

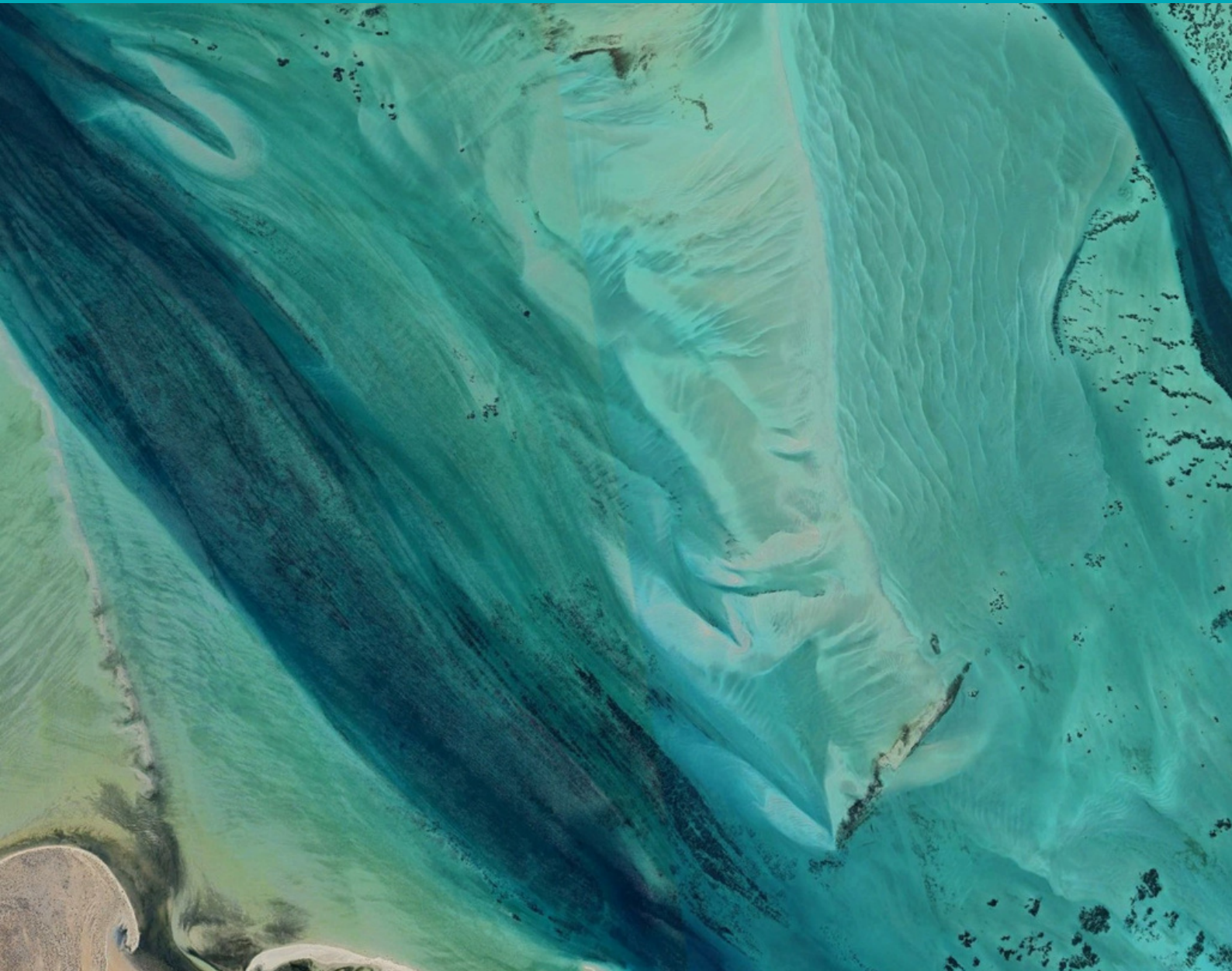


Climate
Systems

National Environmental Science Program

Malgana perspectives of climate risk

Final Report - April 2026



This project is supported with funding from the Australian Government under the National Environmental Science Program

The Climate Systems Hub is a partnership of CSIRO, Bureau of Meteorology, Australian National University, Monash University, University of Melbourne, University of New South Wales and University of Tasmania and the Cross-jurisdictional Community of Practice for Climate Science. For more information visit www.nesp2climate.com.au.

