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Settlement Patterns of the Past to Future Resilience

PHILLIP B. ROÖS

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Indigenous Knowledge and Climate Change: Settlement Patterns of the Past to Adaptation of the Future

Phillip B. Roös, Deakin University, Australia

Abstract: For centuries, the Aboriginal Peoples of Australia have been confronted with major ecological, geological, and climate events, and had to adapt home shelters and settlements to seasonal variations. Many of these changes have been captured in the cultural traditions of the indigenous people of Australia reflecting a harsh coastal environment. Weather patterns and climate change phenomena were gauged by the occurrence of landscape changes and recurring weather events by the acknowledgement of six seasons. Community settlements were established and relocated to adapt to the patterns of nature. This paper investigates if this ancient knowledge can provide answers for adaptation of coastal settlements to a changing climate now and in the future. Drawing upon recent published literature on predicted coastal climate change impacts in the different regions of Australia, and the review of Indigenous knowledge on settlement planning according to a six season cycle, the author explores traditional knowledge as input to a potential Climate Change Adaptation Model that considers a proposed framework, for integrating indigenous knowledge into the contemporary climate change adaptation practice and discourse.

Keywords: Indigenous Knowledge, Aboriginal Settlements, Six Seasons, Adaptation, Climate Change

Introduction

Climate change impacts, the mitigation and adaptation continues to be a prevailing debate internationally, extensively reported in literature of both the sciences and the arts. While various changes in climate and the increase in extreme weather events are already evident, the quantification of these climate changes has challenged many conventional sciences. This discourse has been recorded extensively to understand the need to adapt, mitigate, and to construct strategies for survival in a future changed climate (Jones et al. 2013; Low Choy and Jones 2013; Flannery 2005). The inability to answer important questions about changing climates and environments in Australia, relating to the degree, consequences, and associated patterns to change, is embedded in the knowledge of a short two hundred years of colonial history (Jones et al. 2013). Based on this short term of data and evidence, very much informed by western scientific perspectives and protocols, contemporary literature fails to provide answers on how to adapt and understand the harsh climatic cycles of the Australian continent. With a rapid changing climate due to anthropogenic causes, this limited knowledge is being put to the test (Jones et al. 2013; Roös 2013).

Contrary to this short period of European knowledge, is the accumulated Australian Aboriginal knowledge on the environmental and Indigenous systems of over 40,000 years (O'Connor and Prober 2010). Unfortunately little attempt has been made to understand and include the environmental Australian Aboriginal knowledge in the discourse of climate change adaptation. This paper thus explores the roles and values that Australian Aboriginal knowledge can bring to this debate, shedding light on the Aboriginal perspective of climate change adaption and the potential to include their narratives as answers for adaptation strategies. Further, the paper also reviews the Aboriginal knowledge relating to the coastal environment, investigating the relationship between weather patterns, the landscape and the sea, and how this knowledge was used to inform settlement and migration patterns.

Along the coastline, temporary settlements have been established for millennia by the Aboriginal people of Australia according to the cycles of weather and the climate. The people living in these settlements have been confronted by major and harsh ecological, climate and

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geological changes; they have believed that these natural phenomena are integrally connected with their spiritual and physical wellbeing (Roberts 1975). Recorded by William Thomas, one of these spiritual reflections of a Dreamtime[1] story indicates the closeness to land and the importance of the changing environment, the story of the creation of *Punjil* and *Pallian*, the interconnection of nature and people:

> "*Punjil* is the maker of earth, trees, animals, man and woman. *Punjil* had a wife named *Boi Boi*, but he never saw her face. She bore him two children, one a son named *Binbeal* and the other a daughter named *Kara-karook*. To *Binbeal* is committed the sovereignty of the heaven and to *Kara-karook* the incidental occurrences on earth; while great *Punjil* stalks like a big gentleman in the clouds, on the earth, and always carrying a big sword. *Pallian*, brother of *Punjil*, made all seas, rivers, creeks and waters, also all the fish in the oceans, seas and rivers. He governs the waters, was always in the waters, walking, bathing, and going over the seas. One day when our ancestors awoke, *Punjil*, *Pallian* and *Karakarook* had gone up above. They had departed from *Deen Maar*[2], which remains sacred to our people to the present day." (Thomas 1989, 79)

Additional to the spiritual connection to Country[3], the Aboriginal people relied on their intimate knowledge of the environment, seasonal cycles and understanding of climatic events for ensuring an adequate food supply, including natural medicines as well as protective resources (O'Connor and Prober 2010). Seasonal knowledge in a six or seven annual climatic cycle is the collective body of knowledge held by the Aboriginal people about Country, the plants and animals. This knowledge is part of culture, indigenous law, and day-to-day survival as well as spiritual belief as reflected in the *Punjil* and *Pillian* Dreaming story. Many examples of the seasonal calendars are used from the tropical north, the arid central Australia, and down to the southern part of Australia, including South West Victoria (Clarke 2009,82).

The Dreamtime stories are the master plan for setting out the past, as well as the present, and providing a roadmap for the future (Roös 2013, 226-227; Elkin 1948). The Dreamtime stories provide information for specific patterns that occur in the past, settlement movements and the recording of environmental change in the Indigenous calendars of six seasons. Many of the Indigenous knowledge of seasonal indicators include phenological events; these influenced the migration of groups depending on when and how settlement patterns occur, including the establishment of camps. Coastal Indigenous communities used to settle and adapt according to the changes in nature and the impacts of climate. This close connection to the land helped Indigenous communities to nurture the environment for their own survival, as reflected in this recent statement by the Aboriginal *Boonerwrung* people of Victoria:

> "We the Aboriginal people of Victoria have existed on this land for thousands of years. We have nurtured the environment for thousands of years, always acknowledging our inherent responsibility to care for Country. The lore of the land is the very heart of our existence, and our culture – this is what land means to us. Within this meaning lies our great respect for the land and the understanding that is vital to maintain a holistic relationship with Country." (SAMLIV 2003)

[1] Dreamtime or the Dreaming for Australian Aboriginal people (sometimes referred to as the Dreamtime or Dreamtimes) is when the Ancestral Beings moved across the land and created life and significant geographic features. The Dreaming also means to have insight, and to see creation. Dreaming stories pass on important knowledge and belief systems of the Australian Aboriginal people from one generation to the next. (Australian Government 2008).

