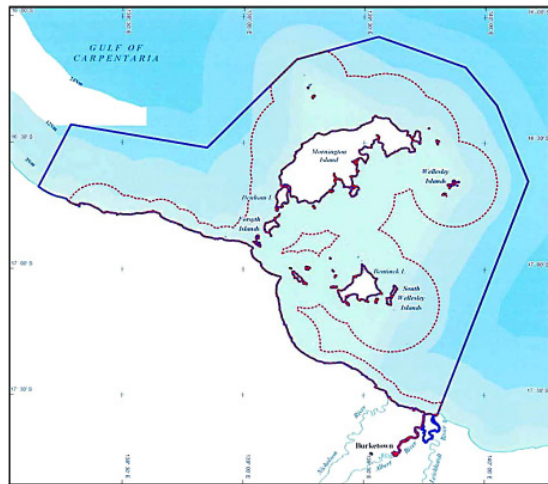


Fig. 15: Wellesley Islands sea claim area (CLCAC 2006, p. 16)

Another artificial separation are the state lines. Even though they are invisible, for Aborigines in the Northern Territory and Queensland the state border has significant consequences. The Gulf of Carpentaria Commercial Fishermen’s Association has produced a *Code of Conduct* to acknowledge that the Gulf and its resources are shared with several indigenous groups. The Gulf borders the Northern Territory and Queensland. For the Northern Territory, the *Code* advised fishers how to respect Aboriginal sacred sites and obtain permits to go ashore on land owned by Aborigines and provides the relevant contact details. For Queensland, any such protocols or contact details are missing. Since the Wellesley Islands area is part of Queensland, the according sea country plan seeks to remedy these omissions (CLCAC 2006).

“As shown in the previous parts of this Sea Country Plan, many lines have been drawn on maps of our Sea Country, indicating Commonwealth, State and Local Government jurisdiction, as well as Commonwealth and Queensland fishing areas, fishing closures, protected wildlife areas etc. We welcome the establishment of some of these zones because if properly enforced they can help to protect and manage our Sea Country. However, most of these lines and zones have been established over our Sea Country without our consent and without our involvement in their management or enforcement. Furthermore, these zones do not reflect the cultural and economic values of our Sea Country to us, and do not respect our traditional authority to make decisions about our Sea Country.” (CLCAC 2006, p. 27).

The Australian government holds firm to its concept of the seas, denying Aborigines rights in the oceans which already have been granted on land. Cultural mapping could be a very effective tool to push for traditional rights by demonstrating Aboriginal sea management practices and life styles. By putting their TEK into GIS their presence in the oceans, which has been ignored for so long, can be made visible to outsiders and attest that this environment is part of Aboriginal life and has been for ages.

4 Cultural Mapping with GIS - Possibilities and Limitations

4.1 Availability, Logistics and Costs

The development and declining costs of GPS, GIS, the internet and easier access to spatial data paved the way for indigenous people to map their own land. Many mapping projects might not have been undertaken without the availability of these technologies (Rundstrom 2009). The first GIS is said to have been invented in Canada in the 1960s (Goodchild 2009). Nowadays, almost everybody can make their own maps. Guidebooks and support networks can be easily found over the internet for free (see Appendix H for more on this matter). Some GPS and GIS technologies do not even require literacy in order to operate them (Poole 2003, Mallie 2010). GIS makes it possible to store, process and analyze huge amounts of data (Bauer 2009). Furthermore, GIS makes the data easily accessible for planners and decision makers as well as indigenous groups themselves. If the data is stored digitally it is more likely to be used for management and planning (Tripathi & Bhattarya 2004). Maps and GIS give data increased credibility and authority (Harris & Hazen 2005, Monmonier 1995, Nietschmann 1995). This can help lessen power inequalities and give indigenous groups a greater voice to pursue their interests (Bauer 2009). One restriction to cultural mapping with GIS is the availability of electricity, the internet and maintenance infrastructure (Corbett et al. 2009). Many Aborigines live in very remote areas in Australia. Only 2% of non-indigenous people live in very remote parts of Australia, whereas 27% of indigenous Australians live in very remote areas (see Fig. 16 and 17) (ABS 2003a).

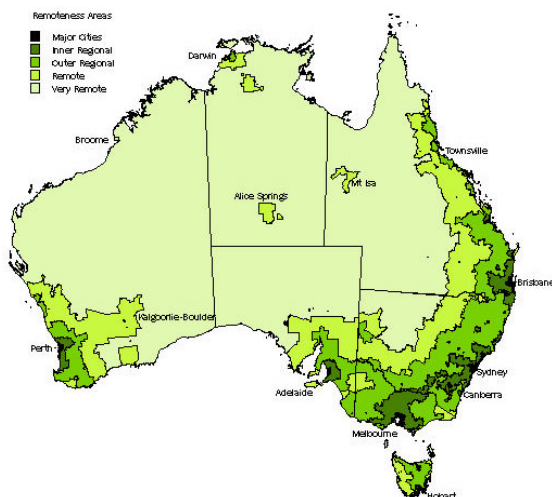


Fig. 16: Remote areas across Australia (ABS 2003b)

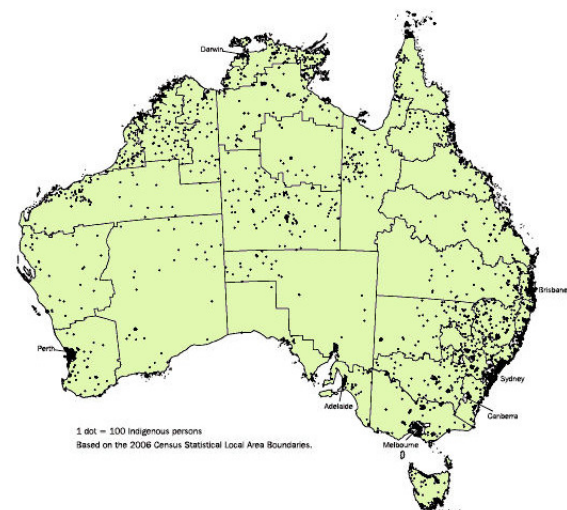


Fig. 17: Indigenous population distribution, 2006 (ABS 2010, altered)

There are a variety of open source GIS softwares available, like Google Earth, GRASS GIS, QGIS or uDig. But to get the most out of a mapping project the software should be selected according to the needs of a project. The process must be data-driven, not technology-driven (CIER 2010, Robbins 2003, Tripathi & Bhattarya 2004). Many projects

purchase complex hardware or GIS technologies before deciding on the methodology or what kind of information will be collected and how it can best be stored and analyzed. Hardware and software are just a means to an end. The information should be at the center of the project (Brooke & Kemp 1995). When the data is intended to be shared with other stakeholders, the software should be compatible with the software used by the stakeholders involved. This guarantees that maps and other data are interchangeable. Most government agencies use ArcGIS, a commercial software from ESRI. Of 23 Canadian indigenous mapping projects that took part in a survey 100% were using ArcGIS (CIER 2010). In the US, ArcGIS is available for free to tribal groups. Groups in Australia have to pay annual license fees, if they choose to employ this software (Mallie 2010). For many groups, no matter what software would fit their needs best, the deciding factor is money that determines what software will be used in the end. The Alngith, north Queensland, looked at several commercial software options before using Google Earth in the end, because their funding would not cover anything else (Morrison 2010).

The software component is not the only aspect that requires funding. Sufficient funding is one of the most critical problems of mapping with GIS (CIER 2010, Chapin & Threlkeld 2001, Morrison 2010, Nielson 2010, Whear 2010). Even though Nietschmann (1995) points out that producing maps is relatively cheap compared to sending indigenous representatives to international conferences in order to make their voice heard because they can be translated easily, generate credibility, can be copied and can be mailed or faxed easily, funding remains one of the main issues attached to cultural mapping. First of all, the hardware and software has to be purchased, set up, maintained and maybe even upgraded later. For operating these systems either outside experts have to be hired or somebody within the community needs to be trained for managing the data (Corbett et al. 2009, Rambaldi et al. 2006). Although a lot of spatial data is available online, it might not fit specific needs and satellite images or the like have to be purchased as well (Brodnig & Mayer-Schönberger 2000). At least one person has to be employed fulltime for updating and managing the data (Mallie 2010, Nielson 2010). Two people would be ideal though, as gender restricted data needs one male and one female officer to be handled appropriately to Aboriginal customs (Mallie 2010).

The problem with many projects is that they can only be maintained short term (Chapin et al. 2005, Moylan et al. 2009). Long-term funding is also an uncertainty for Australian mapping projects (Mallie 2010, Nielson 2010, Whear 2010). According to Buckley (1998) using GIS will initially decrease productivity, as resources have to be directed for equipment, training and data organization. It might take two to three years to actually benefit from initial investments. After that, productivity will surpass that of projects without GIS (Fig. 18).

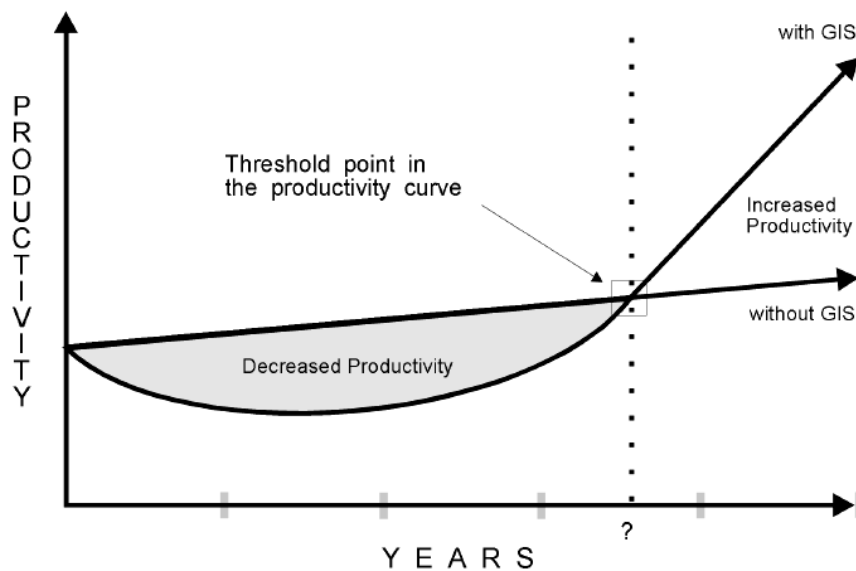


Fig. 18: GIS productivity (Buckley 1998, p. 101)

Based on 23 mapping projects in Canada, the average costs to run a project were between C\$ 60,000 and C\$ 350,000 annually. 44% of these funds came from government or other external sources, 52% were funded through internal department budgets and 4% came from other sources. External funding requires top-notch record keeping and report writing in order to demonstrate what the money has been used for. Inaccurate book keeping can quickly put an end to continual funding. Government funding makes mapping projects especially vulnerable, as political changes and therefore funding priorities or application procedures can change repeatedly. Of the 23 mapping projects in Canada 43% had to shut down their operation at some point due to insufficient funding (CIER 2010).

The problems of funding and accountability for Aboriginal groups in Australia shall be explained with the example of Dhimurru, the Aboriginal corporation representing 20 clans of Yolngu traditional owners in the Northern Territory. Dhimurru receives funding from 30 separate organizations, which all require separate annual applications, regular reports and acquittals. One of these organizations is the Indigenous Heritage Program (IHP). The IHP used to be run by the Aboriginal and Torres Strait Islander Commission (ATSIC). It is now part of the Department of Environment, Water, Heritage and the Arts (DEWHA), formerly the Department for Environment and Water Resources (DEW), which used to be the Department for Environment and Heritage (DEH), when it was taken over from the ATSIC. Dhimurru has received funding from the IHP since 2000, receiving between \$A50,000 and \$A124,000 annually. When the competence changed from ATSIC to DEH rules and procedures changed as well, causing the received funding to be only half of that of the previous year. Dhimurru had not had the opportunity to establish relationships with the new people in charge or to clarify the new guidelines. The next year, funding increased but still did not reach the full amount

that had been applied for. After three years of developing relationships with the IHP and further clarifying grant conditions, Dhimurru received full funding again (Muller 2008a). In order to justify funding, activities have to be clearly identified as part of a project. For most projects this is rather difficult, as day-to-day activities and responsibilities of caring for country often overlap with project-related activities. Project activities have to be listed and measured (in money and time). A lot of Aboriginal heritage, cultural and environmental practices will never be economically accountable, as Western funding schemes cannot account for the complexity of traditional management. Securing funding and fulfilling project tasks can put caring for country activities on the back burner as project activities take precedence. This balancing of obligations, priorities, regulations and laws of two very different systems – the own community and Western bureaucracy – can be very time-consuming and confusing. It is a skill that Muller (2008a, p. 404) calls ‘cultural brokering’. Although the funding is one of the biggest logistical problems, the compatibility of the data fed into a GIS is also an essential aspect of a mapping project, especially if the data is to be shared with other stakeholders. Cultural brokering has to be done there as well, as GIS is a Western tool that was not intended for the purpose it is used.

4.2 GIS and TEK

GIS is a Western tool, developed by Western nations for Western purposes, based on Western cartographic and scientific principles. Cultural mapping combines Western and indigenous world views and information. When these are combined, it often comes to a clash of cultures and concepts. At the same time GIS can also help overcome possible problems, as it acts as a translation tool. Putting indigenous knowledge, also known as traditional ecological knowledge (TEK), into a GIS means putting it into a language that can be understood by Western society.

TEK is local knowledge acquired through generations of observations and trial-and-error testing. Often used synonyms are the terms ‘indigenous ecological knowledge’ or ‘local ecological knowledge’. Other less common terms are ‘community knowledge’ or ‘native knowledge’. TEK is not limited to one specific field but can encompass hunting and gathering, ceremonies, stories and medicinal knowledge (Berkes et al. 2000, Drew 2005, Gerhardinger et al. 2009, Tripathi & Bhattarya 2004). It gets passed on orally and through shared experiences (Berkes et al. 2000, Turner et al. 2000). Many tasks and parts of TEK are age and gender specific. Those skills can often only be taught and learnt by a person of the appropriate age and gender. Men and women often employ different but complementary roles in a community. Therefore, when aiming to understand a local knowledge system in its entirety both genders have to be included in the

research. But often studies are limited to contact with the dominant, and usually male, members of the community, neglecting activities carried out and knowledge held by women (Hamilton & Walter 1999, Omoto 2004). Not all traditional practices are ecologically sustainable and often apply to very specific circumstances. Established TEK systems can become obsolete, if they do not adapt fast enough to changing environmental conditions (Berkes et al. 2000, Schwartzman & Zimmerman 2005). Especially if TEK is transferred to a GIS this needs to be kept in mind. Once the data has been fed into a digital database, it has to be updated regularly to remain useful (Anuchiracheeva et al. 2003).

Compared to Western science (see Table 4), TEK is often either “ignored or used inadequately” (Hamilton & Walter 1999, p 13), “dismissed for being subjective” (Ames 2003, p. 184) or regarded as “methodologically questionable, anecdotal, or – at best - of localized importance” (Brodnig & Mayer-Schönberger 2000, p. 2). Usually, neither indigenous nor Western knowledge provides all answers or is always sustainable. Therefore, many researchers agree that conservation approaches that combine TEK and Western science offer the best protection, combining the strengths of both worlds and providing accountability to each other (Aswani & Hamilton 2004, Aswani & Lauer 2006, Aswani & Lauer 2008, Baelde 2003, Bird et al. 2003, Caillaud et al. 2004, Carter & Hill 2007, Hamilton & Walter 1999).

Traditional Ecological Knowledge	Western Science
Oral tradition	Written tradition
Learned through observation and hands-on experience	Taught and learned abstracted from the applied context
Holistic approach	Reductionist
Intuitive mode of thinking	Analytic and abstract reasoning
Mainly qualitative	Mainly quantitative
Data generated by resource users (inclusive)	Data collected by specialists and experts (exclusive)
Diachronic data (long time-series on one location)	Synchronic data (short time-series over a large area)
Environment as part of social and spiritual relations	Hierarchical and compartmentalized organization
Based on cumulative, collective experience	Based on general laws and theories

Table 4: Comparing TEK and Western science (Brodnig & Mayer-Schönberger 2000, p. 5, after Johnson 1992)

The Quandamooka people of Moreton Bay, Queensland, employ a holistic and interrelated resource management approach, which combines spiritual, economic, environmental and social aspects instead of keeping them separate. But they also acknowledge that Western knowledge is vital in large scale environmental strategies, e. g. when managing migrating species or coordinating the numerous different uses and influences on

the seas, since TEK focuses on the local scale. Furthermore, they “*believe that by marrying the two systems of knowledge (that is Aboriginal scientific knowledge, technology and attitudes to the environment; and Western science and technology), the collective wisdom of both cultures will ensure a more holistic approach to life. Science, technology and the environment ideally would no longer be discrete separate units, but as ongoing interactions within the total ecosystem.*” (Barker & Ross 2003, p. 303). The environment can only profit from multiple perspectives, knowledge systems and management method (Barker & Ross 2003).

But even if people agree that Western and indigenous science should be combined, how well can a GIS accommodate indigenous ideology? Louis (2004, p. 11) criticizes: “*I am silenced by the limitation the tools that Western cartography provide for me as an Indigenous Hawaiian cartographer, tools that have been developed to favor empirical objectivity and thereby marginalize Hawaiian cartographic expressions. Yet, as I search for a means to express myself, I find myself using the language of my colonizer to convey a perception of myself.*”

Indigenous cultures see their environment as a whole. Everything is interconnected and inseparable: ecology, animals, plants, people, religion, spirituality, social issues and heritage (Colding & Folke 2001, Turner et al. 2000). Western conservation management tends to separate all these issues. In a GIS, they are mapped in separate layers and managed accordingly, which would be in complete contrast to the holistic concept of indigenous people (Byrne 2008).

In the Aboriginal conception of the world, everything is interrelated. Where people differentiate between culture and nature, Aborigines see them as one (Pannell 2006, WTAPPT 2005). For Aborigines, everything revolves around ‘country’. Country has many meanings. It encompasses the history, culture, spirituality and resources. Aborigines believe that the landscapes were created by giant animals or people during the Dreamtime. These creatures shaped the mountains, rivers, the sea, islands, reefs and all animals and plants that live in them (ATSIC 1998, Smyth 1996). Dreamtime trails and sacred sites form the center point of Aboriginal land and are part of defining territories (Smyth 1996, McNiven 2003). Aborigines live with their land in symbiosis. The land takes care of the people and the people look after the land. Each territory is part of a family and just like blood ties, these bonds cannot be broken. People and landscape are irrevocably connected. Aborigines cannot be parted from country, even if physically removed (Smyth 1996, Strang 2005). Even if a person dies, the spirit returns into the homeland. People refer to trees or rocks as their mother or their father. Aborigines get ‘raised’ by their ancestral lands. It ‘feeds’ them by ‘allowing’ them to catch fish or gather plants. In return people ‘take care’ of the land. It is a give and take that has been

inherited through the generations. In order to fulfill the responsibilities to the land and to be able to understand it, Aborigines carry maps in their heads based on the stories that criss-cross country. This knowledge ensures the survival and well-being of country and its people. To preserve it, regular interaction with the land is essential. Therefore, even if people do not actually live on country any more, they make every effort to visit it as often as possible (Strang 2000).