© National Environmental Science Program Climate Systems Hub 2026.



Malgana perspectives of climate risk is licensed by The National Environmental Science Program Climate Systems Hub for use under Creative Commons framework, using the Creative Commons-Attribution-NonCommercial 4.0 International Licence (CC-BY-NC 4.0). For licence conditions see <https://creativecommons.org/licenses/by-nc/4.0/>

All images are creative commons unless otherwise referenced.

The Indigenous knowledge holders assert ownership, authority and control over the Indigenous Cultural and Intellectual Property ICIP expressed in the language names, stories, knowledge about plants, animals, seasonal connections, and places. If you want to use the ICIP in this report permission must be obtained from the Indigenous knowledge holders or custodians. **Note sufficient time (at least 4 weeks) must be given to obtain permissions/informed consent.**

Please cite as: Lyons, P., Raisbeck-Brown, N., Braedon, P., Dunlop, M and the Malgana Aboriginal Corporation (2026) *Malgana Perspectives of Risk*. Climate Systems Hub. National Environment Science Program, Australia.

For further information about this report contact Pethie Lyons, CSIRO, ilisapeci.lyons@csiro.au

The National Environmental Science Program (NESP) Climate Systems Hub advises that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, the NESP Climate Systems Hub (including its host organisation, employees, partners and consultants) excludes all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

We would like to acknowledge the Western Australian Marine Science Institution, the staff of Department of Biodiversity, Conservation and Attractions in the Shark Bay World Heritage Area and the Malgana People who supported and actively participated in this work.

The Climate Systems Hub acknowledges the Traditional Custodians of the land across Australia where this work occurred. We pay our respects to Elders past, present and future and recognise the important role traditional knowledge plays in understanding Australia's climate.

Contents

Executive Summary	1
Figures	3
Tables	3
Introduction	4
The Research Question.....	4
World Heritage Area Values and Climate and Landscape of NPA	4
The Project Location	4
Vulnerability of the outstanding universal values of the Shark Bay World Heritage Area to climate change.....	6
The Malgana People’s continuing occupation and relationship with the Shark Bay World Heritage Area.....	6
Approach and Method.....	9
Timeline	13
Seasonal Calendar	14
Mapping places, plants, animals and activities	16
Asset change-persistence cycle.....	17
How this project engaged with the Climate Change Toolkit for World Heritage Properties in Australia	19
Results and Discussion.....	20
Western Science	20
Future uses.....	21
Building the Timeline	21
Future uses of the timeline	24
Creating the Malgana Seasonal Calendar	24
Future uses of the seasonal calendar	28
Mapping, places, plants, animals and activities on Country	28
Future Uses of the Map.....	29
The Malgana Cultural Strategies	32
Governance – What decisions need to be made for the cultural strategies	32
Protocol considerations for species translocation.....	33
Learnings about co-design	36
Considerations for Adapting Seasonal Calendar in the Future.....	38
Reflections on the collaborative co-design and connections with the climate change toolkit for World Heritage properties in Australia.....	38
Conclusion	39

APPENDIX A – Questions to aid the review and record change in the Malgana Seasonal Calendar 42

References 48

Figures

Figure 1 Boundary map of the Shark Bay World Heritage Area 5

Figure 2 Knowledge-sharing tools utilised in the project to develop Malgana cultural strategies 11

Figure 3 Average recorded temperature and rainfall graphs used in the first workshop 13

Figure 4 Malgana women working on their seasonal calendar 15

Figure 5 Malgana participants mapping places, plants, animals, and activities on Country at the second workshop 17

Figure 6 Asset change-persistence cycle 18

Figure 7 Average yearly recorded rainfall and temperature in Shark Bay 20

Figure 8 Timeline Pre-European settlement to mid-1900s 23

Figure 9 Timeline mid 1900s t- 2024 24

Figure 10 Malgana workshop participants mapping places on their Country 28

Figure 11 Asset change-persistence cycle for Mullet 30

Figure 12 Malgana cultural strategies 34

Tables

Table 1 The knowledge sharing tools used over the four workshops 13

Table 2 Annual and biannual events in Gathaagudu with seasonal cycle for Country 27