[2] *Deen Maar* is the Aboriginal name for Lady Julia Percy Island, a protected area of the coast in South West Victoria.

[3] Country is a term used by the Aboriginal people of Australia, to refer to the land to which they belong and the place of their dreaming.

Within the current discourse of climate science and contemporary adaptation and mitigation practice, the inclusion of Indigenous knowledge is missing. The following question formulated by the author, based on a similar argument raised by Jones *et al* is indeed plausible: "Why is it then that Indigenous knowledge and the wealth of environmental and climatic experiences are not considered as alternate avenues to better understand the Australian continent and its climate extremes for adaptation practices?" (Jones et al. 2013, 149). The author argues that this wealth of Indigenous knowledge, systems and the associated environmental experience of the land can offer alternate avenues to better understand adaptive responses to a changing climate in Australia, and this paper thus seeks to find opportunities to include this knowledge in a proposed climate change adaptation model.

Methodology

This research paper pursues an investigative approach following a step-by-step process, by initially identify through extensive literature review of Aboriginal knowledge in Australia, the adaptation and settlement patterns of the past, and their relationship to the climate and environment. Further, the documentation of relevant Aboriginal oral interviews of case study workshops is reviewed and included in this paper to identify Aboriginal knowledge on climatic events and changes. Through this review the Aboriginal six-season climate system is used to identify ancient knowledge of weather changes, and subsequently proposed as input into a climate change adaptation model. The paper concludes with discussions with the opportunities for application in future adaptation methods, and also highlights the identification of further work.

The structure of the paper can be summarised as follows:

1. Identify through literature review and the recording of participatory research the Indigenous knowledge on Aboriginal settlement patterns and climate environmental changes through six season cycles;
2. Identify the process of the application of Indigenous knowledge in research;
3. Establish a proposed climate change adaptation model that considers a framework of the integration of Indigenous knowledge; and
4. Concludes with discussions on findings and identification of further work.

Sea Country and Aboriginal Settlement

For thousands of years the Aboriginal people of Australia followed a specific settlement pattern along the coastlines, using natural resources not only for daily living, but also to manage the landscape. Living close to the land and Sea Country[4], the people adapt and migrate with the cycle of seasonal change. This knowledge was applied by all tribes along the coastal shores, told in Dreaming stories and recorded in many interviews with Elders by researchers and explorers of the past (Thomas 1969, 398-437). A typical reflection of this practice of living with nature is mentioned in the introduction to the *Yawuru* Cultural Management Plan:

> "For thousands of years our ancestors have lived along the foreshores of Roebuck Bay, across the pindan plains, as far inland as the *Walan-garr*, the Edgar Ranges, and along the fringes of the Great Sandy Desert. Our Country is land and sea moulded by the cycle of seasonal change. We live by the seasons, reading the signs to know when and where we should go to harvest the riches of our country. When the first south-east winds start

[4] Sea Country: Aboriginal people make no distinction between sea and land. Country is a term used to refer to the land that they belong to and their place of Dreaming that includes the Sea Country. Sea Country is a term used to differentiate between land and sea (Smyth 1997).

> to blow across Roebuck Bay, bringing the colder weather, we head to the beaches and tidal creeks to fish for salmon. When the weather warms and the winds blow from the west, we head for the reefs to fish for blue-bone and the myriads of other reef fish." (Yawuru RNTBC 2011, 28-29)

The use of the land and the establishment of camps were based on the knowledge and traditions that have been passed down from generation to generation from the ancestors (Elkin 1948). The knowledge of the environment is passed on from elders to young children when they go hunting, fishing, camping and during gatherings. Understanding the subtle changes in Country and following the seasons was used as a guide to where to gather food, establish settlements and how and when to look after the resources of the land.

In *Yawuru* Country the migration of the Aboriginals between the *nagula* (coastal regions) and the *birra* (inland regions) is clearly aligned with the seasons and the changes of plants, migration of animals, birds and the seasons of different species of fish in the area. *Yawuru* peoples' habitats where aligned with the different vegetation, geography and sources of food and shelter. The different groups of the *Yawuru* people are linked to the habitats of the *Yawuru* country, and can be identified with camps in the different *Yawuru* habitats, such as *Niyamarri* (Sand Dunes), *Bilarra* (Wetlands), *Warnangarri* (Rocky country), *Jila* (Permanent freshwater source) and others as indicated in Figure 1.

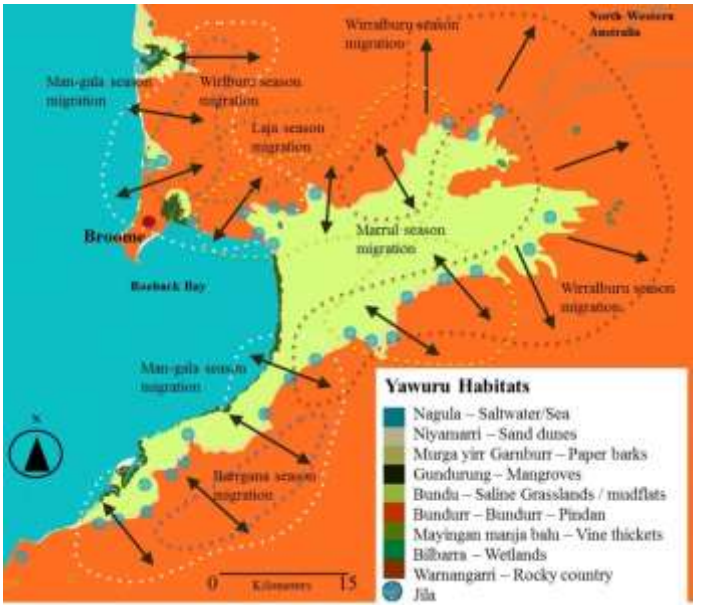

Figure 1: *Yawuru* habitats and the *Yawuru* settlements migration relationship
Source: Redrawn by Roös from (Yawuru RNTBC 2011, 29-38).