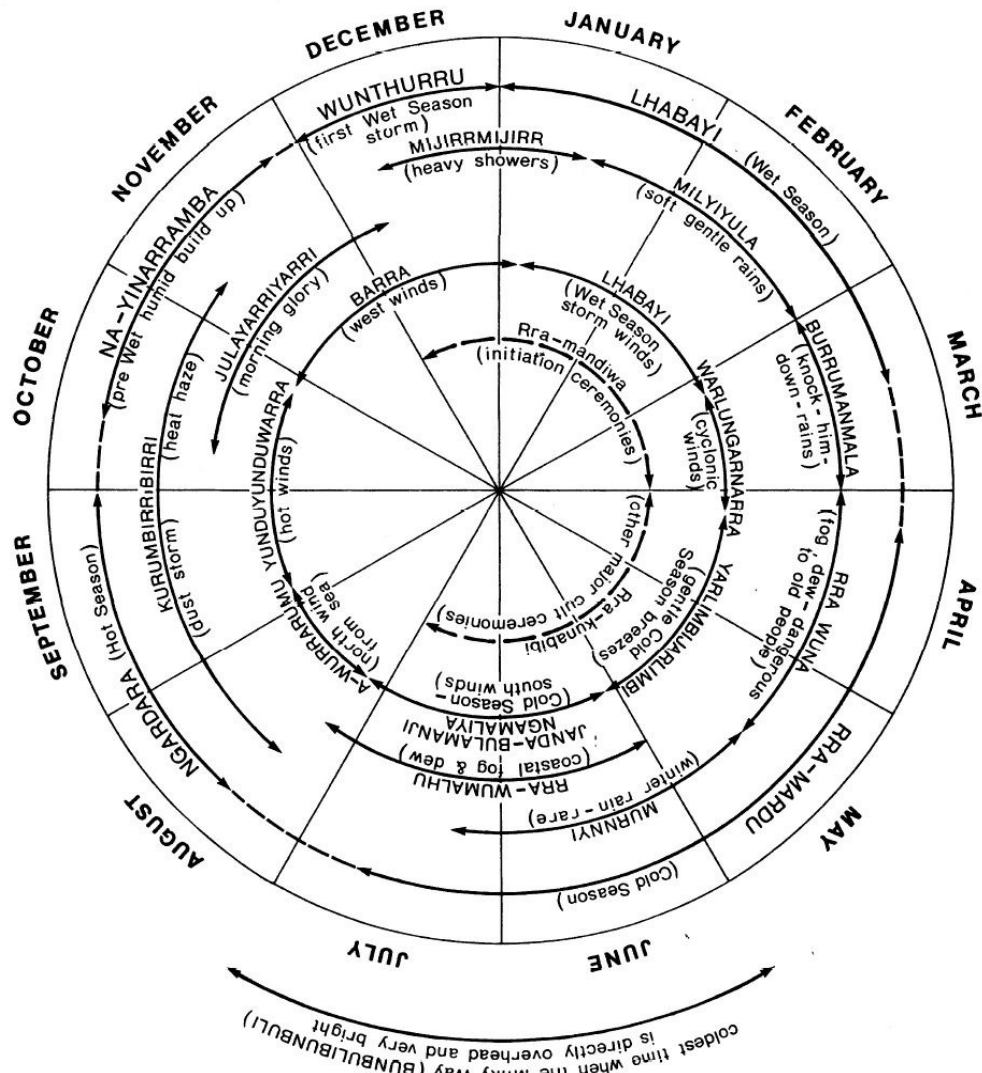


Fig. 19: Yanyuwa concept of seasons (Baker 1992, p. 70)

Aborigines possess meticulous knowledge of their environment. The plant and animal food calendars of the Yanyuwa, Northern Territory, show their detailed understanding of seasonal patterns (Fig. 19) and diverse food sources. All knowledge is inseparably intertwined. They can tell the signs when it is the best time to hunt a certain species by flowering times of specific plants (Baker 1992). They recognize the beginning of the dry season by the arrival of certain species or know when the time is right to harvest goose and crocodile eggs by the appearance of fireflies (Rose 2002).

Hunting patterns can be connected to blooming flowers, the appearance of certain species of birds or insects or might be restricted due to family circumstances (Rundstrom 1995). It is difficult to transfer this holistic view to a GIS. The same problem has been encountered by the Giringun, Queensland. *“If I say that a particular plant coming into flower is the sign to go out and raid the scrub hen nests, how do you map that? The location of the scrub hen nests can be mapped. Different things like this can be mapped by month, but how do we map the knowledge?”* (Nielson 2010). Can GIS make these connections adequately visible? As Rundstrom (1995, p. 47) puts it: *“... GIS does not capture relatedness, it constructs it. ... One important implication is that the principle of ubiquitous relations can be omitted or ignored in technoscience, but not in indigenous thought.”* And through this omission important aspects of the culture are lost. Furthermore, the ideology, the basis and the context of this information is often lost. *“The chief failing of this technology has been its inability to further our understanding of the cultural logic that lies behind the relations of space.”* (Fox 1995, in Pearce & Louis 2008, p. 111). And even though these statements are more than a decade old and GIS technologies have advanced since then, these problems persist. GIS cannot convey the whole depth of TEK because an essential part is the connection to actual space one has to experience to understand it. Mahood (2006, p. 10) took part in the trips of the Wal-majarri to revisit country, where stories were retold and relived, and recounts of her experience: *“Having so recently visited many of the locations it was a strange privilege to feel the relationship of each place to the other on both map and paintings, to know them physically and to experience one’s own vestigial sense of embodied knowledge.”*

Mapping technologies like GIS are not inherently unsuitable for mapping TEK as they can be adjusted to fulfill most indigenous people’s needs. Nevertheless, original and inventive GIS uses are still rather the exception than the rule. Western maps are usually with north at the top, seasonless, fixed in time and space and have no single point of view. These choices of cartographic language determine how one experiences the map and perceives the place it represents. Pearce & Louis (2008) changed those mapping aspects for a coastal area in Hawai’i, Nu’alolo Kai. First they changed the perspective from an aerial view (Fig. 20) to an angle looking at the coast (Fig. 21). This is a much more realistic view, as this coast is only accessible from the water, not from land, as could be assumed from looking at Fig. 20. Fig. 21 and Fig. 22 add the sun’s movements in summer and winter time. This is important information, as the areas that receive no sunlight during winter stay humid and are thus important resource areas producing maggots. Other important information concerning resources are the tides (Fig. 23). For more accuracy, the tides should illustrate the tide changes over the year as well. This animated form of cartography represents important aspects of indigenous mapping.

Nevertheless, it still lacks essential features of traditional Hawaiian representation of space transmitted through song, dance or story telling. They still mainly focus on sight, omitting human interaction, sounds or even smells (Pearce & Louis 2008).

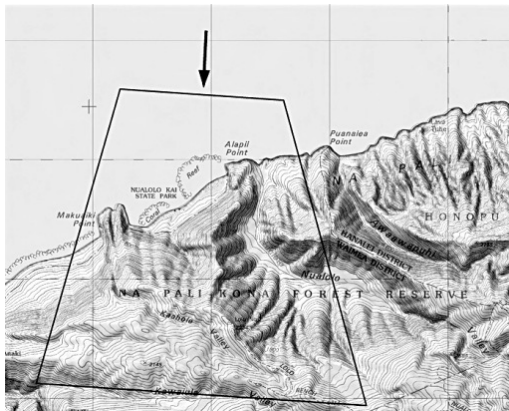


Fig. 20: Aerial view with angle used in oblique perspective (Pearce & Louis 2008, p. 119)

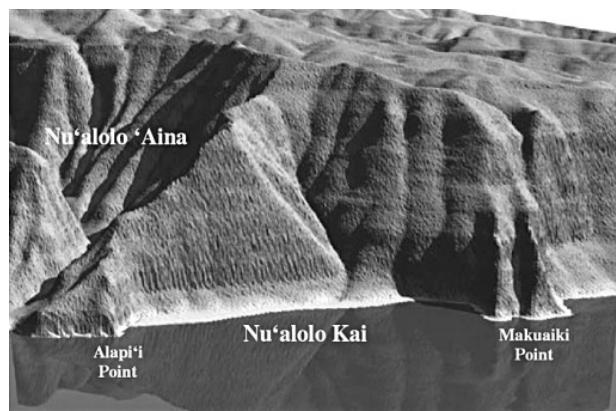


Fig. 21: Oblique perspective (Pearce & Louis 2008, p. 119)

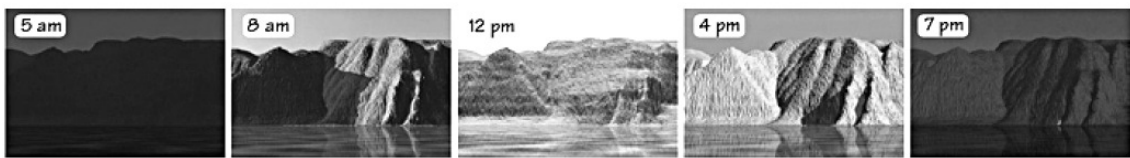


Fig. 22: Animated frames simulate movement of summer sun (Pearce & Louis 2008, p. 121)

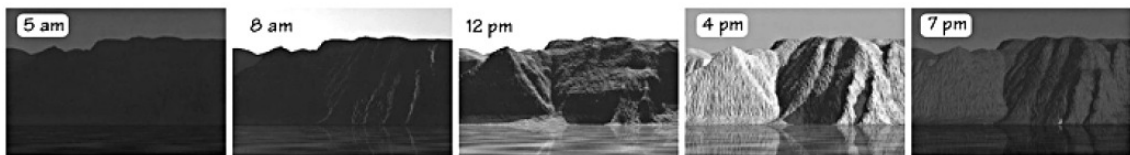


Fig. 23: Animated frames simulate movement of winter sun (Pearce & Louis 2008, p. 121)

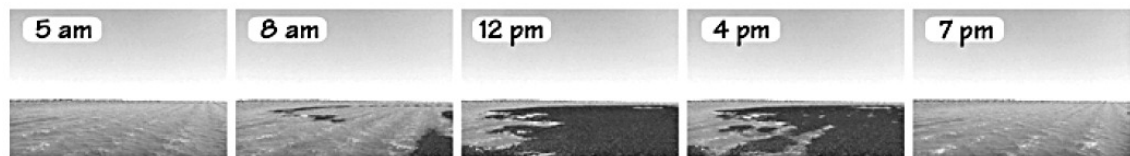


Fig. 24: Animation frames simulate daily tidal cycle (Pearce & Louis 2008, p. 122)

The mapping project from Cape Arid National Park, Western Australia, found especially the connections between the spiritual aspects and the landscape difficult to express with a GIS (Guilfoyle & Morgan 2010). The Giringun came to the conclusion that if they wanted to accommodate holistic relationships a regular GIS would not do. They are trying to solve the issue of connectivity between places with the development of a Wiki. Nielson (2010) explains it like this: “*Cultural mapping isn't just about making maps. Certainly that is part of it but ... the actual mapping of cultural heritage has been becoming a smaller and smaller part. This is because cultural heritage is about*

knowledge.... *It [the Wiki] may not be classical mapping, i.e. landscape component mapping, but it begins to allow linkages to be shown. I believe that in the future this will become the best way to record cultural heritage. Mapping will always play a part, but linking the information together will open new doors for understanding.*"

Mapping TEK is difficult and some aspects are easier to accommodate than others. But even if GIS cannot convey the full depth of a culture, especially the connectivity and overall ideology, many people agree that the combination of Western technology and indigenous culture may not be perfect but can be a powerful combination. There are new programs being developed to gradually overcome the shortcomings of recording TEK with GIS.

4.3 Oral versus Written Culture

Not only the content of TEK poses a problem but also the means with which it is traditionally transmitted, namely primarily orally. This can include stories, songs or poems. TEK can also be transmitted through rituals or dancing, e.g. hula in Hawaii (Johnson et al. 2005, Louis 2004). All these means are categorized as performance cartography (Woodward & Lewis 1998) and stand in big contrast to the written science of Western culture. Whereas oral language plays an essential role for knowledge transmission in indigenous cultures, in Western science the written word is more often than not the only thing accepted to be credible (Tobias 2000). Oral traditions have often been written off as pre-literate, implying that they are not as accurate and not as reliable as if they were recorded on a piece of paper. As some societies developed literacy, the reputation, acknowledgement and value of oral traditions diminished. Compared to the written word, they became 'primitive'. There is a misconception in the Western world, which relies on the written world to record knowledge, that oral traditions are weaker and not as reliable because their own oral abilities are not very accurate. *"It has been documented, however, how long stories and songs passed in the oral tradition may be kept without being written down, whereas many literary persons cannot remember their grocery lists without scribbling them on the back of an old envelope"* (Rice-Rollins 2004, p. 40).

When bringing GIS into the dilemma of written versus oral traditions the implications can be twofold. On the one hand, GIS cannot accommodate complex languages and nuances of different words that might be crucial in oral transmission. Therefore, many groups make audio or video recordings or create separate text files of certain aspects of knowledge, if they cannot be put into a GIS (Guilfoyle & Morgan 2010, Morrison 2010, Nielson 2010). This is especially important in cases where GIS is used to store data to preserve it for future generations and prevent it from being forgotten (see Bennison 2010, Moore 2010, Morrison 2010, Nielson 2010, Whear 2010). On the other hand, GIS

makes it possible to overcome language barriers as it serves as a common language for both sides. Even people that cannot read or are not very eloquent in the language of the dominant culture can use GIS to achieve their goals. Also, GIS gives orally transmitted data more credibility. David Nahwegahbow, an Anishinabe lawyer of the Whitefish River First Nation, Canada, commented on land right claims in the foreword to Tobias (2000, vii): *“Clearly, words were not sufficient. ...we had anecdotal testimony, but that was not good enough. ... So you need to draw them a picture. That’s what land use and occupancy mapping is all about.”*

Language itself is essential for indigenous people and TEK. It is rich in information. Different terms can apply to one and the same landscape feature. The appropriate usage can depend on the time of year or the social or spiritual circumstances. Being familiar with these terms can be essential for proper navigation. Using them incorrectly can be considered bad manners or disrespectful (Rice-Rollins 2004). In many cultures, whole languages or terminology have already been lost due to colonialism. In Canada indigenous languages, ceremonies and other culturally important traditions were deliberately suppressed by the government for decades and some vanished completely. A lot of specialized terminology for plants, animals or places was lost (Turner et al. 2000). The same happened in Australia, where dispossession, assimilation, protectionism, the removal of children (‘Stolen Generations’) and suppression of cultural practices weakened the connections between Aborigines and country (Johnson et al. 2005, Muller 2008a, Nursey-Bray 2003, Smyth 1997). But, considering that Aborigines have more than 200 years of colonialism and post-colonialism behind them, they have been able to conserve their culture rather well. The more fertile regions of eastern and southwestern Australia had to endure heavier influence on Aboriginal culture than other areas (Sutton 1998). Today this knowledge is further threatened from being forgotten due to sedentary lifestyles, the influence of Western culture and substance abuse (Mahood 2006). This loss of cultural knowledge is a big concern in Australia and often at least partly reason for cultural mapping projects (Bennison 2010, Mahood 2006, Moore 2010, Morrison 2010, Nielson 2010, Whear 2010).

Then again, as indigenous cultures and traditions are eroding all around the world, putting TEK into GIS could endanger the survival of oral traditions (Pearce & Louis 2008). It should therefore not be seen as a substitution for traditional methods of knowledge transfer but as complementary. An extreme example of the dangers of lost knowledge and sole relying on GIS is shown in the following example from Canada. Inuit from the Igloodik region, Nunavut, use wind behavior, snowdrift patterns, animal movements and behaviour, tides and currents for orientation. It takes years to learn these methods. The increased usage of GIS units, especially by the younger and less experienced people, is

a cause for concern. In order to survive through snowstorms, whiteouts and fog, Inuit way finding methods need to be reliable, which they are. Until recently, the idea of getting lost has never entered the mind in those regions. The introduction of and the increased dependency on technologies have changed that, as every technical device carries the possibility of malfunction, dead batteries or losing the device. In the most northern reaches of Canada, these mere complications can have fatal consequences, as has happened several times in the 1990s. GIS enables even people who know very little about navigation to travel successfully through environment they are unacquainted with. The machinery does all the work. One does not have to understand the mechanics or data behind it to reach one's destination. Navigation by engaging with the environment is not a necessity anymore. But in hostile ecosystems it is still the safest means of traveling, even today (Aporta & Higgs 2005).

Without having looked yet at how TEK is altered, when it is put into a GIS the mere use of GIS no matter how well it is done can endanger indigenous cultures or at least certain aspects of it. Oral transmissions are not necessary anymore to access this knowledge. But one has to keep in mind that not doing anything to preserve TEK might be just as devastating for some cultures since at least some parts of this knowledge would be preserved in a GIS. In order to better understand and judge what happens to the data when it is transferred from its original state, e. g. a story or a dance, into a computer system, one has to look at the transformations that take place.

4.4 Fixing TEK to x- and y-Coordinates

Mapping means giving a location a name, a meaning, a history or an attribute like what kind of landscape one can find in this specific location. Mapping makes places visible to people who have never been there or who do not even know it existed. Cultural mapping connects a location with information. Sometimes this information was never meant to be put into a map as not every piece of information can be fixed to one x- and y-coordinate on the grid. As Hultman (2007) puts it, one anthropological definition for culture is 'a way of life'. If one wants to map culture, one needs something visible, something tangible. Putting everyday life into a GIS requires it to be put into a grid, therefore fixing culture. Mapping has become a "rush to locate everyone and everything" (Rocheleau 2005, p. 328). It permanently fixes people and resources to x- and y-coordinates limiting dynamic and complex contents to a 2-dimensional plane thereby making them static and reducing their meaning.

Many indigenous cultures have flexible and fluid boundaries. These boundaries can include territories, resource areas or hunting grounds. Making them visible in a GIS can be quite difficult and sometimes requires them to be fixed to one location nonetheless.

What was once dynamic becomes static, eliminating an essential part of indigenous culture (Fox 2002, Johnson et al. 2005, Roth 2007). Mapping freezes information, limiting it in its significance and taking something away from its original meaning. Fixing boundaries can also lead to conflicts as they draw attention to the extent of one's own territory and neighbor territories. Where before everybody was content with overlapping and fluid rights to resources or territory, official boundaries can be contested and fought over (Fox 2002).

As TEK is dynamic and changes over time it adapts to environmental changes. Fixing data to one location might show just one short moment in time that will become outdated in the near future (Stocks 2003). Maps, especially if printed, become outdated and need to be replaced on a regular basis. Indigenous people do not need printed maps. They have a map in their head. These maps allow them to navigate around their land. Australian Aborigines have maps in their heads that have been passed down through generation, allowing them to walk ancient trails that no group member has visited for generations. These maps are both timeless and get renewed continually. The information 'updates' are part of the natural process of the tradition of oral maps (Peat 1996).

For Yolngu, boundaries are based on stories and mythology. They are not simple, meaningless lines but have their own specific stories, reasons and laws attached to them. They can be physical barriers, like rivers or changes in vegetation, but they can be invisible as well. Stories tell them where their land ends. The Yolngu believe that honey sampled by Dreamtime beings and found to be bad is due to the land belonging to another group (Williams 1986). Also, when Aborigines enter land that belongs to another group, they lack the specific knowledge for that land and feel like foreigners (Rose 2002). Thus geographical barriers are established. Stories can easily be adapted to changing circumstances and changing boundaries and everybody in the community can tell stories and 'update' them. Adjusting GIS data to new circumstances is far more complex. And as mentioned before, if the money and staff is not there to do so, the information might not be updated at all.

Fixing boundaries or TEK to one location can have permanent impact on indigenous concepts of space or eliminating them completely with time (Fox 2002). This happened for example in Siam, today known as Thailand. When the British conquered parts of Burma in 1825, they repeatedly asked Siam to negotiate the boundaries between the two territories. The Siamese court responded that there were no boundaries, but if the British wanted some, they would need to ask the people living there as they considered it a local matter. Up to this point in history, Siam had never had a need for fixed boundaries. They saw their land as overlapping, hierarchical power centers. Finally, Siam adopted the British concept of space and boundaries and started using maps for their own pur-

poses. Had they not done this, Siam might have ended up as a colony, too (Winichakul 1994). Even today, the impacts of this decision are noticeable. Thailand controls the majority of its historical and topographical maps and aerial photos, whereas for other countries in Southeast Asia it is usually easiest to obtain those materials from US or European collections. Siam's adoption of Western mapping and keeping possession of its own maps was vital in maintaining control over its lands (Fox 2002). On the one hand, the traditional concepts of space got lost with the adoption of Western mapping principles. On the other hand, it was an effective weapon against colonialism and ensured the survival of the Siamese state.

Making TEK visible on a map, therefore making it tangible, has advantages when negotiating with the Western world. Even if fixed boundaries might not be desirable, if the map is intended for government agencies or other stakeholders, vague or intangible data might not be accepted (Nielson 2010). Projects might lose their credibility right from the beginning and compromises have to be made. So far, we have seen that most impacts of GIS on TEK and indigenous life styles can have positive as well as negative effects, sometimes even at the same time. A lot depends on how and for what the data is used and who uses and controls it. People who are familiar with the data are more likely to handle it appropriately.

4.5 Alteration, Distortion, Assimilation

When TEK is fed into a computer system, it has to be translated or encoded. As with most translations the possibility of something being lost in the process is quite high. Meanings get lost. Information is altered, distorted or assimilated. Knowledge is taken out of context, misinterpreted or reproduced incorrectly. "The information becomes a mere shadow of what it used to be" (Rundstrom 1995, p. 52). On the outside it might appear to be still the same knowledge, but it will be diluted by being taken out of context (Pearce & Louis 2008).

Some aspects of TEK are more prone to alteration, distortion and assimilation than others. When the government of Moorea, French Polynesia, wanted to include TEK for planning marine protected areas around the island, the locals did not trust that GIS databases were adequate to store their non-economic information, such as spiritual aspects, which they felt needed to be part of the project. As they had no access to and no understanding of GIS technologies they feared their data would be misinterpreted or misused once it was fed into the database (Walker 2001).