Table 3 Management actions identified by Malgana workshop participants from the asset change-persistence activity 31

Table 4 Cultural strategy for research and the collection of biological material from Gathaagudu 36

Executive Summary

This co-designed project with Malgana People utilised a strength-based approach to develop knowledge-sharing tools that will assist Malgana People, through their customary governance, to continue to collectively recover, retain, and share their knowledge over time, thereby strengthening their capability as equal partners alongside Western knowledge in managing the Shark Bay World Heritage Area.

Working with three four knowledge tools; a timeline of Malgana Country and People, a seasonal calendar, cultural mapping, and an adapted asset change-persistence cycle, the Malgana People identified cultural strategies that would sustain Malgana values under conditions of increasing environmental, climate and social change.

Introduction

Social and cultural worldviews inform perceptions of climate change and risk, influencing the opportunities, feasibility and acceptability of climate adaptation responses. Indigenous peoples bring a particular perspective of climate risk related to their socio-economic, historical, political, cultural, and environmental circumstances, as well as the worldview of the interconnectedness of the health of people and their Country. This results in perceptions that are often specific to communities and their cultures, places and regions with distinctive community values, as well as their resource and policy circumstances.

The goal of the Malgana climate project in the Shark Bay World Heritage Area in Western Australia was to pilot knowledge-sharing tools to explore and make explicit the climate-related risks of significance to the Malgana People and to develop strategies that address these risks. The knowledge-sharing tools adopted in the project included participatory mapping of values, seasonal calendars, a timeline of events in Malgana Country and cascading consequence (an adapted method). The project aimed to improve the participation of Indigenous peoples in understanding and using climate information for adaptation planning.

The adoption of a co-designed approach and practice in this project ensures that:

- the focus is relevant and appropriate to the Malgana Traditional Owners, and their perceptions of climate risk
- the research process is governed by Malgana Traditional Owners, using the local decision-making structures with cultural authority
- the project addresses key risk issues for Malgana-led Indigenous land and sea management and joint management
- others can meaningfully adapt the learnings gained.

The Research Question

The research underpinning the project asks, *“How, why and under what conditions does the approach of using Indigenous-led tools for two-way sharing on climate risk improve Indigenous participation in understanding and using climate information for Indigenous-led adaptation planning?”*

World Heritage Area Values and Climate and Landscape of NPA

The Project Location

The Shark Bay World Heritage Area, located in Western Australia, is a living natural wonder renowned for its natural heritage value. The Outstanding Universal Values of Shark Bay include the following:

- its extensive and diverse seagrass beds
- the stromatolites in the hypersaline Hamelin Pool
- its refugia for a variety of threatened terrestrial and marine plant and animal species
- remarkable examples of processes of biological and geomorphic evolution.



Figure 1 Boundary map of the Shark Bay World Heritage Area

The seagrass meadows of Shark Bay store a vast reserve of carbon. The Shark Bay World Heritage Area covers 2,197,300 ha, nearly 70% of which is marine environment. It is on the most westerly point of the Australian continent, approximately 800 km north of Perth, with approximately 1,500 km of coastline.

As described in Heron et al. (2020, p.7):

It spans almost from Carnarvon in the north to the Zuytdorp Nature Reserve to the south. The western boundary is up to three nautical miles off the coast, whilst the inland boundary extends approximately 100 km towards the Northwest Coastal Highway. Although the township of Denham and the areas around Useless Loop and Useless Inlet are within the WH boundary, these are specifically excluded from the [World Heritage] property as they were already highly modified areas at the time of inscription in December 1991. Areas within the [World Heritage] property continue to be added to [the] conservation estate, the most recent being Dirk Hartog Island which was declared a National Park in 2009.

Vulnerability of the outstanding universal values of the Shark Bay World Heritage Area to climate change

The climate change stressors likely to have the most significant impact on the Shark Bay World Heritage Area are air temperature change, storm intensity and frequency, and extreme marine heat events (Heron et al., 2020).