This occurrence is evident through all Aboriginal tribes in Australia, and was initially recorded by Donald Thomson and considered as a quantum leap in the theoretical understanding of the Aboriginals by anthropologists (Memmott 2007). In his paper *The Seasonal Factor in Human Culture Illustrated from the life of a Contemporary Nomadic Group* (1939), Thompson demonstrates as part of ethno-architecture the integrated role of the hunter-gatherer lifestyles with the seasons and coastal habitat changes. His paper focuses on the coastal group of the Cape Keerweer[5] region and the *Wik Mungan* people and considers the shelter types that have been

[5] Cape Keerweer is an area located on the Western coastal area of Cape York, the most Northern point of Australia.

constructed according to the cycle of the six seasons. Seasonal shelter types and settlement patterns are described and summarized as what Thompson called "The Seasonal Factor" (Thompson 1939, 209-221).

Settlements and the Seasons

In the explanation of "The Seasonal Factor," Thompson was able to demonstrate that the seasonal year of the *Wik Mungan* and other groups was divided into a specific and discrete number of climatic periods. These where classified with typical settlement patterns, foods, geographic focus, shelter types, as well as domiciliary behaviour (Memmott 2007).

The climate of Cape York is tropical, monsoonal with a distinct dry and wet season with a landscape of savannah woodland, which transforms to savannah forest during the wet season. In the recordings of Thompson the adaptive practices of the *Wik Mungkan* people in this climate are evident in his recordings, indicating seasonal movement patterns, exploitation of food sources within the accessible hunting areas, as well as the types of food collection technology used at different times during the six seasons (Thompson 1939). Migration movements and settlement patterns followed the food sources, and shelter types corresponded to the seasons.

Shelter Types and the Six Seasons

The basic shelter types in the settlements of the *Wik Mungan* and other tribes in the Cape York area correspond to the climatic conditions of the six seasons in the tropical climate of northern Australia. The six shelter types as demonstrated in Figure 2, were employed per season, the windbreak (shelter 1) was used in the dry season, when there was no rain, corresponding with the prevailing south-east winds during the months of April and November. During mid-March to mid-May, when mosquitoes where most prevalent, the sleeping platforms (shelter type 2) where mostly used. From mid-May to July winds are strong, and the vaulted sleeping platform (shelter type 3) where used. The shelter types indicated in Figure 2 reflect the following seasons (Memmott 2007, 158-161):

1	The windbreak	Beginning and end of dry season
2	The sleeping and storage platform	End of wet season
3	The vaulted sleeping platform	Wet season
4	The triangular form with central pole	Transition wet to dry season
5	Dome type shelters	Transition dry to wet season
6	The horizontal shade for diurnal use	Dry season

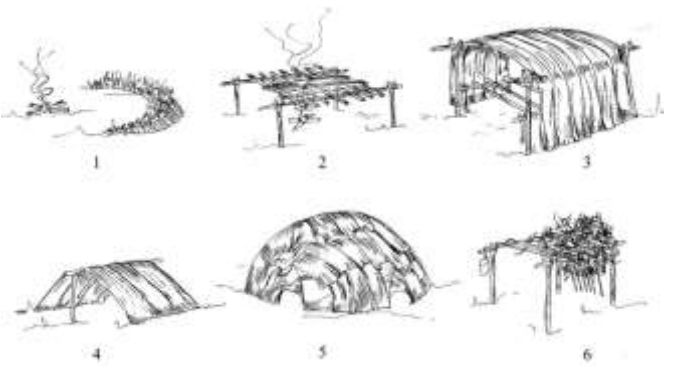

Figure 2: Shelter Types of the *Wik Mungkan* people
Source: Redrawn by Roös from (Memmott 2007, 161).

The different shelter types show the capacity of the Aboriginal people to adapt their homes and settlements and daily activities to the changes in season, align their cultural activities, hunting, settlement and food storage needs with a six cycle changing environment. Thomson documented that the *Arhem* Landers facilitated various different types of structures, as well as location of settlements to particular times of the year (Memmott 2007, 165). It can be concluded that living close to nature and having extensive knowledge of the seasons helped the Aboriginal people to adapt to climatic changes, and their construction methods of shelter for the different seasonal cycles supports this argument. This short-term knowledge of six seasons assisted in migration and shelter construction, but what about the more long-term climate cycles? Indeed this knowledge will be of great value in understanding the climate of Australia, and how to plan adaptive responses to a future changing environment.

Ancient Knowledge of the Changing Environment

Examples of long term climate cycles and knowledge of weather were recorded in the two cycles, the *Mudong*, or life cycle that stretches for 12 years, and the *Garuwanga*, the Dreaming, a cycle that stretches between 12,000 to 20,000 years (Kingsley 2003). These long-term cycles are recorded due to the knowledge of the changing environment over long periods of time, and also have direct relationships with the shorter annual weather cycles of the six seasons. It must be noted that the cycles of seasons are only applicable to Country, locally based in different regions on the Australian continent.

Six-Season Calendar

Aboriginal seasonal knowledge includes the understanding of the cycles of life and its continuity as they occur and comprises of the patterns and cycles of plants, animals, stars, landscape changes, and weather. The lifestyle of Aboriginal people depended very much on this knowledge of the seasons. The six-season calendar also included the knowledge of the sky. When a particular constellation appeared it was time to hunt certain species of animal, or dig up a particular plant (Thomas 1969).