Data loss during the translation process can happen unintentionally as well as intentionally. Some information might get discarded because it would be too difficult or too inconvenient to map because it does not fit prefabricated categories. Too esoteric data

might be dismissed as not scientific enough and unmappable, other data will be prioritized (Bryan 2009, Corbett et al. 2009). For example, some biosystems get preferential treatment because of their “mappability” (Harris & Hazen 2005, p. 108). Some ecosystems are harder to define than others. Compared to islands, water bodies or forests, grasslands are not as distinctive and therefore not as visible on a map (Harris & Hazen 2005).

Combining indigenous with Western concepts might not only have an influence on the data put into a GIS, but also on the culture itself. If indigenous people are constantly confronted with Western concepts and forced to adapt their own ideology to these concepts, they might come to project these concepts onto their own ideologies or neglect their own cultural traditions, at least temporarily for the duration of a mapping project. This leads to less authentic representations of TEK, but consciously so that Westerners are more likely to grab the information content. In other words, Western influence can “displace local vision” (Jolly 2007, p. 509). A good example is ‘Tupaia’s map’. Tupaia was a native from Ra’iatead, Tahiti, who joined James Cook on the *Endeavor* in 1769. Besides acting as a guide and interpreter for Cook, Tupaia produced a now famous map of islands in the Pacific. The map covered the seas from Fiji to the Marquesas Islands, spanning 40 degrees of longitude and 20 degrees of latitude (Lewthwaite 1970, Finney 1998). Tupaia had to adapt his explanations so that Cook and his crew could make sense of them. It was not his indigenous point of view. Although that certain view will never be known, it is likely that among his own kind he would have explained the map through stories and songs (Jolly 2007), not directions of north and south, which he tried to employ and which led to misunderstandings (Finney 1998). Active navigation would have replaced geographical teaching with pen and paper (Jolly 2007).

Aborigines are aware that their maps are not always understood by outsiders, as they are often not supposed to. This deliberate encoding can be mistaken for lack of knowledge on how to do it ‘better’. Therefore, many indigenous people adapt their indigenous worldviews so that they can be understood by outsiders as well. Larrtjannga Ganambarr of the Yolngu was asked to produce a map painted on bark that could be understood by Yolngu as well as Europeans. The end product (Fig. 25) can be recognized as Arnhem Bay (Fig. 26), but it is untypical for Yolngu. Usually paintings from that region are more geometric with a high degree of symmetry and generalization of topographic features. Fig. 25 shows the place where Bul’ngu (thunderman) shaped the clan land. The shark, stingray and barracuda are spirit beings inhabiting the coast. Bul’ngu itself is shown as a more typical bark painting inside the map (Sutton 1998). Compared to indigenous maps shown in chapter three, Fig. 25 is missing important cultural information and the uniqueness of traditional Aboriginal maps. The actual geographic location is

easier to recognize, but the cultural information content has almost decreased to the level of the Western map.

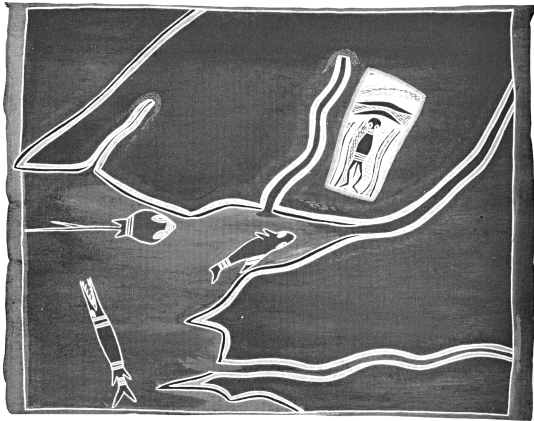


Fig. 25: Map of Arnhem Bay, Arnhem Land, by Larrtjangga Ganambarr (Sutton 1998, p. 404)

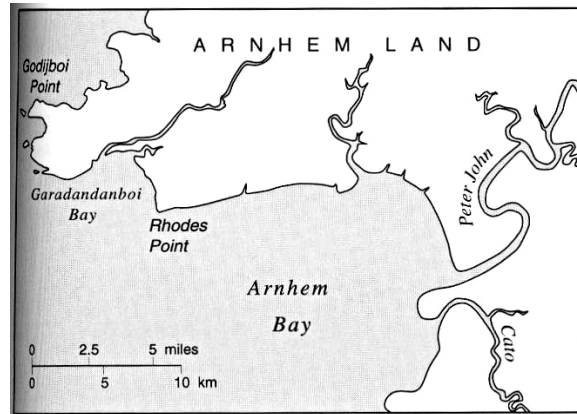


Fig. 26: Map of Arnhem Bay, Arnhem Land (Sutton 1998, p. 405)

Whereas Tupaia's exclusion of indigenous mapping aspects was due to the limitations of the mapping methods of that time and his wish to make to be understood by Cook and his crew, Aborigines in modern Australia sometimes deliberately leave out parts of TEK out of fear that they could be ridiculed or not be taken seriously, like spiritual, supernatural or sacred aspects. This form of self-censorship is the result of cultural restrictions and educational assimilation of the 19th and early 20th centuries as well as suspicious anthropologists doubting the authenticity of such claims. To preempt second-guessing certain aspects of Aboriginal culture, Aborigines may only make edited or abridged versions of their culture available to outsiders (Byrne 2008). Also, Aborigines today produce both kinds of maps, maps in the form of oral transmissions and Western maps. Increasingly, these two systems mix and overlap. Performance mapping is part of educating outsiders just as cultural GIS maps are part of teaching the next generation about country. This increased combination of both systems leads to more reflexive versions of Aboriginal culture and can result in changing it over time (Strang 2000). Possible long-term effects of GIS on indigenous culture are unknown at this point (Rundstrom 2009, Strang 2000).

The problems of cartographic translation have been acknowledged, but solutions are seldom offered (Pearce & Louis 2008). GIS is the most common mapping method today and therefore mapping project will always have a Western factor involved. Alteration, distortion and assimilation are much more likely to happen if uninitiated people from outside the community are hired to operate a GIS (Johnson et al. 2005). They may understand the technology, but since they are missing the cultural background, the misunderstandings might happen before the data is even put into the system. If indigenous people are responsible for feeding the data into the system themselves, they also have better control over what should be put into a GIS and who has access. Morals that

would restrict the usage of certain information are difficult to incorporate into a GIS. Putting TEK into a GIS makes it more accessible, even far away from its geographical place of origin, increasing the chances that the data will be used for other intentions than its original purpose and context.

4.6 Issues of Access and Privacy

Written culture, and therefore GIS as well, have the advantage of making knowledge more widely available, making it easier accessible to relevant stakeholders. At the same time this makes it more vulnerable to misuse. The original owners of this knowledge can lose control over how the information is used (Bauer 2009, Byrne 2008, Turnbull 2007). Especially when it comes to sensitive, restricted information, many indigenous people are reluctant to share it and concerned that cultural restrictions might be rendered inoperative once the data is part of a GIS (Roth 2007, Sithole et al. 2007). Access to a bark painting is easier to control than a digital version of the information contained within.

Aboriginal symbols are often quite cryptic for the untrained eye. These mechanisms are even necessary within the Aboriginal community as knowledge is often restricted to certain members or groups, depending on status, gender or the level of initiation. The simplest and most generalized images, often reduced to geometric forms, are usually the most sacred and powerful designs that carry complex and layered meanings. These, to Western eyes mysterious and puzzling drawing styles, are considered a skill in Aboriginal society. Secrecy and encoding is a goal, not a hindrance or an obstacle (Sutton 1998). By contrast, in Western society a map is considered well done, if the symbolized messages are clear and easily understood. Some symbols, especially representing natural objects, span even the most diverse cultures, e. g. lines that distinguish between water and land, rounded blue shapes that represent lakes, or semi-realistic drawings of vegetation (Kelly 1999, Rambaldi 2005). In order for maps to be used as communicative devices, the cartographic language needs to be understood by all stakeholders involved (Rambaldi 2005). Transferring these Aboriginal levels of access to a GIS can be problematic and is one great concern for Aborigines when putting TEK into a GIS (Mallie 2010, Morrison 2010). Almost all projects questioned if they plan to make data public answered that there were at least some aspects that would be kept for community use only, especially sacred sites or some dreamtime stories (Guilfoyle & Morgan 2010, Moore 2010). Most said that only very little or nothing at all would be shared with outsiders (Bennison 2010, Morrison 2010, Nielson 2010, Whear 2010).

Withholding data to avoid possible misuse, intentional or unintentional, is the logical consequence, since the Western legal system offers only poor protection for indigenous

knowledge. Protecting tangible property through Western legal systems is mostly unproblematic. But intellectual property rights are more complicated, especially when it comes to stories and mythology, which would be considered public domain. Even an original version of a traditional story might prove problematic, as the original basis would still be part of the public domain. TEK in general is therefore a challenging topic, as it has been accumulated over generations. And even if the knowledge is legally protected, who will authorize access and usage? Who is the right-holder inside the community (Gervais 2003)? A case from Australia (*Yumbulul v. Reserve Bank of Australia*) demonstrates this problem quite well. Terry Yumbulul, an Aboriginal artist of the Galpu people, had made a sculpture that was featured on a ten dollar note. He had a copyright for the sculpture and had licensed it to the Reserve Bank. Later he claimed he had not had the authority to do so, as it belonged to the elders. Yumbulul later sued the Bank and claimed that he had been coaxed into signing the license. The case was settled out of court (Golvan 1992). There are several forms of multiple ownership, e. g. joint authorship, work-for-hire, transfer of rights from an individual to the community. But none of these really apply to indigenous societies and their TEK. Copyright was mainly intended to protect individual rights and financial gain. Protecting TEK, with the exception of pharmaceutical uses, is not economically attractive. The system to protect intellectual property would have to be extended to accommodate the needs of indigenous people (Gervais 2003). Therefore, the only way to make sure that TEK is not abused is to determine who gets access and to what in advance. Indigenous people have to be the ones who decide when, how and if this information is passed on to outsiders. With oral traditions the people who possess the knowledge have greater control over who has access and who has not. From an indigenous point of view, a mapping project can only be truly successful, if the community has ownership rights to the maps and data (Chapin & Threlkeld 2001, Fox 2002, Fox et al. 2006, Poole 2006). In Honduras and Panama, indigenous people decided that even if their maps revealed the location of their resources to outsiders it was worth the risk as positive outcomes of the maps would by far outweigh any possible negative effects (Chapin & Threlkeld 2001). Besides, in some cases, confidential information like the location of resources can be estimated from satellite imagery (Chapin 1995).

The Kunjen of Kowanyama, Queensland, initiated a cultural mapping project to claim their ancestral lands and preserve their knowledge for future generations. The elders were concerned about confidentiality, especially that of traditionally restricted knowledge. Doing the project the 'whitefeller way', i. e. employing GIS for storing their knowledge, made them especially suspicious. These worries were only eliminated after

an agreement that the community would have complete control over the data and the map (Strang 2000).

In Australia, if people from outside the community are involved in the mapping, e. g. students from a university, they have to abide by cultural protocols and cannot divulge any information unless authorized by the community (Guilfoyle & Morgan 2010). The Queensland Government operates a heritage database, the Aboriginal and Torres Strait Islander Cultural Heritage Database and Register (DERM 2010a). But anybody who wants access to the data needs to request access from the appropriate Aboriginal community via a formula (DERM 2010b). One already has to know what exactly one is looking for, as there are not publicly accessible register, index or map to search for something. This is different in Victoria. Their database shows grid that indicate the type of cultural data contained within a certain area (Fig. 27). The Giringun point out this data is not anonymous enough as somebody familiar with the matter could spot maybe even secret places, if the approximate area is known. The Giringun instead suggest a different method. If somebody is interested in a specific area, the person or agency can request further information on a need-to-know basis, based on a grid system that does not divulge what kind of cultural sites might be located in the area (Nielson 2010, Pentecost & Nielson 2007).

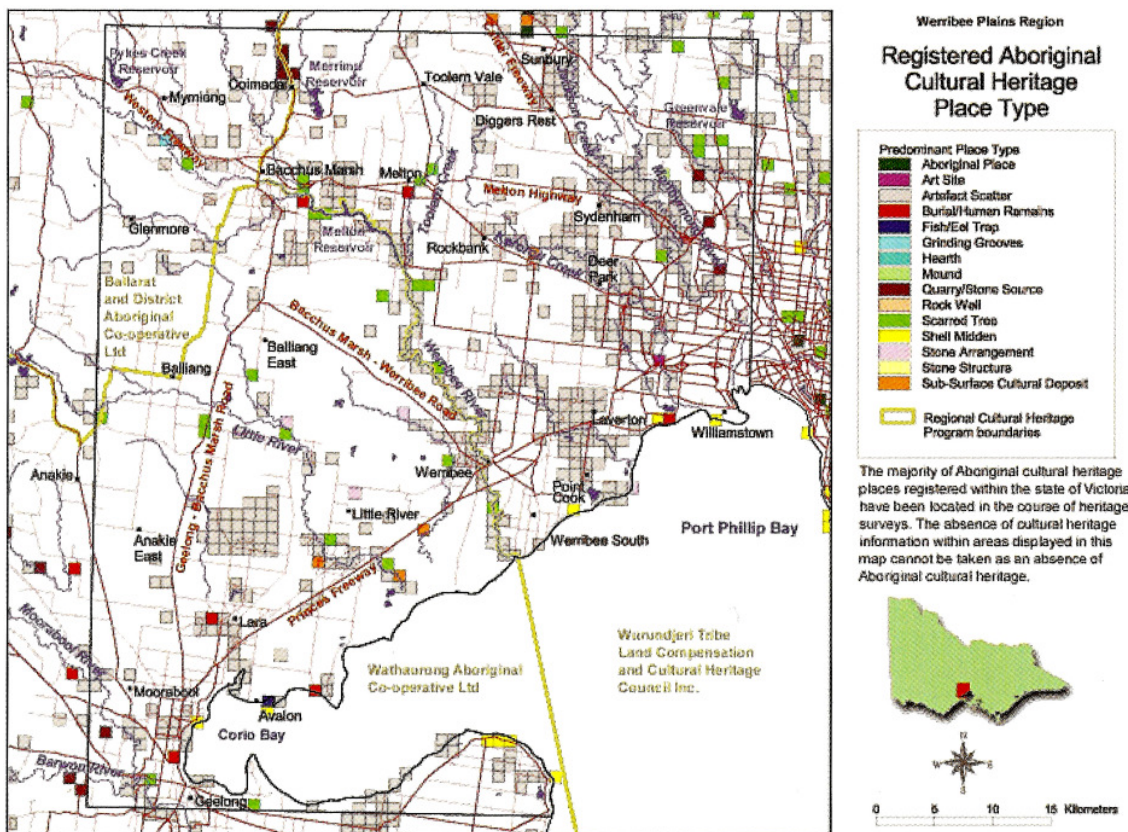


Fig. 27: Cultural heritage grid, Victorian Government (Pentecost & Nielson 2007, p. 32)

The specially for indigenous purposes developed program “Keeping Places”, a GIS and management tool, solves the restricted access problem through password protection. When the program was first used by the Anangu (Uluru – Kata Tjuta National Park) in 2003, user groups allowed for the categories of male, female and public groups. Today each group can determine their own user groups and adapt them to their specific cultural protocols and change them over time if necessary. When somebody logs into the system, it automatically allows the user only to see what he or she is allowed to see. If a male person logs in, he will not have access to data that is classified as exclusively for females. Whenever a clan member feeds new information into a system, the person might decide to restrict the knowledge just to members of his own clan or family. For some groups the decision over who gets access to which information might be made by a board of elders. “Keeping Places” is used by 23 groups, 22 of them in Australia, including the Jawoyn, the Noongar and the Anangu (Mallie 2010).

For any data that is fed into a computer system there is always the danger of hacking or the crashing of the system. To avoid losing this valuable data, the Giringun keep an external back-up off site, which is updated once a week (Nielson 2010). The Algnith store a second copy of their collected knowledge in a national archive operated by the Australian Institute of Aboriginal and Torres Strait Islander Studies (Morrison 2010). No matter what system is used, every program will have advantages and disadvantages for some groups. Finding the right mix between purpose, needs and available resources should determine if and what GIS gets used to store, analyze and manage data for cultural mapping.

5 Conclusion

GIS is a tool that offers almost endless possibilities. Some programs offer so many features and are so complex (e. g. ArcGIS) that it is hard to master it completely or remember all functions and settings if it is not used on a regular basis. One should expect that so complex a system can accommodate any needs. But as has been demonstrated above, Western and indigenous mapping concepts and needs are so dissimilar that this is usually not the case. As GIS was invented by Western society and for Western needs, based on Western cartographic principles, they cannot be expected to match with indigenous concepts and needs. An additional problem poses the often deep-seated distrust between different cultures. Some people might think that for indigenous people to employ a Western mapping tool would be ‘giving in’ by taking on the tools of the dominant system. Instead they could insist on using their own methods, hoping that one day they would be accepted and given as much credit as paper and digital maps. But the advantage of gaining credibility just by picking the right tool is undeniable. Employing

the methods of another culture demonstrates that one understands the concepts behind the system.

GIS can act as a translation tool, overcoming language barriers. When defending interests and competing with other stakeholders such an advantage cannot be forsaken. So even if GIS *were* completely inadequate for TEK, for many purposes of cultural mapping there really is not much choice. But the question of this thesis is not if GIS should be used or not. The question is if GIS is an adequate tool for cultural mapping in Australia. The thesis looked at many advantages as well as disadvantages of GIS (Table 5). Since GIS as an idea and a concept was never really intended for flexible and changing data like TEK, there are areas where GIS is not adequate and has to be amended or adjusted to fit the specific needs of cultural mapping projects. Other aspects of TEK are perfectly compatible though. Should then the data that is difficult to map with GIS be discarded or circumvented to avoid these conflicts? Some groups opt to store data that cannot easily be accommodated in a coordinate system as video or audio recordings or text documents. This reduces the chances of altering or distorting information content by trying to keep it closer to its original form. Some systems can then attach this data to a location on a map.

Advantages	Disadvantages
Giving TEK more authority by putting it into a written form	Holistic approach difficult to simulate with GIS
Community empowerment by increased involvement in decision-making process	Intentional & unintentional alteration, distortion, misinterpretation, misuse and assimilation
Saving TEK from extinction and preserving it for future generations	Difficult to protect knowledge if it becomes public domain
Easier access for Aborigines and government agencies or planners	Easier access for unauthorized people
Easy analyzing of huge amounts of data	Data needs to be kept up to date to be relevant
Some systems can be used without eloquent reading and writing skills	Some systems are very technical
Even people who cannot read can use certain functions of a GIS (depending on the system)	Usually the software is not customized for a specific project
Making TEK and indigenous cultures visible and tangible	Freezing formerly flexible boundaries
Less expensive than attending conferences	Expensive and dependent on continual funding
Complementary storage medium for TEK besides oral traditions	Giving a false sense of security that traditional cultures will survive
Access to own TEK	Threat to oral traditions
Better management opportunities	Access concerns for restricted knowledge (depending on the system)

Table 5: Possible advantages and disadvantages of cultural mapping with GIS

Considering that in Australia, just like in many other countries with indigenous populations, TEK and indigenous cultures are threatened to be lost, putting TEK into a GIS might be the only way to ensure its survival, no matter how well it is done. Conserving something is better than nothing. But for the specific purpose of preserving knowledge for future generations, especially the holistic aspects of TEK are important. If one wants to simply map locations of archaeological sites to protect them from development projects, the location itself matters more than the connection to other cultural sites or story places. The holistic view does not play the most important role. But if the entirety of a knowledge system is to be preserved, the connections and relationships between places are vital. Therefore, knowledge protection is one of the most difficult purposes but also one of the most pressing ones of cultural mapping in Australia.

The worries about GIS being inadequate are more than a decade old (see Fox 1995, Rundstrom 1995). It is rather surprising that not much has changed since then. But usually, these shortcomings are not a 'deal-breaker' for cultural mapping. Cultural mapping has been a very successful tool in giving indigenous agendas a voice and gaining rights. The literature seems very keen to point out the failings of GIS when it comes to TEK, focusing mainly on the issues of freezing and fixing data, neglecting esoteric and holistic concepts and misusing, altering and assimilating knowledge. These concerns are all valid and well-founded. But from reading about these problems I expected them to be addressed more prominently in the questionnaires. However, the issues that concerned Aborigines most were funding and the dilemma of making information easier accessible but at the same time protecting restricted knowledge. The first issue, funding, was mentioned by almost all groups. If a project has to be shut down because of insufficient funding, one does not even have to worry about GIS-related problems. As funding is usually received in yearly intervals, money is the decisive factor for most groups and projects. When one has to continually secure financial support to keep projects going, other problems tend to fade into the background. The second issue, access and privacy concerns, was a big concern but can be solved through password protection. Groups not having this option can choose to keep restricted knowledge not in a GIS. No matter if restricted data is fed into a GIS or not, it is always important that indigenous people remain in control over their own knowledge and determine who has access and for which purposes. This will prevent conflicts over intellectual property rights later on.