Temperature projections include increased average air temperatures in all seasons. By 2050, warming is projected to range between 0.7 - 1.5 C and 1.4 - 2.4°C. In 2050, Denham is projected to experience between 37 and 41 days each year above 35°C. Approximately one-third of each year is projected to have a daily maximum exceeding 30°C in 2050.

Storm intensity and frequency projections indicate fewer but more intense tropical cyclones, more intense extreme short-duration rainfall, and the wettest day of the year will get wetter.

Extreme marine heat projections include a continued increase in sea surface temperatures. Severe heat stress impacting seagrass is projected to occur twice per decade from as soon as 2038, and annually from 2047 (Sutton, A. and Shaw, J. 2020)

Other changes include changes to the Leeuwin Current, rising sea levels and ocean acidification.

Climate change in Shark Bay will likely translate into multiple impacts on the natural heritage. These may include the effects of marine heatwaves on seagrass (which may have knock-on effects on marine fauna and alter the stability of mechanisms that lead to the hypersaline environment of the stromatolites), impacts of reduced precipitation on terrestrial flora but also the potential for increased extreme rainfall events, and changes to air temperature that affect vegetation and turtle nesting (Heron et al. 2020).

The listing of the Shark Bay World Heritage Area does not recognise the ongoing connections between the Traditional Custodians and their sea Country; however, a joint management plan was recently established with the Malgana Aboriginal Corporation in the World Heritage Area.

The Malgana people have been exposed to climate change projections and science actions such as through its partnership with the University of Western Australia seagrass research team (Sinclair et al. 2024), the Western Australia Marine Science Institution science prioritisation project (Sutton A. and Shaw. J, 2020), and in phase I and phase II of this project.

The Malgana People's continuing occupation and relationship with the Shark Bay World Heritage Area

Gathaagudu - Shark Bay is an inherent part of the Malgana descendents' culture and their heritage, with relationships that stretch back up to 30,000 years with two distinct periods of occupation 30,000-18000 and 7000-6000 years ago (Bowdler 1990c, CALM 1996 in Sutton A. and Shaw. J, 2020). Malgana People live in Denham, many live in neighbouring townships of Geraldton and Carnarvon, and others live further (Federal Court of Australia, 2018). Malgana people living near Shark Bay continue to visit and participate in hunting, fishing, gathering and knowledge sharing on their lands and seas (Federal Court Australia, 2018). Bush foods continue to be an important supplement for the Malgana people.

The most common archaeological site found in Shark Bay is middens, which are scattered along the coastline and show evidence of a marine-based diet (McCluskey 2008 in Sutton A.

and Shaw. J, 2020). Malgana People were involved in early European settlement industries: pearling, sheep shearing, guano mining, and fishing (Moore, 1994, McGann, 1990, in Sutton A. and Shaw. J, 2020).

Fishing is a customary activity mainly undertaken by Malgana men. It involves using nets, hooks, and spears. Fishing lines have been adopted as a modern fishing method (Federal Court of Australia 2018).

Local industry

Tourism, fisheries and salt production are three of the leading industries in Gathaagudu - Shark Bay (Shire of Shark Bay website – access 01 December 2024). The most popular water-based activity for locals and visitors is recreational fishing. Line fishing is the most popular method, followed by ballooning and netting (CALM, 1996, Smallwood and Gaughan, 2013, in Sutton A. and Shaw. J, 2020).

Popular shore and small dinghy-based fishing occurs at accessible locations such as Denham, Monkey Mia, Freycinet and Grey Point (Figure 1) (Sumner and Malseed, 2001, Department of Fisheries, 2004, Taylor et al., 2018, in Sutton A. and Shaw. J, 2020). Boat-based fishing predominantly occurs around Dorre and Bernier Islands, off the west coast of Dirk Hartog Island/ Wirruwana and along the coast to Zuytdorp Point (Figure 1).

A 1998/1999 estimate for total annual recreational fishing in Shark Bay revealed over 50% attributable to boats launched from public ramps at Nanga, Denham and Monkey Mia and 20% attributed to boats launched from beaches (eg Tamala Station) in the marine park and 25% for shore-based fishing (Sumner and Malseed, 2001, in Sutton A. and Shaw. J, 2020).