There are different six season calendars recorded in the different areas of Australia, from the monsoonal tropics of the north, to the dry arid regions and down to the south temperate climates of Victoria. These calendars are very much 'local', just as the type of shelters that were built. Due to the large continent, Australia's land area of about 8.5 million square kilometers, the climate differs drastically from the North to the South, as well as from the East to the West. Thus, it is plausible that the Aboriginals of the different regions have developed local seasonal calendars.

For this study three different six-season calendars are reviewed, the seasons of the *Yawuru* Aboriginal people of the North West Australia in the Kimberly region, the *Ngadju* people of South West Australia in the *Nullarbor* region, and the collective calendar of the *Whathaurong, Gadubanud, Jardwadjali*, and *Djab Wurrung* people in South West Victoria. It must be noted that various other calendars were used across the vast continent of Australia, and this paper acknowledges the importance and application of these calendars, for and by the local Indigenous tribes of each region.

Yawuru Seasons

The *Yawuru* people state that they have cultural rules and responsibilities about how they look after the Country, animals and plants, and themselves. These rules align with their six seasons, and are very closely linked to the management and understanding of nature, as described by Mati Gilbert:

> "*Marrul* is after rain finish. *Wirralburu* is first southeast blow and the salmon start. *Barrgana* is proper cold time, when the gardgu tree is blooming. Wirlburu is coming hot. Laja is proper hot time. *Man-gala* is rain time, when we burn *gunggara* and bullock shit for mosquito. When the wattle flowers in *Barrgana* mean that the salmon and catfish are fat. When the wattle seeds, the mullet lay their eggs, and when the seeds open up, the eggs have hatched." (*Yawuru* RNTBC 2011, 81)

The use of the land and its resources, as well as the migration of the *Yawuru* people and establishment of their settlements followed a specific pattern, aligned with the six seasons indicated in Figure 3, and as described in the *Yawuru* Cultural Management Plan.

Figure 3: Illustration of the *Yawuru* six seasons
Source: (Yawuru RNTBC 2011, 80).

The six seasons of the *Yawuru* can be summarized as follows:

1	*Man-gala*	Wet season, Strong winds / cyclones. December to March.
2	*Marrul*	Changing season. Little wind and rain. April to May.
3	*Wirralburu*	Cooling season. Strong winds no rain. May to June.
4	*Barrgana*	Cold season. Dry winds and dust storms. June to August.
5	*Wirlburu*	Warming season. Westerly winds. September to October.
6	*Laja*	Hot. Built up to wet season. Late September to November.

The use of the land by the *Yawuru* people followed the six seasons and a specific migration pattern. This migration pattern is indicated in Figure 1, and matches the six seasons of the local climate as indicated in Figure 3.

Ngadju Seasons

The *Ngadju* people, also known as the *Marlpa* people of South Western Australia retained a very detailed knowledge and records of their six seasons. In the report by O'Connor and Prober, *A calendar of Ngadju seasonal knowledge* (2010), detail summaries of each of the six seasons are provided. They state that a potentially powerful indicator of environmental change may rest in the Indigenous seasonal calendar (O'Connor and Prober 2010). Similarly than the *Yawuru* people,

the knowledge of the land and nature helped them to survive, as indicated in the story from Edward (Snowy) Dimer and John Graham:

> "People used to dry the large purple hibiscus flowers (Alogyne hakeifo-lia), pound them to a powder and throw the powder into a rock hole. It makes the emus go to sleep, and kangaroos and fish too." - Edward Dimer (O'Connor and Prober 2010, 26)

> "The powder from purple hibiscus flowers is poisonous; when the emu drinks the water it falls down dead. You have to quickly cut down the belly and remove the innards or the meat becomes poisonous and will kill you if you eat it." - John Graham (O'Connor and Prober 2010, 26)

As indicated in Figure 4, the six seasons of the *Ngadju* can be summarized as follows:

1	*Ngarnngi*	Hot time, long season. September to March.
2	*Ngawu*	Egging season. September to October.
3	*Nganji*	Hot season. November to March.
4	*Kaluru*	Cold time, long season. April to August.
5	*Kupilya ngarrin*	Sleeping season. April to June.
6	*Karrikunja*	Courting and mating season. July to August.

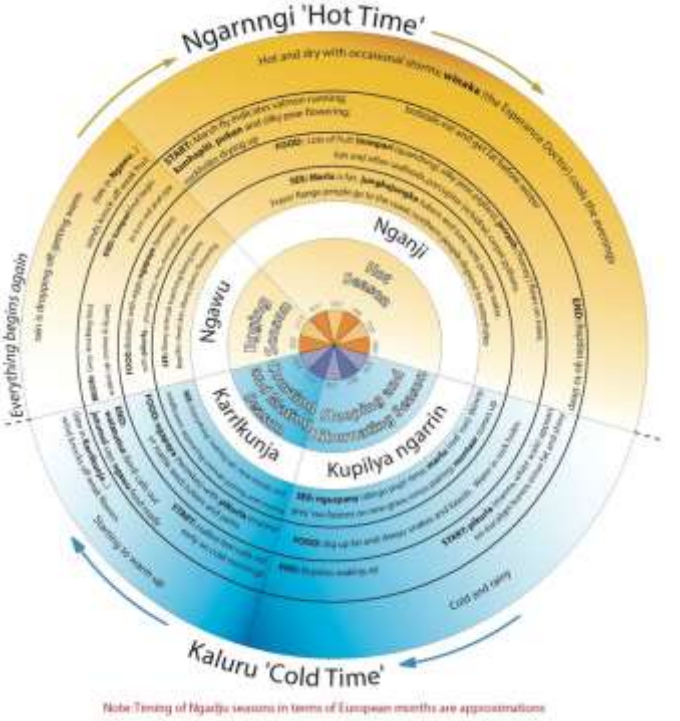

Figure 4: Illustration of the *Ngadju* six seasons
Source: (O'Connor and Prober 2011, 23).