Coming back to the dilemma of holistic concepts, only the Giringun found existing GIS so lacking in the holistic aspects that they are developing their own system to accommodate these connections and relationships via a Wiki. Some groups might choose to focus on the easier mappable data first before addressing the more complex aspects of TEK. It is not a question of positive aspects outweighing the negative ones of GIS, as

just a few GIS features might be enough to accomplish a project's goal. Every group and every project has unique needs and purposes. Ultimately, each group has to decide for itself, if the use of GIS fits their objectives and if they can work around or with the inadequacies GIS when it comes to TEK.

Another issue that was addressed by the literature, but where the outcomes are hard to estimate, at least not in the near future, is the concern that GIS might endanger cultures if oral traditions are displaced or replaced by computer systems. This is a legitimate fear. Therefore, GIS should not be used instead of traditional methods of knowledge transmission but as an addition and a fail-safe system. Otherwise, the essence of what makes indigenous cultures so special might be lost between computer monitors and a bunch of cables.

The holistic view of indigenous people is part of the essence of TEK. Can GIS do this justice? That is hard to say, and the only ones who can answer that truly are indigenous people themselves as it is their knowledge, not mine. But even if GIS is inadequate, the important thing for most cultural mapping projects is that goals are achieved despite these shortcomings. There are often more important issues than creating a GIS that can convey the full authenticity of TEK. There are innovative ways that try to solve these problems. But for most projects it certainly is not necessary to have options like 3D animation. However, it is a sign that something is changing, that GIS is used for more than its originally intended Western purposes. The conflicts created by combining GIS and TEK are a possibility to develop new and unique systems. Without TEK, GIS might never have been challenged to do more and grow beyond its original objectives. Today, there are groups trying to push GIS beyond what it was intended for. Maybe in the future, we will see some systems that overcome their static cartographic principles and heritage. As other technological advances have shown the possibilities are endless. It will take time and money as well as some creative people and some trial and error to do so. TEK did not develop in one day either. It took trial and error over many generations. But maybe one day, the inadequacies of GIS for cultural mapping can be overcome.

Literature

ABS (Australian Bureau of Statistics) (2003a): Population Characteristics of Aboriginal and Torres Strait Islander Australians: 2001 Census. Media Release.

<http://www.abs.gov.au/Ausstats/abs@.nsf/0/4B01828AAE8653CDCA256DCE007F78E2?Open> [02-08-2010]

ABS (Australian Bureau of Statistics) (2003b): Australian Social Trends, 2003: Population distribution: Population Characteristics and Remoteness.

<http://www.abs.gov.au/ausstats/abs@.nsf/2f762f95845417aeca25706c00834efa/add11adceb024dfaca2570eb0082e465!OpenDocument> [02-08-2010]

ABS (Australian Bureau of Statistics) (2010): Year Book Australia, 2009-10: Population: Aboriginal and Torres Strait Islander Population.

<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/415B7843ACA11A17CA25773700169C5F?opendocument> [02-08-2010]

Adler, B. F. (1910): Karty Pervobytnykh Naradow (Maps of Primitive Peoples), Izvestiya Imperatorskago Obshchestva Lyubiteley Yestestvoznanya, Antropologii I Etnografii: Trudy Geograficheskago Otdeliniya (Proceedings of the Imperial Society of the Devotees of National Sciences, Anthropology, and Ethnology: Transactions of the Division of Geography) 11 (2): 117.

AIATSIS (The Australian Institute of Aboriginal and Torres Strait Islander Studies) (2006): Sea Countries of the South: Indigenous Interests and Connections within the South-West Marine Region of Australia.

<http://www.environment.gov.au/indigenous/publications/sea-country-report.html> [08-03-2010]

Ames, T. (2003): Putting Fishermen's Knowledge to Work: The Promise and Pitfalls. In: Haggan, N.; Brignall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 184- 188.

http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]

ANMM (Australian National Maritime Museum) (2010a): Gunda Muruwirri. Saltwater Bark Painting by Mawalan II Marika.

<http://www.flickr.com/photos/anmm/2740246163/#/> [12-08-2010]

ANMM (Australian National Maritime Museum) (2010b): Saltwater Bark Paintings

<http://www.flickr.com/photos/anmm/sets/72157606590129097/with/2740246163/> [12-08-2010]

Anuchiracheeva, S.; Demaine, H.; Shivakoti, G. P. & Ruddle, K. (2003): Systematizing Local Knowledge Using GIS: Fisheries Management in Bang Saphan Bay, Thailand. *Ocean & Coastal Management*, 46: 1049-1068.

Aporta, C. & Higgs, E. (2005): Satellite Culture: Global Positioning Systems, Inuit Wayfinding, and the Need for a New Account of Technology. *Current Anthropology*, 46 (5): 719-753.

Aswani, S. & Hamilton, R. (2004): Integrating Indigenous Ecological Knowledge and Customary Sea Tenure with Marine and Social Science for Conservation of Bumphead

Parrotfish (*Bolbometopon muricatum*) in the Roviana Lagoon, Solomon Islands. *Environmental Conservation*, 31 (1): 69-83.

Aswani, S. & Lauer, M. (2006): Incorporating Fishermen's Local Knowledge and Behavior into Geographical Information Systems (GIS) for Designing Marine Protected Areas in Oceania. *Human Organization*, 65 (1): 81-102.

Aswani, S. & Lauer, M. (2008): Integrating indigenous ecological knowledge and multi-spectral image classification for marine habitat mapping in Oceania. *Ocean & Coastal Management*, 51: 495-504.

ATSIC (Aboriginal and Torres Strait Islander Commission) (1998): As a Matter of Fact: Answering the Myths and Misconceptions about Indigenous Australians. 2nd edn, Canberra.

Baelde, P. (2003): Using Fishers' Knowledge Goes Beyond Filling Gaps in Scientific Knowledge: Analysis of Australian Experiences. In: Haggan, N.; Brignall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 78-86.

http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]

Baker, R. (1992): Traditional Aboriginal Land Use in the Borroloola Region. In G. Baines & N. Williams (eds) *Traditional Ecological Knowledge*. Centre for Resource and Environmental Studies, Australian National University, Canberra, pp. 126-143.

Barker, T. & Ross, A. (2003): The Case of Sea Mullet Management in Moreton Bay, South East Queensland, Australia. In: Haggan, N.; Brignall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 290- 305.

http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]

Basset, T. J. (1998): Indigenous Mapmaking in Intertropical Africa. In: Woodward, D. & Lewis, G. M. (eds.) *The History of Cartography*. Vol. 2, Book 3, *Cartography in the Traditional African, American, Arctic, Australian, and Pacific Societies*. Chicago: University of Chicago Press, pp. 24-48.

Bauer, Kenneth (2009): On the Politics and the Possibilities of Participatory Mapping and GIS - Using Spatial Technologies to Study Common Property and Land Use Change among Pastoralists in Central Tibet. *Cultural Geographies*, 16 (2): 229-252.

Beltrán, J. (ed.) (2000): Indigenous and Traditional Peoples and Protected Areas: Principles, Guidelines and Case Studies. *IUCN & World Commission on Protected Areas, Best Practice Protected Area Guidelines Series No. 4*, Cardiff University, Dept. of City and Regional Planning, Cardiff.

Bennison, K. (2010): Questionnaire Uluru – Kata Tjuta National Park: Cultural Heritage Database by Parks Australia. See Appendix F.

Berkes, F.; Colding, J. & Folke, C. (2000): Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications*, 10 (5): 1251-1262.

- Bess, R. (2001): New Zealand's Indigenous People and their Claims to Fisheries Resources. *Marine Policy*, 25: 23-32.
- Bird, K. E.; Nichols, W. J. & Tambiah, C. R. (2003): The Value of Local Knowledge in Sea Turtle Conservation: A Case from Baja California, Mexico. In: Haggan, N.; Briggall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 178- 183.
http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]
- Bradley, J. & Yanyuwa Families (2007): Yanyuwa Sea Country Plan.
<http://www.environment.gov.au/indigenous/publications/yanyuwa-sea-plan.html>
 [08-03-2010]
- Brazenor, C.; Ogleby, C. & Williamson, I. (1999): The Spatial Dimension of Aboriginal Land Tenure. 6th South East Asian Surveyors Congress, Fremantle, 1-6 November 1999.
- Brodnig, G. & Mayer-Schönberger, V. (2000): Bridging the Gap: The Role of Spatial Information Technologies in the Integration of Traditional Environmental Knowledge and Western Science. *Electronic Journal on Information Systems in Developing Countries*, 1 (1): 1-15.
- Brody, H. (2002). *Maps and Dreams: Indians and the British Colombia Frontier*. Faber and Faber Limited: London.
- Brook, L. F. & Kemp, W. B. (1995): Towards Information Self-Sufficiency: The Nunavik Inuit Gather Information on Ecology and Land Use. *Cultural Survival Quarterly* 18 (4): 25-28.
- Bryan, J. (2009): Where Would We Be Without Them? Knowledge, Space and Power in Indigenous Politics. *Fortunes*, 41: 24-32.
- Buckley, D. J. (1998): *The GIS Primer*. An Introduction to Geographic Information Systems.
<http://www.innovativegis.com/basis/primer/primer.html> [04-05-2010]
- Byrne, D. B. (2003): Nervous Landscapes: Race and Space in Australia. *Journal of Social Archaeology*, 3 (2): 169-193.
- Byrne, D. B. (2008): Counter-Mapping: New South Wales & Southeast Asia. *Transforming Cultures*, 3 (1): 256-264.
- Caillaud, A.; Boengkih, S.; Evans-Illidge, E.; Genolagani, J.; Havemann, P.; Henao, D.; Kwa, E.; Llewellyn, D.; Ridep-Morris, A.; Rose, J.; Nari, R.; Skelton, P.; South, R.; Sulu, R.; Tawake, A.; Tobin, B.; Tuivanuvou, S. & Wilkinson, C. (2004): Tabus or not Taboos: How to Use Traditional Environmental Knowledge to Support Sustainable Development of Marine Resources in Melanesia. *Traditional Marine Resource Management and Knowledge Information Bulletin*, 17: 14-35.
- Carter, J. & Hill, G. (2007): Indigenous Community-Based Fisheries in Australia *Journal of Environmental Management*, 85 (4): 866-875.

Chambers, R. (2006): Participatory Mapping and Geographic Information Systems: Whose Map? Who is Empowered and Who Disempowered? Who Gains and Who Loses? *The Electronic Journal of Information Systems in Developing Countries*, 25 (2): 1-11.

<http://www.ejisdc.org/ojs2/index.php/ejisdc/article/viewFile/238/159> [11-03-2010]

Chapin, M. (1995): Indigenous Land Use Mapping in Central America. In: Greg, D. (ed.) *Local Heritage in the Changing Tropics: Innovative Strategies for Natural Resource Management and Control*. Yale School of Forestry and Environmental Studies Bulletin Series, 98: 195-209.

<http://environment.yale.edu/topics/811> [27-05-2010]

Chapin, M.; Lamb, Z. & Threlkeld, B. (2005): Mapping Indigenous Lands. *Annual Review of Anthropology*, 34: 619-38.

Chapin, M. & Threlkeld, B. (2001): Indigenous Landscapes - A Study in Ethnography. Center for the Support of Native Lands.

http://www.elistore.org/reports_detail.asp?ID=10805&topic=International [10-03-2010]

Chapin, M. & Threlkeld, B. (2008): Mapping Indigenous Lands - A Practical Guidebook. Center for the Support of Native Lands.

<http://www.nativelands.org/PUBLICATIONS/Pub/Guidebook.Jan%202009.pdf> [13-06-2010]

CIER (Centre for Indigenous Environmental Resources) (2010): Good Practices Guide – Success in Building and Keeping an Aboriginal Mapping Program. Prepared for GeoConnections & Natural Resources Canada.

http://www.geoconnections.org/publications/Key_documents/CIER_Good_Practices_Guide_lowRes.pdf [13-06-2010]

CLCAC (Carpentaria Land Council Aboriginal Corporation) (2006): Thuwathu / Bujimulla Sea Country Plan: Aboriginal Management of the Wellesley Islands Region of the Gulf of Carpentaria.

<http://www.environment.gov.au/indigenous/publications/thuwathu-bujimulla-plan.html> [08.03.2010]

Colding, J. & Folke, C. (2001): Social Taboos - “Invisible” Systems of Local Resource Management and Biological Conservation. *Ecological Applications*. 11 (2): 584-600.

Corbett, J.; Rambaldi, G.; Kyem, P.; Weiner, D.; Olson, R.; Muchemi, J.; McCall, M. & Chambers, R. (2006): Mapping for Change: The Emergence of a New Practice. *Participatory Learning and Action*, 54: 13-20.

<http://www.iied.org/pubs/pdfs/14507IIED.pdf#page=42> [22-06-2010]

Corbett, J.; Chapin, M.; Gibson, L. & Rambaldi, G. (2009): Indigenous Mapping. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 377-382.

Crampton, J. W. & Krygier, J. (2005): An Introduction to Critical Cartography. *ACME - An International E-Journal for Critical Geographies*, 4 (1): 11-33.

Crowley, T. (2003): Culture and Common Property: Indigenous Tenure Issues within Western Society. Presented at SIRC 2003 – The 15th Annual Colloquium of the Spatial Information Research Centre. University of Otago, Dunedin, New Zealand. December 1-3, 2003.

http://divcom.otago.ac.nz/Sirc/conferences/2003/07_Crowley.pdf [06-03-2010]

Del Casino Jr., V. J. & Hanna, S. P. (2005): Beyond The 'Binaries': A Methodological Intervention for Interrogating Maps as Representational Practices. *ACME - An International E-Journal for Critical Geographies*, 4 (1): 34-56.

Denniston, D. (1994): Defending the Land with Maps. *World Watch*, 7 (1): 27-32.

DERM (Department of Environment and Resource Management) (2010a): Aboriginal and Torres Strait Islander Cultural Heritage Database and Register. Queensland Government.

http://www.derm.qld.gov.au/cultural_heritage/search_request/search_request_forms.html [08-03-2010]

DERM (Department of Environment and Resource Management) (2010b): Guidelines to Accessing the Aboriginal and Torres Strait Islander Cultural Heritage Database and Register. Queensland Government.

http://www.derm.qld.gov.au/cultural_heritage/search_request/accessing_data_guidelines.html [08-03-2010]

DEWAH (Department of the Environment, Water, Heritage and the Arts) (2009): Working on Country: A Retrospective of 2007-2008.

<http://www.environment.gov.au/indigenous/publications/working-on-country.html> [08-03-2010]

DEWAH (Department of the Environment, Water, Heritage and the Arts) (2010): Indigenous Heritage Program. Grants and Funding.

<http://www.environment.gov.au/heritage/programs/ihp/index.html> [10-03-2010]

Dhimurru (2006): Yolngu Monuk Gapu Wanga Sea Country Plan: A Yolngu Vision and Plan for Sea Country Management in North-east Arnhem Land, Northern Territory. Nhulunbuy, Northern Territory: Dhimurru Land Management Aboriginal Corporation.

<http://www.dhimurru.com.au/Downloads/DhimurruSeaCountryPlan.pdf> [10-03-2010]

Dhimurru (2008): IPA Plan of Management 2008 to 2015. Prepared by Dhimurru Aboriginal Corporation, Wearne Advisors and Samantha Muller, Nhulunbury, Northern Territory.

<http://www.dhimurru.com.au/plans.html> [08-03-2010]

Drew, J. A. (2005): Use of Traditional Ecological Knowledge in Marine Conservation. *Conservation Biology*, 19 (4): 1286–1293.

Fagerholm, N. & Käyhkö, N. (2009): Participatory Mapping and Geographical Patterns of the Social Landscape Values of Rural Communities in Zanzibar, Tanzania. *Fennia*, 187 (1): 43-60.

FAT & WMAC (Framlingham Aboriginal Trust & Winda Mara Aboriginal Corporation) (2004): Kooyang Sea Country Plan.

<http://www.environment.gov.au/coasts/mbp/publications/south-east/kooyang-plan.html>
[08-03-2010]

Faulkner, A. & Silvano, R. A. M. (2003): Status of Research on Traditional Fishers's Knowledge in Australia and Brazil. In: Haggan, N.; Brignall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 110- 116.

http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]

Feinberg, R.; Dymon, U. J.; Paiaki, P.; Rangituteki, P.; Nukuriaki, P. & Rollins, M. (2003): 'Drawing the Coral Heads': Mental Mapping and its Physical Representation in a Polynesian Community. *The Cartographic Journal*, 40 (3): 243-253.

Finney, B. (1998): Nautical Cartography and Traditional Navigation in Oceania. In: Woodward, D. & Lewis, G. M. (eds.) *The History of Cartography*. Vol. 2, Book 3, Cartography in the Traditional African, American, Arctic, Australian, and Pacific Societies. Chicago: University of Chicago Press, pp. 443-487.

Fox, J. (1995): Spatial Information Technology and Human-Environment Relationships. *East-West Center Working Papers, Environment Series*, 43: pp. 15-19.

Fox, J. (2002): Siam Mapped and Mapping in Cambodia: Boundaries, Sovereignty, and Indigenous Conceptions of Space. *Society & Natural Resources*, 15 (1): 65-78.

Fox, J.; Suryanata, K.; Hershock, P. & Pramono, A. H. (2006): Mapping Power: Ironic Effects of Spatial Information Technology. *Participatory Learning and Action*, 54: 98-105.

<http://www.iied.org/pubs/pdfs/14507IIED.pdf#page=42> [22-06-2010]

Freeman, M. M. R. (ed.) (1976): *Inuit Land Use and Occupancy Project*. Ottawa: Ministry of Supply and Services Canada.

Geoscience Australia (2010): Free Data Downloads

https://www.ga.gov.au/products/servlet/controller?event=DEFINE_PRODUCTS [12-02-2010]

Gerhardinger, L. C.; Godoy, E. A. S. & Jones, P. J. S. (2009): Local Ecological Knowledge and the Management of Marine Protected Areas in Brazil. *Ocean & Coastal Management*, 52: 154-165.

Gervais, D. J. (2003): Spiritual but not Intellectual? The Protection of Sacred Intangible Traditional Knowledge. *Journal of International and Comparative Law*, 11: 467-495.

http://works.bepress.com/cgi/viewcontent.cgi?article=1007&context=daniel_gervais
[13-06-2010]

Glöckner, H.; Mkanga, M. & Ndezi, T. (2004): Local Empowerment through Community Mapping for Water and Sanitation in Dar es Salaam. *Environment and Urbanization* 2004; 16: 184-197.

Golvan, C. (1992): Aboriginal Art and the Protection of Indigenous Cultural Rights. *European Intellectual Property Review*, 14 (7): 227-232.

Goodchild, M. F. (2009): GIS and Cartography. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 500-505.

Google Maps (2010): Anatu Island, Solomon Islands. 11°36'39"S, 169°51'01"E.
<http://maps.google.com/> [11-08-2010]

Guilfoyle, M. & Morgan, C. (2010): Questionnaire Cape Arid National Park: Cape Arid Indigenous Heritage Programme by The Gabbie Kylie Foundation. See Appendix D.

Hamilton, R. J. & Walter, R. (1999): Indigenous Ecological Knowledge and its Role in Fisheries Research Design. A case study from Roviana Lagoon, Western Province, Solomon Islands. *Traditional Marine Resource Management and Knowledge Information Bulletin*, 11: 13-21.

Harley, J. B. (1989): Deconstructing the Map. *Cartographica*, 26 (2): 1-20.

Harley, J., & Woodward, D. (eds.) (1987): *The History of Cartography*. Vol. 1, Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean. Chicago: University of Chicago Press.

Harris, L. M. & Hazen, H. D. (2005): Power of Maps: (Counter) Mapping for Conservation. *ACME - An International E-Journal for Critical Geographies*, 4 (1): 99-130.

Herlihy, P. H. & Knapp, G. (2003): Maps of, by, and for the Peoples of Latin America. *Human Organization*, 62 (4): 303-314.

Hughes, Robert (1987): *The Fatal Shore - A History of the Transportation of Convicts to Australia, 1787-1868*. London.

Hultman, J. (2007): Through the Protocol: Culture, Magic and GIS in the Creation of Regional Attractiveness. *Tourism Geographies*, 9 (3): 318-336.

Johnson, J. T.; Louis, R. P. & Pramono, A. H. (2005): Facing the Future: Encouraging Critical Cartographic Literacies in Indigenous Communities. *ACME - An International E-Journal for Critical Geographies*, 4 (1): 80-98.

Johnson, M. (1992): *Lore: Capturing Traditional Environmental Knowledge*. Dene Cultural Institute, Ottawa.