A 2016/2017 study found an estimated total of approximately 41,500 party hours of boat-based recreational fishing for inner Shark Bay and within the Oceanic Management Zone (Taylor et al., 2018, in Sutton A. and Shaw. J, 2020). Fishing was greatest between March and August, with May being the most popular.

Denham Township

Denham township is the main residential centre of Shark Bay. As the gateway to the Shark Bay World Heritage Area, Denham is a major tourist attraction.

In the 2021 Census, the Indigenous population of Denham represented 9% of the total population with a median age of 41 years. As a proportion, the Denham Indigenous population is nearly three times that of the state of West Australia, where Indigenous people make up 3.3% of the total population, with a median age of 24 years (Australian Bureau of Statistics 2021, accessed 25 November 2024).

Denham's main industries of employment are accommodation at 16.8%, supermarket and grocery stores at 5.4%, travel agency and tour services and local government administration both at 4.9% and the conservation sector at 4.4.% (a drop of 7.6% from the 2016 Census). Employment in the same industries for the whole of West Australia, by percentage, are accommodation 0.8%, supermarket and grocery stores 2.4%, travel agency and tour services and the conservation sector both 0.1% and local government administration 1.4% (Australian Bureau of Statistics 2021, accessed 25 November 2024).

Many people going to Denham require accommodation- tourists and travellers for holidays and work, industry workers looking for employment in current and emerging industries and Malgana People returning to live and work on Country. A significant proportion of occupied private dwellings in Denham were rented, 38.4% and 38.7% were owned outright. 14.8% of dwellings in Denham were owned outright, relative to 40% of dwellings owned outright in the state (Australian Bureau of Statistics 2021, accessed 25 November 2024). Denham has a limited supply of housing. Building new homes is difficult due to labour shortages. Malgana workshop participants spoke of these challenges in expressing their wish to return to Country.

Approach and Method

Phase 1: Identifying Knowledge Sharing Tools and Agreeing on a Future Collaborative Project

This project is made up of two phases of NESP knowledge collaboration with Malgana people. The first phase of the project was formed from the First Peoples Dialogue on Climate Change on Yorta Yorta Country in 2018. An approach was made to the Malgana Aboriginal Corporation Chair and Ranger co-ordinator to explore interest of Malgana People and the type of collaboration they would find beneficial. It was agreed that a workshop with Malgana People to shape a future research collaboration would be the appropriate approach. Phase 1 was funded by NESP 1.

The first phase of the research collaboration with Malgana was a three and a half-day workshop in Denham in 2020. The workshop was co-planned with Malgana People. The aims of the workshop were to share knowledge on climate change and Malgana Peoples' experiences of their changing environment; and to collectively explore an opportunity for research collaboration. The Malgana Traditional Owners identified two knowledge sharing tools to build in a future climate-related research project, their seasonal calendar and a map of Country. These knowledge sharing and building tools including the Malgana timeline were piloted to explore Malgana risk perspectives and to develop Malgana climate responses in Phase 2. The Malgana Climate Response Project is co-designed and attends first to Malgana knowledge and capability.

Funding for the second phase was sought from the NESP Climate Systems Hub.

Phase 2: A Strengths-based approach to identifying Malgana Climate Risks and Responses

The Malgana climate response project adopted a strengths-based approach. The strengths-based approach is designed to shift narratives from deficit or lack-based thinking, of the gaze of outsiders, to the inherent strengths of Aboriginal and Torres Strait Islander people and communities (Fogarty, W. et al. 2018). An Indigenous strengths-based approach will include all or most of the following principles (Prehn, J. 2024, p. 5):

1. **Celebrate diversity:** Honour the vibrant strengths within Indigenous communities—cultural wisdom, deep connections to Country, resilience, storytelling, kinship, and art;
2. **Embrace growth:** Acknowledge the inherent strength, resilience, and growth potential in the face of adversity, turning challenges into opportunities for profound development;
3. **Empower aspirations:** Fuel personal and collective growth in the Indigenous context. Support self-determination. Value the aspirations, goals, and visions of Indigenous individuals, families, and communities;

4. **Foster self-determination & collaboration:** Boost self-determination with resources and valued Indigenous voices. Collaboration is key—recognise expertise, knowledge, decision-making authority, and empower through meaningful partnerships;
5. **Utilise resources:** Tap into the wealth of Indigenous resources—cultural knowledge, traditional practices, land, networks, support systems, and cultural strengths—to address challenges collaboratively; and
6. **Cultural grounding:** Root the strengths-based approach in Indigenous culture, care, and context. Respect world views, including knowledge systems, cultural protocols, values, and ways of being. Engage in culturally appropriate ways for interventions aligned with values and cultural safety.