The *Ngadju* six seasons reflects an annual seasonal calendar that identifies the biophysical landscape and the importance of the weather cycles to the *Ngadju* people. The *Ngadju* people used the six seasons to manage their landscape, and daily activities. For example, in the hot season, *Nganji* season, brush shelters were built out of bushes and sticks for coastal camps

(*mirnta*), and because this was bushfire season, the heathlands was avoided for safety from fire (O'Connor and Prober 2011, 31).

Gunditjmara Seasons

The *Gunditjmara* seasons reflect the six seasons adopted by the tribes of the South West Victorian region in Australia, and includes the *Whathaurong, Gadubanud, Jardwadjali*, and the *Djab Wurrung* people. The six seasons of the Gunditjmara are expressed in non-standard temporal phases that can be summarized as follows (Jones et al, 2013):

1	*Kooyong/Koorang*	Season of Eels. Late Jan to late March.
2	*Gwangal Moron*	Season of Honey Bees. March to May.
3	*Chinnup*	Season of Cockatoos. June to late July.
4	*Larneuk*	Season of Nesting Birds, Late July to August.
5	*Petyan*	Season of Wildflowers. Sept to mid-November.
6	*Balalambar*	Season of Butterflies. Mid November to late Jan.

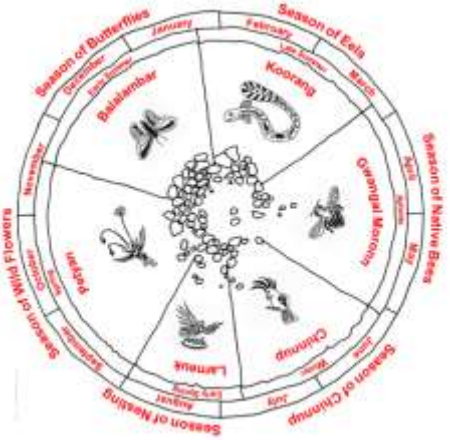

Figure 4: Illustration of *Gunditjmara* six seasons
Source: Redrawn by Roös from (Jones 2010)

A point of interest in the *Gunditjmara* utilisation of the six seasons is the establishment of temporary as well as more permanent settlements. This was built around the seasonal migration of the *Kooyang* (Short-finned eel / Anguilla Australis), nourished for a sustainable food source (Roös 2013, 228-229). The *Gunditjmara* and *Gadubanud* people's food economy was based on building permanent engineering systems in the rivers and wetlands for harvesting the oceanic eels during their migratory runs in fresh water. Shelters of the *Gunditjmara* and *Gabubanud* people included stone structures / houses (Clarke 2009).

Adaptation According to a Seasonal Cycle

It is evident that the Indigenous people adapted their lifestyles to the changes in seasons and long-term cycles. The study of O'Connor and Prober indicate that a number of contributions to the workshop sessions indicate a mention of a long term cycle, signaled by the start and end qualities of a next period of years, as indicated in the following example:

> "If pelicans (*Pelecanus conspicillatus*) arrive in Norseman and other places, they herald drought-breaking rains. The swans (*Cygnus atratus*) and grey crane (probably white-faced herons, *Egretta novaehollandiae*) can come as well. The wet cycle lasts about seven years. Then there may be seven years of dry. Some of the frogs can stay underground for seven years and can be dug up for water in dry times. They come out with the drought-breaking rains too." (O'Connor and Prober 2010, 22)

This knowledge assists in the decisions of settlements and migration patterns corresponding to the broad hypothesis of Memmott (2007) that the climate influenced the settlements and the ethno-architecture of the Aboriginal people across Australia. Analyzing the influence of climate on shelter building and settlement types across the continent can generate the classification of shelter type distribution. The shelter type distribution can broadly be classified as follows:

- Open winter windbreaks – whole continent;
- Summer wet-weather enclosed shelters – central and northern;
- Cold wet-weather enclosed shelters – southern, and;
- Shades for diurnal use – whole continent (Memmott 2007, 7-12).

Another example of environmental management according to nature's cycles is reflected in the traditions of the *Gunditjmara* and *Gadubanud* people in South West Victoria, where the establishment of temporary as well as more permanent settlements was around the seasonal migration of the *Kooyang*[6] (Short-finned eel / *Anguilla australis*), nourished for a sustainable food source (Roös 2013, 228-229; Clarke 2009). The *Gunditjmara* and *Gadubanud* people's food economy was based on building permanent engineering systems in the rivers and wetlands for harvesting the oceanic eels during their migratory runs in fresh water (Roös 2013, 229; Coutts 1978). This season of the eels was classified as late summer, the hottest and driest time of the year, the *Kooyang* season, as indicated in Figure 4. The more semi-permanent shelters included stone houses that were part of a broader use of stone arrangements by function, such as the eel traps in the rivers (Clarke 2009).

Longer term Indigenous knowledge of climate change is evident due to past marine transgressions that have dramatically affected the landscape and Aboriginal settlement along Australian coastlines. These coastlines have varied significantly as a result of the broader climatic and sea level changes during the post last glacial maximum and current sea levels (Marshall 2012). The migration of Aboriginal settlements inland due to rising seawaters can be traced and mapped, through the analysis of patterns of midden sites and their locations.

The Dreaming stories also reflect knowledge of climate change and past adaptation by the Aboriginal peoples, as reflected in the following extract of the account from *Boon Wurrung* Elder, Ms Carolyn Biggs:

> "Many years ago this land that we now call Melbourne extended right out to the ocean. Port Phillip Bay was then a large flat plain where *Boon Wurrung* hunted kangaroos and cultivated their yam daisy. But one day there came a time of chaos and crises. The *BoonWurrung* and the other Kulin nations were in conflict. They argued and fought. They neglected their children. They neglected their land. The native yam was neglected. The animals were killed but not always eaten. The fish were caught during their spawning season. As this chaos grew the sea became angry and began to rise until it covered their plain and threatened to flood the whole of their country.

[6] *Kooyang* is also pronounced *Koorang*.