Jolly, M. (2007): Imagining Oceania: Indigenous and Foreign Representations of a Sea of Islands. *The Contemporary Pacific*, 19 (2): 508-545.

Kelly, J. (1999): Maori Maps. *Cartographica*, 36 (2): 1-29.

Keski-Säntti, J.; Lehtonen, U.; Sivonen, P. & Vuolanto, V. (2003): The Drum as Map: Western Knowledge Systems and Northern Indigenous Map Making. *Imago Mundi*, 55 (1): 120-125.

Klinghoffer, A. J. (2006): *The Power of Projections: How Maps Reflect Global Politics and History*. Westport: Praeger Publishers.

Lemma, T.; Sliuzas, R. & Kuffer, M. (2006): A Participatory Approach to Monitoring Slum Conditions: An Example from Ethiopia. *Participatory Learning and Action*, 54: 58-66.

<http://www.iied.org/pubs/pdfs/14507IIED.pdf#page=42> [22-06-2010]

Levy, R. (1999): Native Title and the Seas: The Croker Island Decision. *Indigenous Law Bulletin*, 4 (17): 20-21.

Lewthwaite, G. R. (1970): The Puzzle of Tupaia's Map. *New Zealand Geographer*, 26 (1): 1-19.

Lewis, G. M. (1998): Maps, Mapmaking, and Map Use by Native North Americans. In: Woodward, D. & Lewis, G. M. (eds.) *The History of Cartography*. Vol. 2, Book 3, Cartography in the Traditional African, American, Arctic, Australian, and Pacific Societies. Chicago: University of Chicago Press, pp. 51-182.

Liebermann, S. & Coulson, J. (2004): Participatory Mapping for Crime Prevention in South Africa - Local Solutions to Local Problems. *Environment and Urbanization*, 16: 125-134.

Louis, R. P. (2004): Indigenous Hawaiian Cartographer: In Search of Common Ground. *Cartographic Perspectives*, 48: 7-23.

Mahood, K. (2006): Mapping Outside the Square - Cultural Mapping in the South-East Kimberley. *Aboriginal History*, 30: 1-28.

Mallie, T. (2010): Interview with Troy Mallie: Cultural Systems Solutions. See Appendix G.

McNiven, I. J. (2003): Saltwater People: Spiritscapes, Martime Rituals and the Archaeology of Australian Indigenous Seascapes. *World Archaeology*, 35 (3): 329-349.

Mohamed, M. A. & Ventura, S. J. (2000): Use of Geomatics for Mapping and Documenting Indigenous Tenure Systems. *Society & Natural Resources*, 13 (3): 223-236.

Monmonier, M. (1995): *Drawing the Line - Tales of Maps and Cartocontroversy*. New York.

Moore, B. (2010): Questionnaire Noongar: Sharing Noongar Heritage by South West Aboriginal Land & Sea Council. See Appendix D.

Morrison, M. (2010): Questionnaire Alngith: Alngith Cultural Heritage Project by Marlu Aboriginal Corporation. See Appendix C.

Moylan, E.; Brown, S. & Kelly, C. (2009): Toward a Cultural Landscape Atlas: Representing all the Landscape as Cultural. *International Journal of Heritage Studies*, 15 (5): 447-466.

Muller, S. (2008a): Accountability Constructions, Contestations and Implications: Insights from Working in a Yolngu Cross-Cultural Institution, Australia. *Geography Compass*, 2 (2): 395-413.

Muller, S. (2008b): Community-Based Management of Saltwater Country, Northern Australia. *Development*, 51 (1): 139-143.

Mulrennan, M. & Scott, C. H. (2000): Mare Nullius: Indigenous Rights in Saltwater Environments. *Development and Change*, 31: 681-708.

NAILSMA (North Australian Indigenous Land & Sea Management Alliance) (2008): An Overview of Indigenous Rights in Water Resource Management. http://www.savanna.org.au/nailsma/publications/downloads/NAILSMA_WaterResManag_web_Aug09.pdf [13-02-2010]

Nevins, J. (2004): Contesting the Boundaries of International Justice: State Counter-mapping and Offshore Resource Struggles between East Timor and Australia. *Economic Geography*, 80 (1): 1-22.

Nielson, R. (2010): Questionnaire Girringun: Girringun's Cultural Heritage Identification, Mapping and Management Project by Girringun Aboriginal Corporation. See Appendix A.

Nietschmann, B. (1995): Defending the Miskito Reefs with Maps and GIS: Mapping with Sail, Scuba, and Satellite. *Cultural Survival Quarterly* 18 (4): 34-37.

Ngarrindjeri Tendi (2007): Ngarrindjeri Nation Sea Country Plan: Caring for Ngarrindjeri Country and Culture. <http://www.environment.gov.au/indigenous/publications/ngarrindjeri-plan.html> [08-03-2010]

NNTT (National Native Title Tribunal) (2010a): What is Native Title? <http://www.nntt.gov.au/What-Is-Native-Title/Pages/default.aspx> [20-07-2010]

NNTT (National Native Title Tribunal) (2010b): Maps and Spatial Data: National Maps. Registered Claims. <http://www.nntt.gov.au/Publications-And-Research/Maps-and-Spatial-Reports/Pages/National-Maps.aspx> [12-02-2010]

NOO (National Oceans Office) (2004a): Living on Saltwater Country: Cape York Peninsula Sea Country Management, Needs and Issues. <http://www.environment.gov.au/coasts/mbp/publications/north/pubs/losc-capeyork.pdf> [07-03-2010]

NOO (National Oceans Office) (2004b): Living on Saltwater Country - Review of Literature about Aboriginal Rights, Use, Management and Interests in Northern Australian Marine Environments. Hobart. <http://www.savanna.org.au/nailsma/downloads/Living%20on%20Saltwater%20Country%20Literature%20Review.pdf> [13-02-2010]

Notzke, C. (1995): A New Perspective in Aboriginal Natural Resource Management: Co-management. *Geoforum*, 26 (2): 187-209.

Nursey-Bray, M. (2003): Fishing for Answers - The Incorporation of Indigenous Knowledge in Northern Australia: Developing Cross Cultural Literacy. In: Haggan, N.;

- Brignall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 321- 327.
http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]
- Omoto, R. (2004): The Context of Gendered Knowledge: A Comprehensive Minimum Dataset on Women in Coastal Communities. *Traditional Marine Resource Management and Knowledge Information Bulletin*, 16: 17-27.
- ORIC (Office of Registrar of Indigenous Corporations) (2010): Homepage.
<http://www.orac.gov.au/> [10-04-2010]
- Pannell, S. (2006) *Reconciling Nature and Culture in a Global Context? Lessons from the World Heritage List*. Cooperative Research Centre for Tropical Rainforest Ecology and Management. Rainforest CRC, Cairns.
http://www.jcu.edu.au/rainforest/publications/nature_culture_text.pdf [25-05-2010]
- Papayannis, T. & Mallarach, J.-M. (eds) (2009): The Sacred Dimension of Protected Areas: Proceedings of the Second Workshop of the Delos Initiative - Ouranoupolis 2007. Gland, Switzerland: IUCN and Athens, Greece: Med-INA.
<http://data.iucn.org/dbtw-wpd/edocs/2009-069.pdf> [04-06-2010]
- Pearce, M. W. & Louis, R. P. (2008): Mapping Indigenous Depth of Place. *American Indian Culture and Research Journal*, 32 (3): 107-126.
- Pearce, M. W. (2009): Non-Western Mapping. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 372-384.
- Peat, F. D. (1996): I Have a Map in my Head. *ReVision*, 18 (3): 11-17.
- Pentecost, L. & Nielson, R. (2007): The Giringun Way: The Integration of Aboriginal Cultural and Environmental Knowledge Systems with GIS for NRM Application – and other Cultural Projects. Cardwell.
- Poole, P. (1995a): Appropriate Geomatic Technology for Local Earth Observation. In: Greg, D. (ed.) *Local Heritage in the Changing Tropics: Innovative Strategies for Natural Resource Management and Control*. Yale School of Forestry and Environmental Studies Bulletin Series, 98: 156-166.
<http://environment.yale.edu/topics/811> [27-05-2010]
- Poole, P. (1995b): Indigenous Peoples, Mapping and Biodiversity Conservation: An Analysis of Current Activities and Opportunities for Applying Geomatics Technologies. Peoples and Forest Program Discussion Paper. Biodiversity Support Program. Washington DC.
http://www.worldwildlife.org/bsp/publications/asia/indigenous_people/indigenous_people.pdf [10-03-2010]
- Poole, P. (2003): Cultural Mapping and Indigenous Peoples - A Report for UNESCO.
http://portal.unesco.org/culture/en/files/17109/10787580083cultural_mapping_1.pdf/cultural_mapping_1.pdf [06-03-2010]
- Poole, P. (2006): Is there a Life after Tenure Mapping? *Participatory Learning and Action*, 54: 21-27.

<http://www.iied.org/pubs/pdfs/14507IIED.pdf#page=42> [22-06-2010]

Prince, N. (2003): Plateau Fishing Technology and Activity: Stl'atl'imx, Secwepemc and Nlaka'pamux Knowledge. In: Haggan, N.; Brignall, C. & Wood, L. (eds.). *Putting Fishers' Knowledge to Work*. UBC Vancouver, Fisheries Centre Research Reports, 11 (1): 381- 391.

http://www2.fisheries.com/archive/publications/reports/report11_1.php [10-03-2010]

Rambaldi, G.; Kwaku Kyem, P. A.; McCall, M. & Weiner, D. (2006): Participatory Spatial Information Management and Communication in Developing Countries. *The Electronic Journal on Information Systems in Developing Countries*, 25 (1): 1-9.

Rice-Rollins, J. A. (2004): The Cartographic Heritage of the Lakota Sioux. *Cartographic Perspectives*, 48: 39-56.

Robbins, P. (2003): Beyond Ground Truth: GIS and the Environmental Knowledge of Herders, Professional Foresters, and other Traditional Communities. *Human Ecology*, 31: 233-253.

Robinson, C. & Mercer, D. (2000): Reconciliation in Troubled Waters? Australian Oceans Policy and Onshore Native Title Rights. *Marine Policy*, 24: 349-360.

Rocheleau, D. (2005): Maps as Power Tools: Locating Communities in Space or Situating People and Ecologies in Place? In: Brosius, J. P.; Lowenhaupt Tsing, A. & Zerner, C. (eds.) *Communities and Conservation: Histories and Politics of Community-Based Natural Resource Management*. Walnut Creek: AltaMira Press, pp. 327-362.

Rose, D. B. (2002): *Country of the Heart: An Indigenous Australian Homeland*. Aboriginal Studies Press, Canberra.

Roth, R. (2007): Two-Dimensional Maps in Multi-Dimensional Worlds: A Case of Community-Based Mapping in Northern Thailand. *Geoforum*, 38 (1): 49-59.

Rundstrom, R. A. (1990): A Cultural Interpretation of Inuit Map Accuracy. *Geographical Review*, 80 (2): 155-168.

Rundstrom, R. A. (1991): *Mapping, Postmodernism, Indigenous People and the Changing Direction of North American Cartography*. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 28 (2): 1-12.

Rundstrom, R. A. (1995): GIS, Indigenous Peoples, and Epistemological Diversity. *Cartography and Geographic Information Science*, 22 (1): 45-57.

Rundstrom, R. A. (2009): Counter-Mapping. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 314-318.

Russa, G. R. & Zeller, D. C. (2003): From Mare Liberum to Mare Reservarum. *Marine Policy*, 27: 75-78.

Schwartzman, S. & Zimmerman, B. (2005): Conservation Alliances with Indigenous Peoples of the Amazon. *Conservation Biology*, 19 (3): 721-727.

- Sharp, N. (2002): *Saltwater People - The Waves of Memory*. Toronto.
- Sithole, B. & Hunter-Xenie, H. with Williams, L.; Saegenschnitter, J.; Yibarbuk, D.; Ryan, M.; Champion, O.; Yunupingu, B.; Liddy, M.; Watts, E.; Daniels, C.; Daniels, G.; Christophersen, P.; Cubillo, V.; Phillips, E.; Marika, W.; Jackson, D. & Wayne Barbour (2007): *Aboriginal Land and Sea Management in the Top End: a Community Driven Evaluation*. CSIRO: Darwin.
- Smith, C. D. (1982): The Emergence of 'Maps' in European Rock Art: A Prehistoric Preoccupation with Place. *Imago Mundi*, 34: 9-25.
- Smyth, D. (1996): *Understanding Country: The Importance of Land and Sea in Aboriginal and Torres Strait Islander Societies*. Council for Aboriginal Reconciliation Key Issue Paper, Council for Aboriginal Reconciliation, Canberra.
- Smyth, D. (1997): *Australia's Ocean Policy: Saltwater Country Aboriginal and Torres Strait Islander Interest in Ocean Policy Development and Implementation*. Socio-Cultural Consideration, Issue Paper 6.
<http://www.environment.gov.au/coasts/oceans-policy/publications/issues6.html> [08-03-2010]
- Steinberg, P. (2001): *The Social Construction of the Ocean*. Cambridge: Cambridge University Press.
- Stocks, A. (2003): Mapping Dreams in Nicaragua's Bosawas Reserve. *Human Organization*, 62 (4): 344-356.
- Stone, M. (1998): Map or be Mapped. *Whole Earth*, 94: 54-55.
- Strang, V. (2000): *Showing and Telling: Australian Land Rights and Material Moralities*. *Journal of Material Culture*, 5 (3): 275-299.
- Strang, V. (2005): Knowing Me, Knowing You: Aboriginal and European Concepts of Nature and Self and Other. *Worldviews: Environment, Culture, Religion*, 9 (1): 25-56.
- Strelin, L. (2009): *Compromised Jurisprudence: Native Title Cases since Mabo*. 2nd ed. Aboriginal Studies Press. Canberra.
- Sutton, P. (1998): Traditional Cartography in Australia. In: Woodward, D. & Lewis, G. M. (eds.) *The History of Cartography*. Vol. 2, Book 3, *Cartography in the Traditional African, American, Arctic, Australian, and Pacific Societies*. Chicago: University of Chicago Press, pp. 353-418.
- Tindale, N. B. (1974): *Tribal Boundaries in Aboriginal Australia*. Screenshot of Interactive Map.
http://www.samuseum.sa.gov.au/page/default.asp?site=2&page=TIN_Tribal&level=1
 [14-2010]
- Tobias, T. (2000): *Chief Kerry's Moose Guidebook to Land Use and Occupancy Mapping, Research Design and Data Collection*. Ecotrust Canada, Vancouver.
http://www.ubcic.bc.ca/files/PDF/Tobias_whole.pdf [08-03-2010]

Tripathi, N. & Bhattarya, S. (2004): Integrating Indigenous Knowledge and GIS for Participatory Natural Resource Management - State-of-the-Practice. *The Electronic Journal of Information Systems in Developing Countries*, 17 (3): 1-13.

Thrower, N. J. W. (2008): *Maps and Civilization: Cartography in Culture and Society*. 3rd ed. Chicago: The University of Chicago Press.

Turnbull, D. (1993): *Maps Are Territories: Science Is an Atlas: A Portfolio of Exhibits*. Chicago, IL: University of Chicago Press.

Turnbull, D. (2007): Maps Narratives and Trails: Performativity, Hodology and Distributed Knowledges in Complex Adaptive Systems - An Approach to Emergent Mapping. *Geographical Research*, 45 (2): 140-149.

Turner, N. J.; Ignace, M. B. & Ignace, R. (2000): Traditional Ecological Knowledge and Wisdom of Aboriginal Peoples in British Columbia. *Ecological Applications*. 10 (5): 1275-1287.

UNESCO (2010): Cultural Mapping.

<http://www.unescobkk.org/culture/our-projects/cultural-diversity/cultural-mapping/> [09-03-2010]

Utrilla, P.; Mazo, C.; Sopena, M. C.; Martínez-Bea, M. & Domingo, R. (2009): A Palaeolithic Map from 13,660 calBP: Engraved Stone Blocks from the Late Magdalenian in Abauntz Cave (Navarra, Spain). *Journal of Human Evolution*, 57 (2): 99-111.

Walker, B. L. E. (2001): Mapping Moorea's Lagoon: Conflicts over Marine Protected Areas in French Polynesia. Conference Paper. Tradition and Globalisation: Critical Issues for the Accommodation of CPRs in the Pacific Region, the Inaugural Pacific Regional Meeting of the International Association for the Study of Common Property. Brisbane, September 2-4, 2001.

<http://hdl.handle.net/10535/1734> [10-06-2010]

Watson, H. and the Yolngu community at Yirrkal (1993): Aboriginal-Australian Maps. In: Turnbull, D., *Maps Are Territories: Science Is an Atlas: A Portfolio of Exhibits*. Chicago, IL: University of Chicago Press, pp. 28-36.

Whear, R. (2010): Questionnaire Jawoyn. Cultural Heritage Mapping by Jawoyn Association Aboriginal Corporation. See Appendix E.

Williams, N. M. (1986): The Yolngu and their Land: A System of Land Tenure and the Fight for its Recognition. In: *The Principles of Land Tenure*, Australian Institute of Aboriginal Studies, Canberra, pp. 75-91.

Winichakul, T. (1994): *Siam Mapped: A History of the Geo-Body of a Nation*. Honolulu: University of Hawaii Press.

Winlow, H. (2009): Mapping, Race and Ethnicity. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 398-408.

Wood, D. (1992): *The Power of Maps*. New York: The Guilford Press.

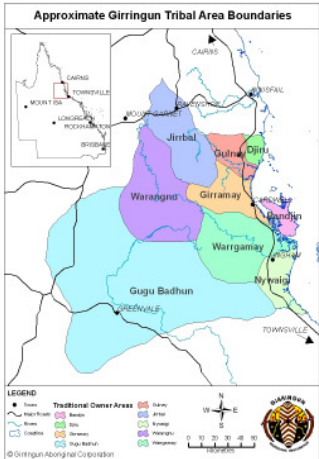
Wood, D. & Krygier, J. (2009a): Critical Cartography. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*: 421-430.

Wood, D. & Krygier, J. (2009b): Maps. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 340-344.

WTAPPT (Wet Tropics Aboriginal Plan Project Team) (2005): Caring for Country and Culture - The Wet Tropics Aboriginal Cultural and Natural Resource Management Plan. Rainforest CRC and FNQ NRM Ltd. Cairns.

http://www.rrrc.org.au/rfrcrc/aboriginal_plan.html [07-03-2010]

Appendix A: Questionnaire Girringun
(filled out by Rod Nielson)

Name of your organization	Girringun Aboriginal Corporation
Name of your project	Girringun's Cultural Heritage Identification, Mapping and Management Project. The Management, Presentation and Use of Cultural Heritage Information Project (2010 – 2011, if it gets funded).
Location of mapping area	The project area is from North Maria Creek in the north to Rollingstone Creek in the south, from the areas around and between Greenvale, Mount Garnet and Ravenshoe in the west to the eastern edge of the Great Barrier Reef Marine Park, including all islands and reefs, in the east. 

1. Is this the first mapping project in your community? (please mark with an "X")

X	No
	Yes

Comment: This project has been on-going over the last ten or twelve years in less and now more intensive forms. I was employed four years ago because the project had faulted due to poor management without a full-time staff person.

2. How large is the area being mapped?

The area is approximately 25,000km² over land and about 20,000km² over the Great barrier Reef Marine Park and Islands.

3. What is the duration of your mapping project (including preparation, mapping, analyzing data)?

Start date	Some time in the late 1990's
End date	On-going (due to funding availability)

Comment: On-going-funding for this project is the main issue and therefore an end date is almost impossible to give. Currently we have to apply for funding annually which is time consuming and inconclusive, leaving staff wondering what will happen after the end of June each year. While information has been getting collected for decades, the aggregation of this information really began in the late '90's.

4. How long did the actual mapping process take?

On-going, and is dependant on new information, and better ways to map areas more realistically, e.g. 10m² grids. The project no longer takes into account just archaeological sites. We are now putting together all forms of cultural information whether this is related to a point in the landscape or not, including Law, Lore and other cultural practices.

5. What methods are used for the mapping process? (check all that apply with an "X")

<input checked="" type="checkbox"/>	Geographic Information Systems (GIS)
<input checked="" type="checkbox"/>	Pen and paper
<input type="checkbox"/>	3D-models (e. g. made from cardboard / clay etc.)
Other	Hard-copy maps

Comment: Currently as I have the time I am trying to put together information using a Wiki. This enables linkages between sites and stories etc. which otherwise would be virtually impossible to do.

6. Was there any schooling done before the mapping (e. g. introduction to GIS, mapping techniques etc.)?

<input type="checkbox"/>	No
<input type="checkbox"/>	Yes

Comment: I am unable to say from the beginning. Since I have been working on the project there has been very little schooling for the others involved. They all look at GIS as a black box and are quite happy to have someone else in the seat making it all work.