The strengths-based approach focuses on the resources and resilience of families and individuals even in challenging social, economic, historical and institutional conditions.

The Malgana Climate Response project was co-designed to focus on the strengths and diverse attributes of Malgana knowledge, experiences and governance. It works with knowledge-sharing tools suited to how Malgana seek to engage and share their knowledge. The project prioritised Malgana knowledge sharing, collective re-creating of memories and knowledge making. The project partnership applied four knowledge-sharing tools, two of which were prioritised by Malgana People in a 2020 workshop - the seasonal calendar and mapping of Country. A timeline of events on Malgana Country and of Malgana People was created together from the conversations about observed and known changes on Malgana Country. A fourth tool that combined the loss-persistence and cascading consequence concepts was developed to guide the identification of values-focused management actions. The tools support the mobilisation of Malgana knowledge to work alongside western science and the strengths-based approach has been designed to support Malgana in continuing to collectively build their knowledge as part of their joint management role in the Shark Bay WHA.

The project **strengths-based approach** meant the team began by working with tools that explicitly attended to Malgana Peoples' knowledge of and relationship with Country. As the project progressed, it became clear that Malgana participants saw opportunities to continue building on the knowledge products they created. The Malgana response triggered and shifted different thinking in the NESP research team. The key question for the team was how it would ensure it delivers tools that Malgana People can continue to build based on their changing knowledge and experiences. The second question for the team was, what is the role of these knowledge tools when Western science and knowledge delivers its view of changes happening or are projected to happen on Country?

Method

Climate-related risks are understood through the particular lens Malgana People brought into the project. Knowledge-sharing tools were drawn on as a collective knowledge building process and to understand the types of and diversity of values Malgana People hold for their Country, the risks to Malgana customary relationships, and to develop cultural strategies to respond to the effects of and the drivers of change. The cultural strategies developed by the

Malgana People in this project reflect the approaches that deliver meaningful outcomes for them.

The four knowledge-sharing tools utilised in the project, the seasonal calendar (see McNamara, K et al. 2010 for method), timeline (see Mooney, M. et al. 2014 for process), mapping of Country (see <https://centrefarm.com/co-mapping-on-country/> accessed 28 February 2023 for the foundational process) and the assets change-persistence cycle (adapted from the Climate Change Toolkit for World Heritage Properties in Australia, Lin et al. 2022), were developed with Malgana People and focused on knowledge recovery and building, transfer, retention and use. The tools engage with different dimensions of Malgana knowledge, including seasonal knowledge, experiences and observations of health and change to Country; spatial dimension of knowledge, observations, experience and practice; recording of local and regional events over time that can complement changes explored in the seasonal calendar and combining shared information and knowledge to systematically consider responses that can help Malgana People to sustain and strengthen their cultural values (see Figure 2 for steps and process adopted in this project).