> The people went to *Bunjil*, their creator and spiritual leader. They asked *Bunjil* to stop the sea from rising. *Bunjil* told his people that they would have to change their ways if they wanted to save their land. The people thought about what they had been doing and made a promise to follow *Bunjil. Bunjil* walked out to the sea, raised his spear and directed the sea to stop rising. *Bunjil* then made the *Boon Wurrung* promise that they would respect the laws." (Low Choy and Jones. 2013, 183)

The question is how can we use this knowledge and apply it to contemporary adaptation models? Firstly we need to acknowledge the wealth of information from Indigenous ecological knowledge and its relationship to climate changes, and then apply this to an adaptation model.

Climate Change and Indigenous Knowledge

While traditional ecological knowledge is key to comprehending adaptive capacity for coastal settlements, as well as contemporary Indigenous communities, the knowledge is primarily communicated via local language and through Dreaming stories (Low Choy and Jones 2013). This reinforces community and Aboriginal group priorities for adaptation and cultural obligation through the Indigenous Law. It is also acknowledged that Aboriginal knowledge and law, are little understood, but holds significant information on possibilities of climate change adaptation in the future (Roös 2014). A very good example of this knowledge and Law of the land is reflected in the story told by Big Bill Neidjie:

> "We walk on earth, we look after, like rainbow sitting on top. But something underneath the ground we don't know. You don't know. What do you want to do? If you touch, you might get cyclone, heavy rain of flood. Not just here, you might kill someone in another place. Might be kill him in another country. You cannot touch him." (Neidjie 2002)

Australia's Aboriginal people live close to the land, and they have a distinctive way of identifying our connection with the world. Instead of viewing actions of nature and man as instant and individual disconnected processes, they tend to see the whole picture (Flannery 2005). The story of Big Bill Neidjie tells us about the impact of mining, and the results of poisoning the earth. In a handful of words he describes the great cycle of climate change impacts that we are now facing as a human species. In one question he challenges us to change the behaviours that damage the environment and threatens the survival of future generations – *"What do you want to do?"*

Contextually, this Aboriginal knowledge is little appreciated in contemporary climate change research in Australia and globally. It is this same ignorance of our western civilization that is now putting many coastal settlements in Australia at risk of sea level rise, coastal inundation and extreme weather events. Australia is a coastal nation with a significant part of its urban and regional towns located along the coastline (Norman 2009), its coastal settlements are particularly vulnerable to sea level rise and extreme weather events (CSIRO 2009).

Similarly, today's Aboriginal communities acknowledge current climate change impacts and threats, and the signs of climate change are noted. An example of this is the comments by the *Ngadju* people (O'Connor and Prober 2010, 43):

- Sea levels has gone up and down in the region, different from the past;
- Some flowers don't flower;
- Gum trees aren't blossoming;
- Flowers are smaller;
- Birds are dying out, an example included 'Used to have pretty colourful Kingfishers coming when season good; haven't seen now for 15 to 20 years';

- The heat is getting hotter;
- Bush foods are becoming scarcer;
- Water sources are drying up; and
- Animals are gone after a long drought.

As reflected from the identification of climate changes as above, under future climate effects the coastal landscape will continue to change and the recession of the coastline will impact the visual, coastal, cultural, and landscape values. Settlements on the coast exist due to the high visual and natural attributes of these assets, natural habitats, including significant Indigenous heritage sites (Green 2010).

Considering the importance of the natural environment, the coastal zone, estuaries and location of cultural sites, the loss of these habitats will be detrimental to cultural Indigenous values, as well as the general attributes of the coast that is the core of survival of today's communities living in the coastal regions of Australia.

Clearly there is a pattern that indicates the linkage of historical Aboriginal knowledge with current climate change issues, and by acknowledging this knowledge; we can use these changes in the landscape and traditional knowledge as input to potential design and adaptation methods for settlements along the coastline of Australia.

Application of Indigenous Knowledge

Indigenous knowledge[7] as a way of knowing is similar to western science in that it is based on an accumulation of observations. It is also very different from western science in many fundamental ways. These two ways of knowing are two parallel methods of acquiring knowledge about the earth and the universe, but distinct from each other as noted by anthropologist Claude Levi-Strauss: "…. the physical world is approached from opposite ends in the two cases, one is supremely concrete, the other supremely abstract." (Levi-Strauss 1962, 269). In both Scientific and Indigenous knowledge, information is organized to include experience as well as beliefs into "knowledge". Smylie *et al* summarise the two systems as follows:

> "In Western knowledge systems this process involves the organization of individual data into abstract theoretical systems, composed of multiple components, each of which requires a 'specialist' to be fully understood. In Indigenous knowledge systems, generation of knowledge starts with "stories' as the base units of knowledge, proceeds to 'knowledge', an integration of the values and processes described in the stories, and then accumulates into 'wisdom', an experiential distillation of knowledge. This process can be viewed as cyclical, as 'wisdom' keepers in turn generate new 'stories' as a way of disseminating what they know." (Smylie et al. 2003, 141)

The understanding and application of Indigenous knowledge is a difficult task. Firstly the knowledge must be acknowledged and understood with a consideration on how this knowledge is translated by the Indigenous peoples themselves. The fundamental principle is to understand that Indigenous knowledge is holistic in nature. As noted by Ohmagari and Berkes (1997), Indigenous knowledge is holistic in outlook and adaptive by nature, gathered by generations through observation whose lives depended on this information for survival. The knowledge often accumulates incrementally and tested by trial-and-error, told in story lines from generation to generation and shared in practical experiences (Berkes et al. 2000; Ohmagari and Berkes, 1997).

[7] When referred to *Indigenous Knowledge*, reference is made to knowledge of Indigenous or Traditional Cultures of the world, inclusive of Australian Aboriginal knowledge, unless otherwise indicated. *Aboriginal Knowledge* refers only to the Aboriginal and Torres Strait Islander Peoples of Australia.