7. Did you use any specific guidelines, articles or books for the mapping project?

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (please list or describe them below)

Comment: Dr. Luke Godwin's book "*Towards an indigenous social and cultural landscape of the Bowen Basin : Bowen Basin Aboriginal Cultural Heritage Project / by Scott L'Oste-Brown, Luke Godwin and Carl Porter in association with Bowen Basin Aboriginal Steering Committee*" provided some inspiration in the beginning but we have pretty much written the book ourselves.

8. Is your mapping project based on or motivated by another case study / another community from Australia or another country?

<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes (please describe below)

Comment: Inspired by – see above

9. How many people are approximately working on the project (mapping, analyzing data)?

<input checked="" type="checkbox"/>	0-5
<input type="checkbox"/>	5-10
<input type="checkbox"/>	10-15
<input type="checkbox"/>	15-20
<input type="checkbox"/>	20-25
<input type="checkbox"/>	25-30
<input type="checkbox"/>	More than 30

Comment: Just me at the moment.

Technically there is one other person working on the “Traditional Knowledge Recording Project” which is supposed to parallel with the mapping project but information just never seems to flow between the two projects, i.e. from the TKRP project to the cultural heritage database.

10. Are any parts of the mapping process or analyzing done by an outside party (e.g. government agency)?

X	No
	Yes (<i>please list or describe them below</i>)

Comment:

11. What is the main purpose of the mapping (e.g. land management, land claim, preserving knowledge, basis for another project etc.)?

Native Title (land claims); Preserving knowledge; Repatriation of knowledge; Intergeneration knowledge transfer; Inspiration for further education; Employment based on Cultural Heritage; Empowerment in the processes of land and sea resource management.

12. What was the main reason that triggered your mapping project (e. g. lack of management plan, threat to cultural knowledge etc.)?

In the beginning the Elders of seven local Traditional Owner groups decided that they wanted a greater role in the management of and access to their previously recorded cultural heritage information (recorded by archaeologists and other researchers. So with the help of a couple of local archaeologists they set out to start what has become Girringun Aboriginal Corporation. A couple of years later, two more Traditional Owner groups came on board: the Bandjin, Djiru, Girramay, Gulnay, Gugu Badhun, Jirrbal, Nywaigi, Warungnu and Warrgamay Peoples.

13. What is your anticipated outcome of the project (e. g. one map, several maps, maps at different scales, report, management plan etc.)?

A cultural heritage recording and management system that is the envy of all other Traditional Owner groups nationally and comparable with anything in the world, outside of national museums and government departments.

14. What are the main features (e. g. contents, categories) of the map?

The question is wrong. A map only shows where something is and rarely what else it is related and how.

While Girringun’s system does allow the mapping of cultural heritage places, these maps are not for public viewing, except in certain circumstances with particular permission.

Girringun’s mapping project has a greater focus on the locations of cultural heritage places and then the analytic ability of that information with other information to enable informed decision making, including Traditional Owners in the process. The western world in general views more highly organisations which as able to come to a negotiating table with tangible information in hand. Girringun has worked with government departments and private organisations in the building and maintenance of infrastructure, and with Queensland Parks and Wildlife Service with its prescribed burning program to name a few.

Taking the Parks example, QPWS forwards maps of where they intend to do fuel reduc-

tion burns to Giringun. This information is digitized and analysed to determine what sites may be affected by the fires. This information then goes to the traditional owners who then meet with QPWS to determine what steps need to be taken to ameliorate any adverse impacts.

As such, categories of analysis, rather than maps, are tailored to meet the requirement at the time.

15. Are any of the following recorded in the mapping? (check all that apply with "X")

	Water sources
X	Sacred sites
X	Places relevant in Dreamtime
X	Hunting grounds
	Food gathering areas
	No-take areas
	Seasonal information
Other	

Comment: Water sources aren't a big issue in the Wet Tropics of Australia until you get to the usage issues of water. Waterholes etc. are mapped where there is a known language name or where artefacts have been found.

Hunting grounds – Giringun has a TUMRA (Traditional Use of Marine Resources Agreement with the Commonwealth Government via the Great Barrier Reef Marine Park Authority. Under this agreement the Traditional Owners, who have traditional hunting rights under native title, have decided to regulate their take of turtle and forgo their right to hunt and take dugong for a time. They have also decided to limit their hunting to certain areas within the TUMRA area. These areas have been mapped, described and agreed to by the GBRMPA.

Other food gathering areas are restricted to areas which have not been cleared for agriculture and in many cases are limited to the riparian areas along the local creeks and rivers. These areas have not been mapped as such but we have an intention to do so in the future.

Other resources which have been well recorded anthropologically such as the grasses and cane used in the local basket making have not been mapped. It is an intention to do this also in the future as part of a possible land use and occupancy project.

Seasonal information is currently being collected as part of the vegetation database including plant calendar information. Seasonal inundation information has been mapped by the Queensland State Government. Seasonal movement will hopefully be mapped as part of the on-going project.

16. Is any sea country included in your mapping?

	No (<i>go to question 20</i>)
X	Yes (<i>continue with question 17</i>)

17. Which parts of sea country are included in your mapping? (check all that apply with an "X")

X	Coasts / Coast lines
X	Islands
X	Open ocean
	Reefs
	Lagoons

<input checked="" type="checkbox"/>	Sacred sites
<input checked="" type="checkbox"/>	Places relevant in Dreamtime
<input checked="" type="checkbox"/>	Hunting grounds
<input checked="" type="checkbox"/>	Food gathering areas
<input checked="" type="checkbox"/>	No-take areas
	Tidal information
	Seasonal information
Other	
Comment: Just a note here while I think about it. Not all sites are “sacred sites”. All sites have significance, but many are simply cultural places – somewhere that something is known about.	

18. Do any of the mapped contents include seasonal / flexible information (e. g. hunting, gathering, no-take areas etc.)?	
<input type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please explain below</i>)
Comment: Currently no but this will change in the future (funding permitting).	

19. Do your mapping aspects / features / contents differ between land and sea country?	
<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please explain below</i>)
Comment: Cultural heritage is cultural heritage. This is where other information and systems come into play such as stories, law and lore. It is also where the use of a Wiki comes into its own. Being able to demonstrate linkages, that can’t be mapped, between places.	

20. Are any larger text passages part of the mapping project (e. g. stories, history, traditional ecological knowledge (TEK) etc.)?	
<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes (<i>please explain below</i>)
Comment: Stories, law, lore and particularly traditional ecological knowledge are at the heart of cultural heritage. Giringun has more recently begun to lean towards aggregating this information also in it’s different forms. Giringun’s cultural heritage project and TKRP project are both using digital video, audio and still photography to record all of this extra information. To do this, we have undertaken several float trips in canoes and boats along a couple of the local rivers to record stories, places and ecological knowledge.	

21. Will there be any gender-specific data in the map?			
<input checked="" type="checkbox"/>	No		
<input type="checkbox"/>	Yes	<input type="checkbox"/>	only male-specific data
<input type="checkbox"/>		<input type="checkbox"/>	only female-specific data
<input type="checkbox"/>		<input type="checkbox"/>	both
Comment: Currently the Traditional Owners we work with haven’t discriminated between men’s and Women’s business as far as the cultural heritage mapping project has been concerned. They have done as part of the TKRP project a couple of times though.			

22. Did you experience any problems during the mapping process?	
X	No
Problems:	

23. Did you encounter any other problems?	
	No
	Yes (<i>please explain below</i>)
Problems:	
<p>Mapping location is not really an issue. What becomes more difficult is how to map knowledge and whether knowledge should be mapped at all. In terms of paper maps it becomes difficult to demonstrate relationships between places particularly is one place relates to two or three other places differently. Then including ecological knowledge becomes another headache.</p> <p>Enter the Wiki. This allows the author to link to different aspects of places and knowledge in the same way the Wikipedia does.</p> <p>It is this development that looks to change the current paradigm in mapping cultural heritage.</p>	

24. What landscape contents were the hardest to transform into a map?	
<p>Currently the biggest problem we have in this area is the lack of the top level GIS software. This means that we are unable to do analysis using DEM's etc, but then again this is seen as only a very minor issue as it has less importance that the information content of the total cultural heritage.</p>	

25. Was there any landscape data you were not able to transform into a map (e. g. especially seasonal / flexible information)?	
	No
	Yes (<i>please explain below</i>)
Comment: Not applicable	

26. Which aspects of the map or gathered information will be published?	
<p>Probably very little into the foreseeable future. The information belongs to and is controlled by the Traditional Owners and it is their decision who gets to see and use it. It may be advantageous in the future for the Giringun Elders to create an educational package to be used in the schools, but then again, this is up to the Traditional owners.</p>	

27. Who will have access to the finished map?	
Traditional Owners and those to whom permission has been given.	

28. Will any aspects of the map be for internal use only (inside the community)?	
	No
X	Yes
Aspects: Yes – see above. Internal maps are produces for Traditional Owners to meet what requirements they have at the time.	

29. What measures are taken to protect traditional ecological knowledge (TEK) and cultural knowledge?

The Giringun Board is made up of one representative of each of the nine Traditional Owner groups. Requests for information come through the cultural heritage unit and any information extracted is forwarded to the Traditional Owners to then be given to the requestee. This single information portal is one of the biggest strengths and also one of the biggest weaknesses of the system.

1. It is an honour/integrity system and is based entirely on trust.
2. If the gateway person suddenly gets hit by a bus, there is no current succession plan for the database.
3. To this end, a significant amount of energy has been used to fully document the database and its ancillary documents.
4. Giringun's cultural heritage database model is currently being given out to other Traditional Owner groups, outside of the nine Giringun affiliates, for their own use. Training accompanies the installation of the database on to other organisation's computers creating a number of people who will have a good knowledge of the system and how it works (theoretically).
5. The database and all of the ancillary information is backed up to an external hard drive weekly, which is stored off site.

30. Do you plan to do another mapping project in the future?

	No
X	Yes

Comment: Hopefully a more full land use and occupancy study along with further recording of ecological information.

31. What would you do differently in a future mapping project?

	Nothing
--	---------

Improvements: Probably document things better. At the moment they are better than just about anything going but they could always be better.

32. Do you have any further comments or ideas?

Cultural mapping isn't just about making maps. Certainly that is part of it but over the four years I have worked on this project the actual mapping of cultural heritage has been becoming a smaller and smaller part. This is because cultural heritage is about knowledge. If I say that a particular plant coming into flower is the sign to go out and raid the scrub hen nests, how do you map that? The location of the scrub hen nests can be mapped. Different things like this can be mapped by month, but how do we map the knowledge?

Currently the best answer to that question is the Wiki. It may not be classical mapping i.e. landscape component mapping, but it begins to allow linkages to be shown. I believe that in the future this will become the best way to record cultural heritage. Mapping will always play a part, but linking the information together will open new doors for understanding.

Appendix B: Questionnaire Cape Arid National Park
(filled out by David Guilfoyle, Cat Morgan)

Name of your organization	The Gabbie Kylie Foundation
Traditional Owner groups involved	Nkooring, Wudjari, Ngadju
Name of your project	Cape Arid Indigenous Heritage Programme
Location of mapping area	Cape Arid National Park, 120 kms east of Esperance, Western Australia

1. Is this the first mapping project in this community? (please mark with an "X")	
X	No
	Yes
<p>Comment: The Gabbie Kylie Foundation is a community-based organization that was set up by the traditional owners of the Esperance area to carry out natural and cultural heritage projects in the region. A number of successful projects have been carried out by Gabbie Kylie since their establishment in 2007. Including:</p> <ul style="list-style-type: none"> - Conservation & cultural mapping at Tookle-Jenna Heritage Complex - Cultural mapping & weed eradication Woody Island, Recherche Archipelago - Heritage assessment & rehabilitation of Len Otte (Belinup) Heritage Trail, Cape Arid National Park - Mount Ridley Rock Art Restoration Project - Cultural Values Assessment of the Recherche Archipelago - Cultural Mapping of the Wittenoom Stone Arrangement Complex 	

2. How large is the area being mapped?
The Cape Arid National Park covers an area of 279 832 hectares.

3. What is the duration of your mapping project (including preparation, mapping, analyzing data)?	
Start date	June 2009
End date	ongoing
<p>Comment: The mapping has been designed so a number of intensive fieldwork sessions can be carried out over two years, with data processing and write ups done in between field sessions. The fieldwork will be completed by the end of 2010 and the mapping and write-up completed by early 2011.</p>	

4. How long did the actual mapping process take?
2 years, the project is still ongoing.

5. What methods are used for the mapping process? (check all that apply with an "X")	
X	Geographic Information Systems (GIS)
	Pen and paper
	3D-models (e. g. made from cardboard / clay etc.)
Other	Collection of data using hand held GPS with 3-5m accuracy.
<p>Comment: The data is collected using a handheld Garmin GPS, with a GPS log and</p>	

notes filled out each time a point is taken. Data is then transferred onto a PC and manipulated using mapping software called mapsourc. Mapsourc is a basic software which can be used to manipulate the data, store it and also view the data using Google Earth.

Detailed maps are created using ArcGIS and Adobe Illustrator. Features on the map can be elaborated upon within the Park's Management Plan.

6. Was there any schooling done before the mapping (e. g. introduction to GIS, mapping techniques etc.)?

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes

Comment: The principal archaeologist David Guilfoyle has had experience carrying out cultural mapping in both Australia and USA. He has had extensive experience using mapping software such as ArcGIS and Garmin Mapsourc.

7. Did you use any specific guidelines, articles or books for the mapping project?

<input type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please list or describe them below</i>)

Comment: The Gabbie Kylie Foundation Model follows the Burra Charter (The Australia ICOMOS charter for places of cultural significance - <http://www.nationaltrust.com.au/burracharter.html>) in regards to Cultural Heritage work.

8. Is your mapping project based on or motivated by another case study / another community from Australia or another country?

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please describe below</i>)

Comment:

9. How many people are approximately working on the project (mapping, analyzing data)?

<input type="checkbox"/>	0-5
<input type="checkbox"/>	5-10
<input type="checkbox"/>	10-15
<input checked="" type="checkbox"/>	15-20
<input type="checkbox"/>	20-25
<input type="checkbox"/>	25-30
<input type="checkbox"/>	More than 30

Comment: The field sessions are designed around field schools which are coordinated by the Gabbie Kylie Foundation. A representative from each Traditional owner family is present during every field session, as well as student participants from around Australia and the world. Every person can be involved over these field sessions in the data collection and processing.

10. Are any parts of the mapping process or analyzing done by a party outside the Indigenous community (e.g. government agency, university)?

<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes (<i>please list or describe them below</i>)

Comment: Gabbie Kylie Coordinator & Principal of Applied Archaeology Australia –

David Guilfoyle (Ma Cultural Heritage)

Student participants in the Gabbie Kylie Field schools from all over the world.

11. What is the main purpose of the mapping (e.g. land management, Native Title, preserving knowledge, basis for another project etc.)?

The cultural mapping in the Cape Arid National Park was designed to carry out a preliminary heritage assessment of the national park and to develop a cultural heritage management plan. The traditional owners had identified that the national park had a number of cultural features that were being impacted upon by visitors to the park and had indicated that these features needed to be managed in order to conserve and protect for future generations.

12. What was the main reason that triggered your mapping project (e. g. lack of management plan, threat to cultural knowledge etc.)?

The traditional owners had identified that the cultural features in the park were being impacted upon and were concerned at the lack of a management plan.

13. What is your anticipated outcome of the project (e. g. one map, several maps, maps at different scales, database, report, management plan etc.)?

The outcome of the project will include:

- Cultural Heritage Management plan for Cape Arid National Park
- A large database of cultural features throughout the park to add to data previously collected on the islands in the Recherche Archipelago and the surrounding region of the national park.
- A number of maps at different scales indicating the type and number of cultural features in the cultural landscape.

14. What are the main features (e. g. contents, categories) of the map?

- Number and type of cultural features (i.e. stone arrangements, lizard traps, artefact scatters)
- Sites or features linked to dreamtime/creation stories
- Place names
- Areas in need of environmental rehabilitation and protection

15. Are any of the following recorded in the mapping? (check all that apply with an "X")

X	Water sources
X	Sacred sites
X	Places relevant in Dreamtime / Story places
X	Rock paintings
	Rock engravings
X	Axe grinding grooves
X	Stone arrangements
X	Hunting grounds
X	Food gathering areas
	No-take areas
X	Seasonal information
Other	Artefact scatters, quarry sites, lizard traps

Comment:

16. Is any sea country included in your mapping?	
	No (<i>go to question 20</i>)
X	Yes (<i>continue with question 17</i>)

17. Which parts of sea country are included in your mapping? (check all that apply with an "X")	
X	Coasts / Coast lines
X	Historic coast lines
	Islands
	Open ocean
	Reefs
	Lagoons
	Sacred sites
X	Places relevant in Dreamtime
	Shell middens
	Hunting grounds
	Fish traps
	Food gathering areas
	No-take areas
	Tidal information
	Seasonal information
Other	
Comment:	

18. Do any of the mapped contents include seasonal / flexible information (e. g. hunting, gathering, no-take areas etc.)?	
	No
X	Yes (<i>please explain below</i>)
Comment: Certain resources (plants/animals) were hunted or gathered at different times of the year so as to ensure the continuity of the species and to avoid over-exploitation.	

19. Are any larger text passages part of the mapping project (e. g. stories, history, traditional ecological knowledge (TEK) etc.)?	
	No
X	Yes (<i>please explain below</i>)
Comment: The project is primarily to identify cultural features (map them using a hand held GPS) and then develop a cultural heritage management plan. This management plan will integrate Traditional knowledge (excluding of course sacred/dreamtime stories) on all levels, including traditional ecological knowledge, oral histories and "shared" histories.	

20. Are the text passages linked to the map / a location?	
	None are linked to a location
	Some are linked to a location
X	All are linked to a location
Comment: The Spirituality of the Indigenous people in Australia is linked to the landscape/environment. Every place, water holes, major landmark has a name or a story	

attached to it telling of its creation. Although some of this knowledge has been lost due to the European invasion and subsequent forced assimilation of Indigenous people, the Esperance Traditional Owner community has retained traditional knowledge and continues to carry out traditional practices such as Caring for Country.

21. Will there be any gender-specific information in the map / database?

<input checked="" type="checkbox"/>	No		
<input type="checkbox"/>	Yes	<input type="checkbox"/>	only men's business
<input type="checkbox"/>		<input type="checkbox"/>	only women's business
<input type="checkbox"/>		<input type="checkbox"/>	both
Comment:			

22. Did you experience any problems during the mapping process?

<input type="checkbox"/>	No
Problems: Cape Arid National Park covers a large area and it is not possible to cover every part of it. Decisions had to be made as to what particular areas/ types of environments would be covered. Such as, a certain percentage of coastal areas are surveyed, as well as flat coastal plains, mountainous areas such as Mt Arid and Mt Ney and inland lakes, riverways and inland plains.	

23. Did you encounter any other problems?

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please explain below</i>)
Problems:	

24. What landscape contents were the hardest to transform into a map?

Maps are useful for plotting out particular features within an area, however it is difficult to portray the spiritual associations in a landscape or to plot out detailed information in regards to individual features. This is why a large body of text is useful for elaborating on or explaining different features.

25. Was there any landscape data you were not able to transform into a map (e. g. especially seasonal / flexible information)?

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please explain below</i>)
Comment:	

26. Which aspects of the map or gathered information will be published?

An article to be submitted to an academic journal will be developed explaining the process and outcomes of the Cultural mapping project.

27. Who will have access to the finished map?

Various stakeholders such as Department of Environment and Conservation, the funding body and the Traditional Owner community of Esperance.

28. Will any aspects of the map be for internal use only (inside the community)?

	No
X	Yes

Aspects: The location of sacred sites/ dreamtime stories.

29. What measures are taken to protect traditional ecological knowledge (TEK) and cultural knowledge?

The data is retained by the traditional owner community who control access to the information. Cultural protocols are followed by every participant of the mapping project.

30. Do you plan to do another mapping project in the future?

	No
X	Yes

Comment: This project is part of a larger ongoing mapping project that will cover a larger area around Esperance. The data will be integrated into a Master database and will be used to protect and conserve the natural and cultural values of the area.

31. What would you do differently in a future mapping project?

X	Nothing
---	---------

Improvements: Each project is designed accordingly with the area and type of work to be carried out.

32. Who funded the project?

The Program was funded by the Indigenous Heritage Program, Department of The Environment, Heritage, Water and the Arts (DEHWA).