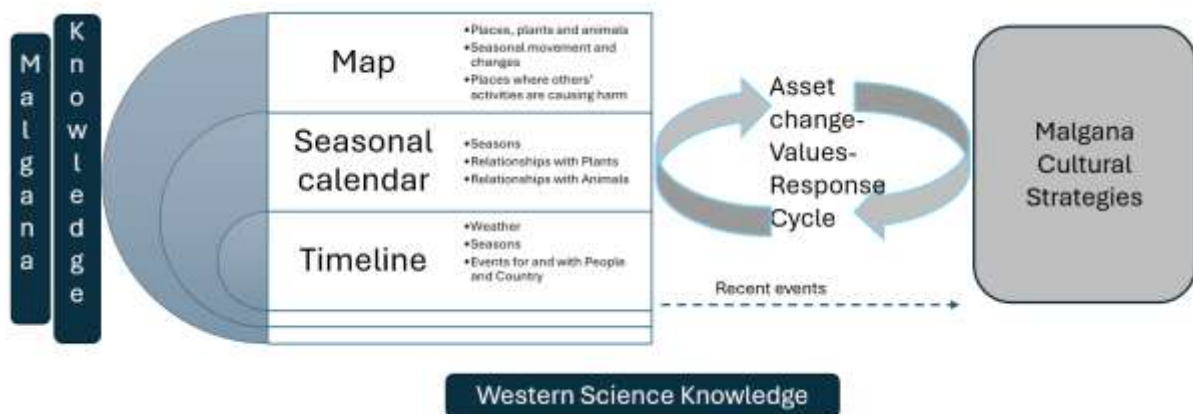


Figure 2 Knowledge-sharing tools utilised in the project to develop Malgana cultural strategies

In this project, western science and knowledge sat alongside the three knowledge-sharing tools and was woven into elements of the timeline and the asset change-persistence cycle discussion.

Traditional Owner's knowledge and customary practices and governance are equally important to Western science and are the foundation to working with Western science as well as addressing the multiple immediate pressures of change on their Country.

Four workshops were held over the two years of 2023 and 2024. Workshop participants were selected by the Malgana Aboriginal Corporation and included board members, rangers and elders. The project sought additional funding from the Indigenous Research Grant within CSIRO to ensure the right people and an acceptable number of people participated in the project workshops. The additional funding was necessary for the project to follow Malgana protocols. A core cohort of participants participated in each of the four workshops, including board members, rangers and elders, while others engaged in one or two of the gatherings. Participants included residents of Gathaagudu - Shark Bay and Malgana People who live in

Geraldton, Carnarvon and Perth. This report uses the Malgana name Gathaagudu for Shark Bay, which includes the World Heritage Area.

Consent and privacy forms were shared with and signed by workshop participants. The research team also checked in with Malgana participants throughout the workshop discussions to confirm whether they could record what was being stated. This report was shared with the Malgana Aboriginal Corporation board to review, edit and approve for publication.

Western science is the primary working knowledge of government and research agencies in Shark Bay. Western science and information were shared from the first workshop, beginning with average yearly recorded temperature and rainfall graphs (see Figure 3 and Figure 7) and discussions about weather events such as marine heatwaves and floods. The conversation covered the scientific projections of extreme weather events and increasing sea and surface temperatures. The second workshop involved a presentation from project C.S. 2.7 Climate-effective management for threatened species and protected places on the six-month projection for Shark Bay. The team incorporated information from the presentation into the workshop discussions relating to the ranger work program and the seasonal calendar. Unfortunately, the rangers were not on the first day of the workshop to explore the potential future use of the six-month projections.

The team explored and drew on climate projections for the Shark Bay World Heritage Area within the discussions of the knowledge-sharing tools. The knowledge-sharing tools were developed iteratively over the four workshops (see Table 1). The tools were reviewed, added to and finalised in the fourth workshop. The final workshop focused on the development of the cultural strategies.

A digital copy of each tool and the cultural strategies have been returned to Malgana Aboriginal Corporation. The tools have been designed to be added to and adapted by the Malgana People for their specific purpose and to refresh their cultural strategies.

	Workshop 1	Workshop 2	Workshop 3	Workshop 4
Timeline (see Mooney, M. et al. 2014 for process)	Average temperature and rainfall, then Malgana People added people and Country	Continued building the timeline of temperature, rainfall, people, Country,	Timeline included national and state events related to Indigenous peoples	Timeline distinguishes events that relate to Malgana People and their Country
Seasonal calendar (see McNamara, K. et al. 2010 for method)	Began building the Malgana seasonal calendar	Added to the seasonal calendar in men's and women's group	Clarified elements in the seasonal calendar	Further clarification to the seasonal calendar. Malgana agreed on the seasons and the changeability of seasons and language labels.