In Australia the knowledge from Elders of the Aboriginal people are only made available if the group of Elders grants permission. Etiquette and cultural customs needs to be followed, and the researcher engaged with the community showing respect conforming to these customs. Methods of Indigenous knowledge generation and application are participatory, communal and experimental reflective of the geographical location and context. Collecting data and gaining and understanding of the Aboriginal knowledge in Australia is through listening to the story telling of the elders at focus group knowledge workshops, interviews and fieldwork assessments with accommodating Elders, "walking the land, our Country". The demonstration of the '*Indigenous Knowledge Generation Process*' by Smylie *et al* are adapted by the author in Figure 5 to demonstrate the process for capturing local Aboriginal knowledge related to this research. The overall fundamentals of the approach are participatory based.

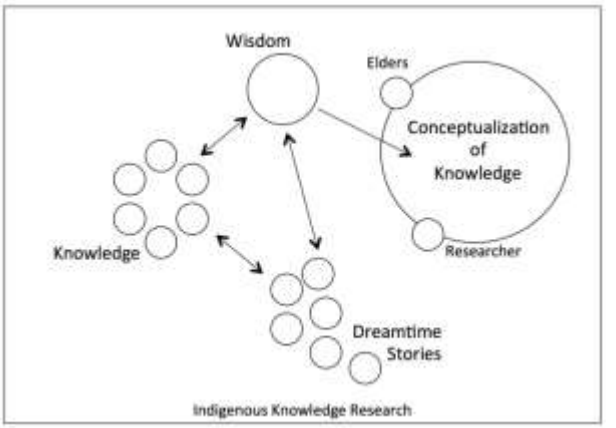

Figure 5: Indigenous Knowledge[8] Generation and Knowledge Capture Process
Source: (Roös 2014, adapted from Smylie et al. 2003)

This process reflective in Figure 5 encapsulates also how Aboriginal knowledge has been applied in other fields of research. Examples of this participatory model trace back many years, and was used by early researchers of Australian Aboriginal culture and history, such as Howitt's *The Native Tribes of South East Australia* (1996). More recently examples include the works of Cultural Management Plans such as the *Planning for the future: Yawuru Cultural Management Plan (*2011), the *Ngarrindjeri Sea Country Plan* (2006), and the *Bunya Mountains Aboriginal Aspirations and Caring for Country Plan* (2010). All of these examples show how participation, interviews and local knowledge can be conceptulised and then recorded in the format of a cultural management report for the Aboriginal peoples of that region.

The question is how can we apply this participative model to the integration of Indigenous knowledge into climate change adaptation science? The paper proposes a process to achieve this outcome, capturing Indigenous knowledge of the climate and seasonal changes, as well as adaptive settlement practices as described above, used as input to the proposed climate change adaptation model, as demonstrated in detail in the following section.

Climate Change Adaptation Model and Indigenous Knowledge

In Australia, various frameworks and models have been developed to address the issues relating to adaptation for climate change impacts in coastal areas. Coastal adaptation policy approaches also varies due to location to deal with climate change. Coastal planning policy in Australia usually include four classifications to deal with climate change impacts, and responses are

[8] Including Australian Aboriginal knowledge.

formulated based on the classification of do nothing, retreat, defend or adapt (Roös and Jones 2013; Norman 2009). The approaches have been widely used to examine response to climate change impacts (Norman 2009). Although decisions can be made for climate change adaptation actions based on contemporary risk assessments and planning policies, this paper argues that it is necessary to include the extensive knowledge of Indigenous people. Many Dreaming stories express events that explain climate change events and landscape change as consequences of climatic events (Low Choy and Jones 2013). The Indigenous methods of landscape management also provides opportunities for developing landscape management and settlement planning scenarios considering the effects of future climate.

Input to the proposed climate change adaptation model will take into account Indigenous perceptions, environmental mapping of patterns determined and influenced by shelter types, land use management, food gathering, bush burning, and the seasonal movement of settlement patterns. This knowledge underpins long-term land management and adaptation strategies from a thousand to ten thousand years but also offer information to climate change implications because of the recording of variations in seasonal cues (Jones et al. 2013).

When combining the process of a risk based adaptation framework with a landscape management and settlement-planning model based on Indigenous knowledge, the proposed climate change adaptation model can be used to chart the changes and consequences through planning and design. This will help the coastal communities along the Australian coast to better appreciate how the landscape will change, using backup information from events of the past as recorded in Indigenous knowledge, and can therefore inform adaptive responses of the physical and social infrastructure under future climate effects (Roös 2013). The relationship between the risk-based adaptation framework, Indigenous knowledge and a climate change adaptation process are demonstrated in Figure 6.

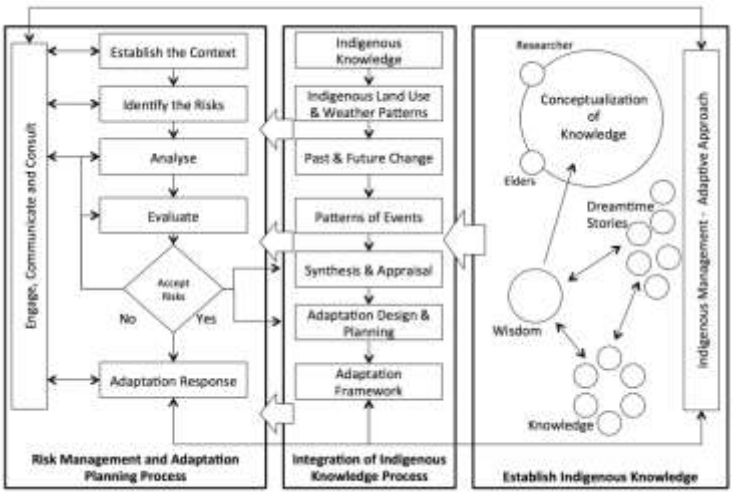

Figure 6: Indigenous Knowledge integrated in the Climate Change Adaptation Model.
Source: (Roös 2014).