33. Do you have any further comments or ideas?

For more information on the Gabbie Kylie Foundation:
http://www.naturalheritage.org.au/Gabbie_Kylie_Foundation.html

Appendix C: Questionnaire Alngith
(filled out by Mick Morrison)

Name of your organization	Malaruch Aboriginal Corporation
Traditional Owner groups involved	Alngith People
Name of your project	Alngith Cultural Heritage Project
Location of mapping area	Weipa region, western Cape York – north eastern Australia

1. Is this the first mapping project in the Indigenous community? (please mark with an "X")	
	No
X	Yes
Comment: Previous work has focused upon archaeological survey and has largely overlooked other types of cultural places.	

2. How large is the area being mapped?	
Approximately 30 x 10 km is being mapped at a very general level (identifying prominent places) and an area perhaps 10 x 2 km is being mapped in higher detail.	

3. What is the duration of the mapping project (including preparation, mapping, analyzing data)?	
Start date	August 2008
End date	July 2010
Comment: Area is relatively remote and thus work occurs in short-stints each around 2 weeks in duration every 2-3 months.	

4. What methods are used for the mapping process? (check all that apply with an "X")	
X	Geographic Information Systems (GIS)
X	Pen and paper
	3D-models (e. g. made from cardboard / clay etc.)
	Video recording
X	Audio recording
X	Photos
Other	
Comment:	

5. Did you use any specific guidelines, articles or books for the mapping project?	
	No
X	Yes (please list or describe them below)
Comment: Only at a general level since such projects are uncommon in Australia. We draw on: Byrne, D. & Nugent, M., 2004. <i>Mapping attachment: a spatial approach to Aboriginal post-contact heritage</i> , Sydney: Department of Environment and Conservation (NSW). Which is about the closest example we have benefitted from.	

6. Is the mapping project based on or motivated by another case study / another community from Australia or another country?	
	No
X	Yes (<i>please describe below</i>)
Comment: Yes – see previous question	

7. How many people are approximately working on the project (mapping, analyzing data)?	
	0-5
X	5-10
	10-15
	15-20
	20-25
	25-30
	More than 30
Comment: This includes myself (coordinator), a research assistant and community members (approx 8-10 in total)	

8. Are any parts of the mapping process or analyzing done by a party outside the Indigenous community (e.g. government agency, university)?	
	No
X	Yes (<i>please list or describe them below</i>)
Comment: Yes – I am based at Flinders University (Adelaide) where I teach archaeology and cultural heritage management. The cultural mapping project is ongoing and I expect to get some additional students working on various aspects of it.	

9. Was there any schooling done before the mapping (e. g. introduction to GIS, mapping techniques etc.)?	
X	No
	Yes
Comment:	

10. What is the main purpose of the mapping (e.g. land management, Native Title, preserving knowledge, basis for another project etc.)?	
Cultural heritage management, land management and ultimately, community education and public interpretation (for non-Indigenous visitors and locals)	

11. What was the main reason that triggered your mapping project (e. g. lack of management plan, threat to cultural knowledge etc.)?	
Ongoing damage to cultural heritage places Lack of systematic recording of cultural places Loss of traditional knowledge as Elders pass on Strong interest from young people to see that cultural heritage information (places, oral histories) is recorded and stored in the community Academic research into the history and contemporary cultural heritage values of the community.	

12. What is your anticipated outcome of the project (e. g. one map, several maps, maps at different scales, database, report, management plan etc.)?

Community accessible/controlled database (base on Google Earth)
 Detailed report on places, their significance, summaries of their history/importance
 A plan of management to assist land management organizations to ensure that cultural places are adequately looked after and mitigative or rehabilitation works are undertaken.

13. What are the main features (e. g. contents, categories) of the map?

Interactive Google Earth coverages with the ability to click on features within different layers (eg historic places, archaeological places, language names, natural heritage areas, etc) and to retrieved associated 'place details' that includes photos, description, management issues and so on. This will only be accessible to community members.

14. Are any of the following recorded in the mapping? (check all that apply with an "X")

X	Water sources
X	Sacred sites
X	Places relevant in Dreamtime / Story places
	Rock paintings
	Rock engravings
	Axe grinding grooves
X	Stone arrangements
X	Hunting grounds
X	Food gathering areas
X	No-take areas
X	Seasonal information
Other	Oral history places (i.e. places that feature in local oral histories), archaeological places, historical places (former dwellings/features that no longer exist)

Comment:

15. Is any sea country included in your mapping?

	No (go to question 17)
X	Yes (continue with question 16)

16. Which parts of sea country are included in your mapping? (check all that apply with an "X")

X	Coasts / Coast lines
	Historic coast lines
	Islands
	Open ocean
X	Reefs
	Lagoons
X	Sacred sites
	Places relevant in Dreamtime
X	Shell middens
X	Hunting grounds
	Fish traps
X	Food gathering areas

X	No-take areas
	Tidal information
	Seasonal information
Other	Intertidal sand banks that are the location of story places.
Comment:	

17. Do any of the mapped contents include seasonal / flexible information (e. g. hunting, gathering, no-take areas etc.)?

	No
X	Yes (<i>please explain below</i>)
Comment: Yes, some areas have seasonal abundances of particular resources or become active/important at particular times of the year (eg. dry season/wet season).	

18. Are any larger text passages part of the mapping project (e. g. stories, history, traditional ecological knowledge (TEK) etc.)?

	No
X	Yes (<i>please explain below</i>)
Comment: Large oral histories are being documented about particular places and events. These are being transcribed for posterity and the annotated summaries about various places are added to a 'place record' – which is essentially like a site card that provides a summary about the place, including photos, management info and so on.	

19. Are the text passages linked to the map / a location?

	None are linked to a location
X	Some are linked to a location
	All are linked to a location
Comment: Those text passages associated with a particular place are linked to spatial information.	

20. Will there be any gender-specific information in the map / database?

	No		
X	Yes		only men's business
			only women's business
		X	both

Comment: Restricted knowledge will not be included since this is very hard to manage. However, places that are restricted access for men/women is being included as part of 'access restrictions' so that at least this is being document.

21. Did you encounter any problems during the recording / mapping?

	No
X	Yes (<i>please explain below</i>)

Problems: Managing the data is very complicated and we are still getting our heads around this particular aspect of the project. Of particular difficulty is setting up a system to link audio/photos/text to Google Earth coverages in a way that is easy to use and efficient. At present we are using Google Fusion Tables however this is far from ideal.

Follow-up question: Have you come across the "Keeping Places" system from Cultural Systems Solutions?

That is a good system - I have been in touch with them about employing it at Weipa,

however unfortunately it is quite expensive to get up and running. In the interim, we are using Google Earth as an exclusively in-house database.

22. What has been the biggest challenge for your project?

<input checked="" type="checkbox"/>	Funding
	Community support
<input checked="" type="checkbox"/>	Lack of technological equipment (hardware, software)
<input checked="" type="checkbox"/>	Lack of technological knowledge
<input checked="" type="checkbox"/>	Training
	Access to data
	Human resources
	Too much ground to cover
<input checked="" type="checkbox"/>	Too many sites to choose from / making decisions to focus on less sites
Other	
Comment:	

23. What landscape contents were the hardest to transform into a map?

Places with non-specific boundaries – such as resource areas - are sometimes difficult to incorporate into this mapping framework. We attempt to document spatial characteristics by recording polygons, lines or points.

24. Was there any landscape data you were not able to transform into a map (e. g. especially seasonal / flexible information)?

	No
<input checked="" type="checkbox"/>	Yes (<i>please explain below</i>)

Comment: General traditional information about resource types, methods of preparation/consumption, cultural rules around consumption, access and so on, along with general oral histories that don't related to particular places certainly falls outside of this system. Our approach has been to have a dual process of documenting information – one focusing on mapping places and adding these (and associated info) into a spatial database, the other is more ethnographic and aims to document oral histories, cultural knowledge and so on. Some of this is linked to spatial data, though much of it is not.

25. Which aspects of the map or gathered information will be published?

Probably only methodological elements. The map itself is the property of Traditional Owners who wish to keep the information private.

26. Who will have access to the finished map?

Community approved people. In time, different levels of access will be established however at this stage we lack funding or resources to set up differing levels of access to the database.

27. Will any aspects of the map be for internal use only (inside the community)?

	No
<input checked="" type="checkbox"/>	Yes

Aspects: At this stage, the entire map is for community use only. None is aimed at external parties, though this may change in time.

28. What measures are taken to protect traditional ecological knowledge (TEK) and cultural knowledge?

The researcher is ethically bound to keep such information private and confidential unless permission is granted to share it. The community will manage a copy of all the data in their own facilities, with a second restricted copy held by a national archive.

Follow-up question: What national archive is the data stored in?

We have a wonderful facility in Canberra called the Australian Institute of Aboriginal and Torres Strait Islander Studies - AIATSIS - <http://www.aiatsis.gov.au/> where it is possible to lodge cultural information of various types and to place it under restricted access, if necessary.

29. What would you do differently in a future mapping project?

Nothing

Improvements: More time for data management and development of the database since this is a very time consuming process. I would also incorporate funding to employ someone with greater technical skills in GIS to develop a more simple to use database that can be plugged into Google Earth.

30. Who the funded for the project?

The Australian Government Indigenous Heritage Program

31. Do you have any further comments or ideas?

Great research, very keen to see your results and would greatly appreciate if you could provide an electronic copy if possible!

Appendix D: Questionnaire Noongar
(filled out by Brendan Moore)

Name of your organization	South West Aboriginal Land & Sea Council (SWALSC)
Traditional Owner groups involved	Noongar
Name of your project	Sharing Noongar Heritage
Location of mapping area	South West of Western Australia

1. Is this the first mapping project in the Indigenous community? (please mark with an "X")	
X	No
	Yes
Comment: Tindale was probably most notable, but Lyon .. Bates	

2. How large is the area being mapped?
193,957 sq km

3. What is the duration of the mapping project (including preparation, mapping, analyzing data)?	
Start date	1/07/09
End date	30/6/10
Comment:	

4. What methods are used for the mapping process? (check all that apply with an "X")	
X	Geographic Information Systems (GIS)
	Pen and paper
	3D-models (e. g. made from cardboard / clay etc.)
	Video recording
X	Audio recording
X	Photos
Other	
Comment: We can add sites using GPS co-ordinates, then attach sound, video, text and image files	

5. Did you use any specific guidelines, articles or books for the mapping project?	
	No
X	Yes (please list or describe them below)
Comment: This report helped: Indigenous Information Management Workshop 26-27 June 2009, Cairns, Facilitators report July 2008	

6. Is the mapping project based on or motivated by another case study / another community from Australia or another country?	
	No

<input checked="" type="checkbox"/>	Yes (<i>please describe below</i>)
Comment: Yes, a company called Environmental Systems Solutions and Cultural Systems Solutions have developed similar GIS based mapping projects for indigenous groups in Australia	

7. How many people are approximately working on the project (mapping, analyzing data)?	
<input checked="" type="checkbox"/>	0-5
<input type="checkbox"/>	5-10
<input type="checkbox"/>	10-15
<input type="checkbox"/>	15-20
<input type="checkbox"/>	20-25
<input type="checkbox"/>	25-30
<input type="checkbox"/>	More than 30
Comment:	

8. Are any parts of the mapping process or analyzing done by a party outside the Indigenous community (e.g. government agency, university)?	
<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please list or describe them below</i>)
Comment:	

9. Was there any schooling done before the mapping (e. g. introduction to GIS, mapping techniques etc.)?	
<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes
Comment:	

10. What is the main purpose of the mapping (e.g. land management, Native Title, preserving knowledge, basis for another project, World Heritage listing etc.)?	
Preserving knowledge, perhaps Native Title	

11. What was the main reason that triggered your mapping project (e. g. lack of management plan, threat to cultural knowledge etc.)?	
Colonial Government Heritage Act (1974, DIA) does not protect sites / heritage. Elders passing on and losing knowledge	

12. What is your anticipated outcome of the project (e. g. maps, database, report, management plan, book etc.)?	
Mapping, education, knowledge transfer	

13. What are the main features (e. g. contents, categories) of the map (e. g. stories, cultural places, rock art, traditional knowledge etc.)?	
See www.noongarculture.org.au	
<ul style="list-style-type: none"> - DIA sites - SNC sites (Single Noongar Claim) – Native Title - Other unrecorded sites 	

14. Are any of the following recorded in the mapping? (<i>check all that apply with an "X"</i>)	
X	Water sources
X	Sacred sites
X	Places relevant in Dreamtime / Story places
X	Rock paintings
X	Rock engravings
X	Axe grinding grooves
X	Stone arrangements
X	Hunting grounds
X	Food gathering areas
	No-take areas
	Seasonal information
Other	Women's and Men's sites, Artifact scatter
Comment:	

15. Is any sea country included in your mapping?	
	No (<i>go to question 17</i>)
X	Yes (<i>continue with question 16</i>)

16. Which parts of sea country are included in your mapping? (<i>check all that apply with an "X"</i>)	
X	Coasts / Coast lines
	Historic coast lines
	Islands
	Open ocean
	Reefs
	Lagoons
	Sacred sites
X	Places relevant in Dreamtime
X	Shell middens
	Hunting grounds
X	Fish traps
X	Food gathering areas
	No-take areas
X	Tidal information
	Seasonal information
Other	
Comment:	

17. Are any larger text passages part of the mapping project (e. g. stories, history, traditional ecological knowledge (TEK) etc.)?	
	No
	Yes, written text
	Yes, audio recordings
X	Yes, both
Comment:	

18. Are the text passages linked to the map / a location?	
	None are linked to a location
X	Some are linked to a location
	All are linked to a location
Comment:	

19. Will there be any gender-specific information in the map / database?			
	No		
X	Yes		only men's business
			only women's business
		X	both
Comment:			

20. Did you encounter any problems during the project (during the preparation, mapping process or while analyzing the data)?	
	No
X	Yes (<i>please explain below</i>)
Problems: IT-related problems, server selection, and we have 2500 members so there is a lot of consultation	

21. What information / landscape contents were the hardest to record or map?	
None, just difficult to get to spots, i.e. far away in forest	

22. Was there any data you were not able to transform into a map or record to your satisfaction (e. g. seasonal / flexible information)?	
	No
	Yes (<i>please explain below</i>)
Comment:	

23. Which aspects of the gathered information will be published?	
Information that can be shared, will be shared	

24. Who will have access to the information?	
All Noongars have access	

25. Will parts of the data be for internal use only (inside the community)?	
	No
X	Yes (<i>please explain below</i>)
Comment: Men's site, women's sites Our members can keep their data secret (user groups)	

26. What measures are taken to protect traditional ecological knowledge (TEK) and cultural knowledge?	
Restricting information to limited user groups	

27. Do you plan to do another mapping project in the future?	
<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes
Comment:	

28. What would you do differently in a future mapping project?	
<input type="checkbox"/>	Nothing
Improvements: Setting up the Content Management System was difficult first time	

29. Was the funding for the project solely done by the Australian Government (IHP)?	
<input type="checkbox"/>	Yes
Other contributors: The IHP contributed \$100,000 and SWALSC \$18,500.	

30. Do you have any further comments or ideas?	
You just have to be creative and work at something intangible for a long time for it to eventually work	

Appendix E: Questionnaire Jawoyn
(filled out by Ray Whear)

Name of your organization	Jawoyn Association Aboriginal Corporation
Traditional Owner groups involved	Jawoyn
Name of your project	We have multiple projects but Cultural Heritage Mapping is just one part of the overall plan.
Location of mapping area	Jawoyn Lands totaling 1.8M Ha

1. Is this the first mapping project in the Indigenous community? <i>(please mark with an "X")</i>	
<input checked="" type="checkbox"/> X	No
<input type="checkbox"/>	Yes
Comment: It is not the first project; however previous efforts have only focused on only very small areas.	

2. How large is the area being mapped?
1.8M Ha

3. What is the duration of the mapping project (including preparation, mapping, analyzing data)?	
Start date	2006
End date	Ongoing
Comment:	

4. What methods are used for the mapping process? <i>(check all that apply with an "X")</i>	
<input checked="" type="checkbox"/> X	Geographic Information Systems (GIS)
<input checked="" type="checkbox"/> X	Pen and paper
<input type="checkbox"/>	3D-models (e. g. made from cardboard / clay etc.)
<input checked="" type="checkbox"/> X	Video recording
<input checked="" type="checkbox"/> X	Audio recording
<input checked="" type="checkbox"/> X	Photos
<input type="checkbox"/>	Other
Comment:	

5. Did you use any specific guidelines, articles or books for the mapping project?	
<input checked="" type="checkbox"/> X	No
<input type="checkbox"/>	Yes <i>(please list or describe them below)</i>
Comment:	

6. Is the mapping project based on or motivated by another case study / another community from Australia or another country?	
<input checked="" type="checkbox"/> X	No
<input type="checkbox"/>	Yes <i>(please describe below)</i>
Comment:	

7. How many people are approximately working on the project (mapping, analyzing data)?	
<input checked="" type="checkbox"/>	0-5
<input type="checkbox"/>	5-10
<input type="checkbox"/>	10-15
<input type="checkbox"/>	15-20
<input type="checkbox"/>	20-25
<input type="checkbox"/>	25-30
<input type="checkbox"/>	More than 30
Comment:	

8. Are any parts of the mapping process or analyzing done by a party outside the Indigenous community (e.g. government agency, university)?	
<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes (<i>please list or describe them below</i>)
Comment:	

9. Was there any schooling done before the mapping (e. g. introduction to GIS, mapping techniques etc.)?	
<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes
Comment:	

10. What is the main purpose of the mapping (e.g. land management, Native Title, preserving knowledge, basis for another project etc.)?	
Land management, Cultural heritage, and preserving knowledge.	

11. What was the main reason that triggered your mapping project (e. g. lack of management plan, threat to cultural knowledge etc.)?	
Threat to cultural knowledge. Very few elders with knowledge are still alive.	

12. What is your anticipated outcome of the project (e. g. one map, several maps, maps at different scales, database, report, management plan etc.)?	
Recording of Cultural and Heritage knowledge whilst remaining elders are still alive.	

13. What are the main features (e. g. contents, categories) of the map?	
As listed in Q14. As well as walking tracks, meeting places, Clan associations, Clan boundaries, Clan land ownership. We are also currently looking a linking genealogical information to the mapping.	

14. Are any of the following recorded in the mapping? (check all that apply with an "X")	
<input checked="" type="checkbox"/>	Water sources
<input checked="" type="checkbox"/>	Sacred sites
<input checked="" type="checkbox"/>	Places relevant in Dreamtime / Story places
<input checked="" type="checkbox"/>	Rock paintings
<input checked="" type="checkbox"/>	Rock engravings

X	Axe grinding grooves
X	Stone arrangements
X	Hunting grounds
X	Food gathering areas
X	No-take areas
	Seasonal information
Other	
Comment:	

15. Do any of the mapped contents include seasonal / flexible information (e. g. hunting, gathering, no-take areas etc.)?	
	No
	Yes (<i>please explain below</i>)
Comment:	

16. Are any larger text passages part of the mapping project (e. g. stories, history, traditional ecological knowledge (TEK) etc.)?	
	No
X	Yes (<i>please explain below</i>)
Comment: Everything that the elders know is recorded including stories, history and traditional ecological knowledge.	

17. Are the text passages linked to the map / a location?	
	None are linked to a location
X	Some are linked to a location
	All are linked to a location
Comment: Some are simply stories related to customs and traditions that aren't necessarily linked to specific areas of land.	

18. Will there be any gender-specific information in the map / database?			
	No		
X	Yes		only men's business
			only women's business
		X	Both
Comment:			

19. Did you encounter any other problems during the recording / mapping?	
	No
X	Yes (<i>please explain below</i>)
Problems: Just some memory problems with the old people.	

20. Did you encounter any other problems?	
	No
	Yes (<i>please explain below</i>)
Problems:	

21. What has been the biggest challenge for your project?	
X	Funding
	Community support
	Lack of technological equipment (hardware, software)
	Lack of technological knowledge
	Training
	Access to data
	Human resources
	Too much ground to cover
	Too many sites to choose from / making decisions to focus on less sites
Other	
Comment:	

22. What landscape contents were the hardest to transform into a map?	
High concentrations of rock art in some areas.	

23. Was there any landscape data you were not able to transform into a map (e. g. especially seasonal / flexible information)?	
X	No
	Yes (<i>please explain below</i>)
Comment:	

24. Which aspects of the map or gathered information will be published?	
Very little.	

25. Who will have access to the finished map?	
Traditional Owners, Jawoyn Association and Jawoyn land managers.	

26. Will any aspects of the map be for internal use only (inside the community)?	
	No
X	Yes
Aspects: Cultural Heritage Database located in each Community	

27. What measures are taken to protect traditional ecological knowledge (TEK) and cultural knowledge?	
The database system holding this knowledge is a very secure system with access granted by Elders using a password system related to multiple criteria such as age, clan, gender etc. Who has access to the system is decided by the Jawoyn Council of Elders.	