The proposed Climate Change Adaptation Model uses a systematic process according to the different scenarios of adaptation. This systematic process consists of clear patterns that follow specific sequences (Roös and Jones 2013). The opportunity is thus there to combine the process of a climate change adaptation framework with Indigenous knowledge that also includes specific patterns in settlement planning according to the six seasons.

Integration of Aboriginal Knowledge into the Adaptation Model

The integration of the Aboriginal knowledge into the proposed climate change adaptation model place the emphasis on the integration process of knowledge, and link the *Western knowledge system* with the *Indigenous knowledge system*. In the context of climate change adaptation practice, Figure 6 indicates a flow chart diagram of activities, with the *Risk Management and Adaptation Planning Process* (from AS/NZS ISO 31000:2009) of contemporary climate change adaptation practice on the left, informed by a *Integration of Indigenous Knowledge Process*, using input from the participatory approach in *Establish Indigenous Knowledge* on the right.

Proposed in this paper, the emphasis on the integration of Aboriginal knowledge can be achieved through the following three steps:

The first step will be to identify the collection of Aboriginal knowledge of the environment and climate events, settlement behaviours and cultural adaptive practices. This can be achieved by the participatory process through knowledge sharing from the Aboriginal Elders, and then conceptualise with the researcher the knowledge of Dreaming stories, local environmental knowledge and wisdom. The previous chapters of this paper provide an example of capturing Aboriginal knowledge of the six seasons and adaptive settlement practice as a first step.

Secondly, the Aboriginal knowledge needs to be integrated into the development of a climate change adaptation model. This can be achieved through analysing and comparing the Aboriginal knowledge systems of land use and weather patterns with Western science systems, and identifying past and future change patterns. The patterns of events can be tested through the synthesis and appraisal of the knowledge, and the identification of potential adaptation and planning options for establishing an adaptation framework, that includes both Indigenous knowledge and Western science on climate change.

Thirdly, the model considers and includes the risk management process concurrently with developing and integrating both the adaptation planning and the Aboriginal knowledge, as indicated in Figure 6. The accepted risks from climate change impacts will be reviewed as part of the *Synthesis & Appraisal* and *Design & Planning* stages of the proposed model.

Finally, the model proposes a cyclical method of continuously reviewing and adapting the three processes through engaging, communicating and consulting with participants on the one hand, and integrating Indigenous management and adaptive approaches on the other.

Discussion and Conclusion

It is noticeable from the previous sections that the Aboriginal peoples of Australia retain a wide knowledge across the continent of their Indigenous seasons, seasonal activities and long-term cycles of climatic events. This knowledge provide important opportunities to discuss with the Indigenous peoples their aspirations for future climate change as well as share their knowledge with us to identify opportunities for input to adaptation, about Country, landscape management, and opportunities to assist in the resilience of coastal community adaptation.

The research and analysis of this paper has resulted in the following tentative conclusions and considerations:

- Aboriginal knowledge in Australia of weather patterns and climate change were gauged by the occurrence of natural events such as the tidal changes, sea level rise, landscape changes, behaviour of animals, and the availability of food sources;
- Aboriginal people have adapted and migrated along the coastal areas according to short term and long term climatic events;
- Climate knowledge and the use of the Aboriginal six seasonal calendars can assist in today's land management practice in Australia which to better appraise short and long term environmental patterns and changes;

- The temporary shelters constructed to adapt as per a six season cycle, are a guide to considering more adaptive structures for our future buildings and homes, so that they can be flexible in changing with the forces of the environment;
- Aboriginal settlement patterns and landscape management based on the principles of human connection to nature, the understanding of nature and its cycles provides for an holistic approach to climate change adaptation; and
- The Aboriginal local environmental knowledge to ultimately survive in any climatic and environmental situations must be useful in a range of contexts, as well as providing scholars insight to Indigenous adaptation practices.

Thus, adaptation planning and design for resilience against future climate impacts can be strongly supported by the development of a climate change adaptation model based on the combination of a risk management framework, a design planning process and the integration of environmental adaptation knowledge of the Aboriginal people of Australia. This paper proposes such an integration model, that includes these three considerations. The Aboriginal knowledge of climate and natural phenomena provide a culturally integrated framework as input to this new proposed adaptation model that could better the climate change adaptation models currently in practice in Australia and globally. Further this model can be adopted in other countries using the Indigenous knowledge as input to a localised climate change adaptation model.

Most importantly is to develop approaches that develop an approach that support the co-evolution of human and natural systems so that both natural and social capital is supported under a future climate scenario, as reflected in the Dreaming stories and the beliefs of Australian Aboriginal people, all concerned with the changes in the landscape that is happening now and in the future (Roös 2014).

In the words of Trevor Donaldson, member of the *Ngadju* Aboriginal people in South West Australia, he is concerned that climate change will further change the behaviors of local animals and will upset the cycles of nature, and the balance and wholeness of the earth will be lost (O'Connor and Prober 2010):

> "Once, the dreaming controlled where the animals went. Dreamtime would tell 'em to stop, like the *marlu*. Law forbade them to go further. Now the introduced animals have no dreaming, they move everywhere - camels, horses, sheep, foxes, rabbits. Climate change will upset the balance of it all too." (O'Connor and Prober 2010, 31)

The opportunity is there to learn from the Elders of the Aboriginal people of Australia, bringing knowledge of climatic events that stretch more than 40,000 years long. The message is clear; it is evident in the Dreaming stories that we have to consider alternative methods to support the adaptation of both human and natural systems in the future.

It is also evident and demonstrated in this paper, that traditional Australian Aboriginal knowledge and other country's indigenous knowledge can be applied to potential climate change adaptation models. The outcomes of this research also identifies the opportunities for further work to apply this model to case studies, where the planning and design of coastal settlements considers the integration of traditional Indigenous knowledge, as part of their future adaptive responses for achieving resilient settlements in a changing climate.

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ABOUT THE AUTHOR

Phillip B. Roös: PhD Scholar and Sustainable Design Practice Leader, School of Architecture and Built Environment, Faculty of Science and Technology, Deakin University, Geelong, Victoria, Australia

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