28. Do you plan to do another mapping project in the future?	
	No
X	Yes
Comment: Project is ongoing subject to funding.	

29. What would you do differently in a future mapping project?	
X	Nothing
Improvements:	

30. Was the funding for the project solely done by the Australian Government?

No

Yes

Other contributors: Jawoyn Association, Kim McKenzie, Dr Murray Garde also added considerable funding and resources to the project.

31. Do you have any further comments or ideas?

No

Appendix F: Questionnaire Uluru – Katat Tjuta National Park

(filled out by Kerrie Bennison)

Name of your organization	Parks Australia
Traditional Owner groups involved	Anangu
Name of the project	Cultural Heritage Database
Location of mapping area	Uluru-Kata Tjuta National Park

1. Is this the first mapping project in the Indigenous community? *(please mark with an "X")*

<input type="checkbox"/>	No
<input type="checkbox"/>	Yes

Comment: unsure

2. How large is the area being mapped?

1625 square kilometres

3. What is the duration of the mapping project (including preparation, mapping, analyzing data)?

Start date	
End date	

Comment: On -going

4. How long did the actual mapping process take?

On-going now for 3 years

5. What methods are used for the mapping process? *(check all that apply with an "X")*

<input checked="" type="checkbox"/>	Geographic Information Systems (GIS)
<input type="checkbox"/>	Pen and paper
<input type="checkbox"/>	3D-models (e. g. made from cardboard / clay etc.)
Other	

Comment:

6. Did you use any specific guidelines, articles or books for the mapping project?

<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes <i>(please list or describe them below)</i>

Comment: Guidelines came from Anangu regarding what sites need to be classed as sensitive (and therefore password protected).

7. Is the mapping project based on or motivated by another case study / another community from Australia or another country?

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes <i>(please describe below)</i>

Comment:

8. How many people are approximately working on the project (mapping, analyzing data)?	
	0-5
X	5-10
	10-15
	15-20
	20-25
	25-30
	More than 30
Comment:	

9. Are any parts of the mapping process or analyzing done by a party outside the Indigenous community (e.g. government agency, university)?	
	No
X	Yes (<i>please list or describe them below</i>)
Comment: Staff at Uluru-Kata Tjuta National Park	

10. Was there any schooling done before the mapping (e. g. introduction to GIS, mapping techniques etc.)?	
X	No
	Yes
Comment:	

11. What is the main purpose of the mapping (e.g. land management, Native Title, preserving knowledge, basis for another project etc.)?	
Cultural site management and the preservation of knowledge	

12. What was the main reason that triggered the mapping project (e. g. lack of management plan, threat to cultural knowledge etc.)?	
To improve the management of cultural sites.	

13. What is your anticipated outcome of the project (e. g. maps, database, report, management plan etc.)?	

14. What are the main features (e. g. contents, categories) of the map?	
GIS coordinates of cultural sites	
Recording of all management activities associated with cultural sites	

15. Are any of the following recorded in the mapping? (check all that apply)	
X	Water sources
X	Sacred sites
X	Places relevant in Dreamtime / Story places
X	Rock paintings
X	Rock engravings
	Axe grinding grooves
	Stone arrangements
	Hunting grounds

	Food gathering areas
	No-take areas
	Seasonal information
Other	
Comment:	

16. Do any of the mapped contents include seasonal / flexible information (e. g. hunting, gathering, no-take areas etc.)?	
X	No
	Yes (<i>please explain below</i>)
Comment:	

17. Are any larger text passages part of the mapping project (e. g. stories, history, traditional ecological knowledge (TEK) etc.)?	
	No
X	Yes (<i>please explain below</i>)
Comment: Oral histories	

18. Are the text passages linked to the map / a location?	
	None are linked to a location
	Some are linked to a location
X	All are linked to a location
Comment:	

19. Will there be any gender-specific information in the map / database?			
	No		
X	Yes		only men's business
			only women's business
		X	Both
Comment:			

20. Did you experience any problems during the mapping process?	
X	No
Problems:	

21. Did you encounter any other problems?	
X	No
	Yes (<i>please explain below</i>)
Problems:	

22. What landscape contents were the hardest to transform into a map?	

23. Was there any landscape data you were not able to transform into a map (e. g. especially seasonal / flexible information)?	
X	No
	Yes (<i>please explain below</i>)
Comment:	

24. Which aspects of the map or gathered information will be published?	
None	

25. Who will have access to the finished map?	
Only parks staff and Anangu	

26. Will any aspects of the map be for internal use only (inside the community)?	
	No
X	Yes
Aspects:	

27. What measures are taken to protect traditional ecological knowledge (TEK) and cultural knowledge?	
Password protection based on level of knowledge allowed.	

28. Do you plan to do another mapping project in the future?	
X	No
	Yes
Comment:	

29. What would you do differently in a future mapping project?	
X	Nothing
Improvements:	

30. How is the Cultural Site Management System funded?	
We fund the database out of our parks operational budget.	

31. Do you have any further comments or ideas?	

Appendix F: Interview with Troy Mallie (August 31st, 2010)

Your name	Troy Mallie
Name of your organization	Cultural Systems Solutions (working closely together with Environmental Systems Solutions) Software: Keeping Places

1. Could you tell me a little bit about your background?

I am an indigenous person (Kuku-Yalanji) from around Cairns, Queensland. I started in conservation and land management. I was also a park ranger at Uluru and got into heritage management, GIS and IT.

2. What was prompted the development of the software?

Traditional Owners at Uluru, where I was a park ranger, wanted easier access to data collected about their lands. Archaeologists came to Uluru for surveys and the Anangu wanted access to the data after the researchers had left. The information was collected in big reports that collected dust somewhere and where not easily accessible. In 2000, a workshop with the Traditional Owners was set up to solve this problem. They drew designs in the sand of how they imagined it should work. The development took about 3 years, it was used for the first time in 2003.

3. How many groups are using the software at the moment?

23 groups (22 in Australia, one in Vanuatu)

Some of these groups / organizations are:

- Uluru Kata-Tjuta National Park, NT
- Wet Tropics (four traditional owner groups), QLD
- Jawoyn Association, NT
- Ngalia, WA
- SWALSC (South West Aboriginal Land and Sea Council), WA
- TALSC (Tasmanian Aboriginal Land and Sea Council Aboriginal Corporation), TAS
- Dhimurru, NT
- Waluwarra, QLD

4. What groups are using the program (small / large groups)?

Many of the groups using the software are bigger groups with good organization, because it is often easier for them to secure funding.

But there are also some smaller groups. For example, one group in Arnhem Land consists of one elder and his family. They work together with researchers from ANU (Australian National University) in Canberra. ANU applied for funding for them.

5. Do groups approach you, do you approach them or are you recommended by other groups?

- Word of mouth
- Presentations and workshops at conferences or at Land Council meetings

6. From your experience, what data and what information is mainly stored in the system?

Data: Photos, video, text, audio recordings

Data on maps / satellite imagery can also depict line, points and polygons

Information: Some example are cultural places, natural resources, stories, story lines, rock art

7. From your experience, what are the main purposes the groups are using the system?

- Data recording, data storage, data access
- As a management tool, to produce management plans, to make management decisions
- Knowledge protection
- Heritage and site management
- Monitoring field work
- Producing reports for funding (e. g. “Caring for Country”)
- Interacting with stakeholder (e. g. mining companies)
- Native Title

Example 1: The group in Vanuatu used it to produce documentation to apply for World Heritage Listing. The listing was granted in 2008.

Example 2: For some groups it can create employment and income opportunities. Groups with mining stakeholders can do their own archaeological surveys, the mining companies won't have to hire outside experts. The groups produce their own surveys and reports and get a “fee for service”. They need no one to act as an in-between.

8. Can the software be used for sea country as well as on land?

Yes

9. How long does it usually take to set up the system, finish configurations and train people to use the system?

That depends a lot on the needs of the group. Three months is about the quickest it can be done. But it may take up to a year. Support, updates and additional features might go on continually, if the group wishes it.

10. How many people are necessary to keep up / manage the system?

That depends. One big problem is the funding (to pay people, to keep the system running).

One example could be five or six rangers to do field work and two data management officers (female and male). There always need to be two data management officers in order to feed restricted information from both men and women into the system.

11. The software has settings that can restrict access. For what kind of information can the permission settings be used?

The permission settings can be used, for example, for gender, clan or family. Groups can create their own user groups. They can decide themselves what user groups or restriction they deem useful or necessary. The system can be adapted to fit their specific cultural protocols. Before, the system used to be more static, it only allowed for three user groups: male, female, public. Nowadays, the system is dynamic. User groups can be changed and adapted as they are needed. In some groups, a board of elders decides over who gets access to what information and to which user group one belongs.

12. What do groups appreciate most about your software?

They appreciate that the program is customized and not off the shelf. They get to be involved in the development process. They can choose their own designs, include their own logos and customize the data entry forms. The program gets built based on their individual needs. For example, we offer customized user interfaces, e. g. specially made for elders or school kids, or for the people who enter the data into the system.

13. Where do you see the advantages and disadvantages of using GIS for cultural mapping?

There are quite complex GIS like ArcGIS or MapInfo. Open source GIS is usually more user friendly. Keeping Places is similar to Google Earth, one can navigate around a map.

We wanted to avoid high level GIS and complex settings. Instead we focus on basic data entry and GPS coordinates to make the program more user-friendly.

One advantage of GIS is that the satellite imagery that is fed into the system can be used to actively look for cultural sites.

14. Where do you see restrictions in your software that prevent the mapping of landscape content?

There aren't really any. Unless you wanted to capture the whole holistic way of doing things. But you can do an awful lot with just lines, points and polygons. Some groups even create their storylines with them. For most groups, there are simply more urgent matters to think about. Knowledge being lost is a big worry in Australia. Storing cultural information is a pressing matter, just like securing funding to keep everything running.

15. What are the most common problems groups encounter during their projects or with the software?

One of the biggest problems is probably long-term support and funding to maintain the system. The system needs to be kept in use to be effective. All projects are still up and running. But I can't say how much they really get used. It could be every day, could be a lot less.

16. Are any new developments planned for the software?

In the past data collection was done in paper form before it got fed into the system. This can be a problem when not everybody is perfectly literate in written English. In another couple of weeks the data collection will be paperless. Data will be collected with a hand-held device, similar to a PDA, with a very user-friendly interface. Nobody will have to worry about reading and writing anymore, it will just be pushing buttons. Before, it was a big task with long forms, it was a boring activity. Now it will be enjoyable. The data can be loaded right into the system. It will also save a lot of time. The pre-set answers can also act as a quality control.

17. How do the costs of Keeping Places compare to ArcGIS or similar programs?

In the US, ArcGIS is free for all tribal groups, but not in Australia. Here one has to pay a license fee every year. For 'Keeping Places' the groups pay just once for the set-up. There are hardly any ongoing costs, unless groups want to add any additional features later. Or they choose to get their web hosting done by our company, for which they would have to pay an annual fee.

Appendix H: Guidebooks and Online Support

Empirical literature on cultural mapping projects comes mainly from North America, Latin America, South East Asia. Fewer articles cover Africa and some Oceania (Chapin et al. 2005, Corbett et al. 2009, Poole 2003). While there have been several publications about Pacific Islands, work on cultural mapping projects from New Zealand and Australia is rather rare. Also remarkable is the fact that most literature is written by non-indigenous people, therefore often omitting the indigenous point of view of these projects. And many other projects remain under the radar, as the people involved either have no time to publish their findings and experiences or because they are reluctant to do so due to political or cultural sensitivities (Chapin et al. 2005, Rundstrom 2009). Very few of the articles that involve working with indigenous communities list the indigenous communities as co-authors, such as Feinberg et al. (2003) or Watson & the Yolngu (1993), as is considered good practice for example in Australia.

There are numerous guidebooks on mapping. Many can be accessed online and for free. They have mostly been developed from actual case studies and have been published by the overseeing organizations. In addition to a how-to-do-it-list the guidelines usually include positive and negative experiences from the case studies. This rather practical than theoretical approach based on concrete field experience makes the guidelines easy to understand and relate to. As Chapin et al. (2005) point out, guidebooks from and for countries where the relationship between indigenous peoples and the government are more strained usually focus rather on technical than political aspects of mapping.

A guide on participatory tools in general, primarily intended for forest communities, was published by Evans et al. (2006). As mapping is just one of ten different tools outlined in the guide, the part on mapping is rather short but gives a good and clear overview of the matter. Jackson et al. (1994) also focus on participatory mapping in connection with forestry. The Center for the Support of Native Lands (Chapin & Threlkeld 2001) published a methodology based on sketch mapping, which had been developed from experiences in Honduras and Panama. Although the projects were focused on enabling Indigenous Peoples to gain long-term rights over their lands and natural resources, the methodology can be applied to a diverse set of cultural or political goals. Another guide by the same authors (Chapin & Threlkeld 2008) draws on the same method but each step is accompanied by good and bad experiences from case studies in Bolivia, Cameroon, Honduras, Panama, Suriname, West Papua and Papua New Guinea. A guidebook on land use and occupancy mapping from Canada, by Tobias (2000), was specifically developed to guide First Nations in their attempt to prove their rights to land and natural resources, so the maps would be accepted as hard evidence of such rights by the government and in court. The Centre for Indigenous Environmental Resources' (CIER) (2010) *Good Practices Guide* focuses on GIS-related mapping projects in Canada. The guide points out important factors that can mean success or failure (funding, training etc.) for a project. Based on experiences from 23 Aboriginal organizations, the advice given can be applied to all programs that employ geomatics. The Makivik Corporation (2008a, 2008b), an Inuit institution, published a two-volume guide on geospatial data for mapping and information needs. A guideline based on case studies from South America (Brazil, Colombia and Suriname) has been published by ACT (Amazon Conservation Team) Brazil (2008). The methodology uses pen and paper approach for their mapping projects. Rambaldi & Callosa-Tarr (2000, 2002) wrote two detailed guidelines on 3-dimensional modeling based on cases from the Philippines for the National Integrated Protected Area Programme (NIPAP), which is part of the Philippines Department of Environment and Natural Resources. After the government had mostly ignored submitted sketch maps, NIPAP found that accurately scaled relief models were more efficient. The first case of 3-D modeling was applied to a marine pro-

tected area and proved that this mapping is suitable for land and sea. Rambaldi & Callosa-Tarr (2002) also included a step-by-step instruction on how to digitize data from the models and enter it into a GIS.

Another source of information for indigenous peoples is the *Aboriginal Mapping Network* (AMN) (<http://www.nativemaps.org/>), probably one of the most prominent online platforms for indigenous peoples when it comes to mapping. The AMN was founded in 1998 by the Gitksan and Ahousaht First Nations and Ecotrust Canada, with Ecotrust Canada as the managing body. What started out as a forum for knowledge sharing for local First Nations in British Columbia, Canada, has developed into a worldwide platform that provides publications and information on a diverse set of relevant topics, from mapping technology, information management, legal matters to funding. Other websites include the *Integrated Approaches to Participatory Development* (<http://www.iapad.org>) maintained by Giacomo Rambaldi, the *Open Forum on Participatory Information Systems and Technologies* (<http://ppgis.iapad.org>) and the *Philippine Association for Intercultural Development* (<http://www.pafid.org>).

Literature

ACT (Amazon Conservation Team) Brazil (2008): Methodology of Collaborative Cultural Mapping. Brasília.

http://www.equipe.org.br/publicacoes_dentro.php?tipoid=1 [08-03-2010]

Chapin, M. & Threlkeld, B. (2001): Indigenous Landscapes - A Study in Ethnocartography. Center for the Support of Native Lands.

http://www.elistore.org/reports_detail.asp?ID=10805&topic=International [10-03-2010]

Chapin, M.; Lamb, Z. & Threlkeld, B. (2005): Mapping Indigenous Lands. *Annual Review of Anthropology*, 34: 619-38.

Chapin, M. & Threlkeld, B. (2008): Mapping Indigenous Lands - A Practical Guidebook. Center for the Support of Native Lands.

<http://www.nativelands.org/PUBLICATIONS/Pub/Guidebook.Jan%202009.pdf> [13-06-2010]

CIER (Centre for Indigenous Environmental Resources) (2010): Good Practices Guide – Success in Building and Keeping an Aboriginal Mapping Program. Prepared for GeoConnections & Natural Resources Canada.

http://www.geoconnections.org/publications/Key_documents/CIER_Good_Practices_Guide_lowRes.pdf [13-06-2010]

Corbett, J.; Chapin, M.; Gibson, L. & Rambaldi, G. (2009): Indigenous Mapping. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 377-382.

Evans, K., W. De Jong, P. Cronkleton, P. Sheil, T. Lynam, T. Kusumanto and C. J. P. Colfer. 2006 *Guide to Participatory Tools for Forest Communities* Jakarta: Center for International Forestry Research (CIFOR).

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.118.7442&rep=rep1&type=pdf> [08.03.2010]

Feinberg, R.; Dymon, U. J.; Paiaki, P.; Rangituteki, P.; Nukuriaki, P. & Rollins, M. (2003): 'Drawing the Coral Heads': Mental Mapping and its Physical Representation in a Polynesian Community. *The Cartographic Journal*, 40 (3): 243-253.

Jackson, B.; Nurse, M. C.; Singh, H. B. (1994): Participatory mapping for community forestry. Rural Development Forestry Network Paper 17e. Overseas Development Institute, London.

<http://www.mekonginfo.org/mrc/rdf-odi/english/papers/rdfn/17e-i.pdf> [20-04-2010]

Makivik Corporation (2008a): Aboriginal Community Land and Resource Management: Geospatial Data Needs Assessment and Data Identification and Analysis -Volume 1: Aboriginal Mapping and Information

Needs: Experiences from Ten Land Use Planning Processes Across Canada. Prepared for GeoConnections & Natural Resources Canada.

http://www.geoconnections.org/publications/Key_documents/Volume1_E.pdf [13-06-2010]

Makivik Corporation (2008b): Aboriginal Community Land and Resource Management: Geospatial Data Needs Assessment and Data Identification and Analysis - Volume 2: Data Identification and Analysis. Prepared for GeoConnections & Natural Resources Canada.

http://www.geoconnections.org/publications/Key_documents/Volume2_E.pdf [13-06-2010]

Poole, P. (2003): Cultural Mapping and Indigenous Peoples - A Report for UNESCO.

http://portal.unesco.org/culture/en/files/17109/10787580083cultural_mapping_1.pdf/cultural_mapping_1.pdf [06-03-2010]

Rambaldi, G. & Callosa-Tarr, J. (2000): Manual on Participatory 3-D Modeling for Natural Resource Management. Essentials of Protected Area Management in the Philippines, Vol. 7 NIPAP, PAWB-DENR, Philippines.

http://www.iapad.org/p3dm_guiding_principles.htm [10-03-2010]

Rambaldi, G. & Callosa-Tarr, J. (2002): Participatory 3-Dimensional Modelling: Guiding Principles and Applications. ASEAN Regional Centre for Biodiversity Conservation (ARCBC), Los Baños, Philippines.

http://www.iapad.org/publications/ppgis/p3dm_nipap.pdf [10-03-2010]

Rundstrom, R. A. (2009): Counter-Mapping. In: Kitchin, R. & Thrift, N. (eds) *International Encyclopedia of Human Geography*. Oxford: Elsevier, pp. 314-318.

Tobias, T. (2000): Chief Kerry's Moose Guidebook to Land Use and Occupancy Mapping, Research Design and Data Collection. Ecotrust Canada, Vancouver.

http://www.ubcic.bc.ca/files/PDF/Tobias_whole.pdf [08-03-2010]

Watson, H. and the Yolngu community at Yirrkal (1993): Aboriginal-Australian Maps. In: Turnbull, D., *Maps Are Territories: Science Is an Atlas: A Portfolio of Exhibits*. Chicago, IL: University of Chicago Press, pp. 28-36.

Appendix I: Non-plagiarism Statement

By this letter I declare that I have written this essay, paper or thesis completely by myself, and that I have used no other sources or resources than the ones mentioned.

The sources used have been stated in accordance with the rules and regulations that are applied at the Faculty of Spatial Sciences of the University of Groningen. I have indicated all quotes and citations that were literally taken from publications, or that were in close accordance with the meaning of those publications, as such.

Moreover I have not handed in an essay, paper or thesis with similar contents elsewhere. All sources and other resources used are stated in the bibliography.

In case of proof that the essay, paper or thesis has not been constructed in accordance with this declaration, the Faculty of Spatial Sciences considers the essay, paper or thesis as negligence or as a deliberate act that has been aimed at making correct judgment of the candidate's expertise, insights and skills impossible.

In case of plagiarism the examiner has the right to exclude the student from any further participation in the particular assignment, and also to exclude the student from further participation in the MSc programme at the Faculty of Spatial Sciences of the University of Groningen. The study results obtained in the course will be declared null and void in case of plagiarism (also see Article 12 of Rules and Regulations Exams).

Name

Place

Date

Signature