Map (see Mahood, M. 2011 for process)	Began talking about places on Country and identified sites of historical importance, , bush food, fishing and places and where there's high tourism impacts	Added to the map	Additions to the map	Digital map Corrections made and further additions
Asset change-persistence cycle (see Lin, B. et al. 2022 for the Change-Persistence method)			Introduced and was based on things discussed across the three tools. Climate change was included in the discussions	Refined to focus on Malgana capability and cross-generational capability and knowledge sharing

Table 1 The knowledge sharing tools used over the four workshops

Western science projections that supported the workshop discussions included a timeline of recorded average temperature and rainfall, long-term climate projections for Gathaagudu - Shark Bay and six-month projections for Shark Bay.

Timeline

A timeline was first developed to display average recorded rainfall and temperature events in Gathaagudu-Shark Bay between 1900 & 2022 (see Figure 3). It was created to discuss recorded temperature and rain events on Malgana Country and to invite discussion of Malgana experiences or stories of weather-related events. Weather events such as cyclones, floods, exceptionally cold seasons, marine heatwaves and associated impacts on Country were added in the workshop discussions.



Figure 3 Average recorded temperature and rainfall graphs used in the first workshop

Malgana workshop participants added historical events that expressed Peoples' memories and changing relationship with Country, the changing nature of their relationship with government that includes native title determination, land and sea management partnerships,

the recent joint management agreement with the West Australian government, and the impacts of increasing tourism and fishing on Malgana Peoples lifeways and Country. Other events added to the timeline were the establishment of pearling camps, the first Malgana fishing business, formal recognition of Malgana Native Title and other related events. The timeline evolved into a chronology of weather, local, regional, national, and other historical and contemporary events.

The research team added some additional local events based on grey literature and media articles, as well as regional and national events, such as the introduction of the Native Title Act to the timeline. The timeline was reviewed and added to in each of the four workshops (see Table 1).

In the second and third workshops participants discussed the drivers of change on Gathaagudu, based on events on the timeline and peoples' experiences of change on Country, and how these drivers are affecting Country and the way Malgana People connect to Country. The drivers identified by workshop participants were Malgana People governance, Western laws/policies, industry, tourism, and the environment (changing and affecting the way people experience Country).

A digitised version of the visual timeline was presented to Malgana workshop participants in the fourth workshop for final review. Participants requested that events specific to Malgana People be highlighted and that Malgana People's names be removed. The research team colour-coded the drivers or themes of change identified by Malgana workshop participants (see Figures 8 and Figure 9).

Malgana workshop participants agreed that the research team would leave a version of the Word document and digital visual timeline with the Malgana People to continue adding to in the future, for example, addition of new archaeological information.

The Climate Systems Hub researchers presented a six-monthly seasonal projection based on Western science modelling. Their research reported on the projected weather conditions based on the nature of the regional climate drivers. The presentation included the projected likelihood of a marine heatwave, as well as rain and temperature conditions. The three climate drivers shared in the workshop were the Indian Ocean- El Nino/La Nina, Southern Annular Mode (SAM) and the Indian Ocean Dipole (IOD).

Seasonal Calendar

The Malgana elders confirmed their strong interest in creating a Malgana seasonal calendar in Phase 2 of the research collaboration. The elders, in particular the fishermen, led the activity. As can be seen in Table 1, the content of the seasonal calendar was developed over the four workshops and finalised in the fourth workshop. Figure 4 shows a women's group working on the Malgana seasonal calendar.

Malgana workshop participants agreed that the research team would provide Malgana Aboriginal Corporation with two calendar templates. One is of the Malgana seasonal calendar, based on Malgana cultural knowledge, and the second records events in the calendar year, such as fishing season and peak holiday time. The latter is basic but can be added to or combined with the Shark Bay Shire annual events calendar.

The seasonal calendar templates left with Malgana People can be reviewed and adjusted to reflect significant changes in the seasons in 10 to 20 years. A set of questions at the end of the report is intended to be an accompaniment to the Malgana seasonal calendar, to aid Malgana People to review and update their seasonal calendar in the future, in 10 to 20 years' time (see Appendix 1).



Figure 4 Malgana women working on their seasonal calendar

Mapping places, plants, animals and activities

The project adopted an iterative approach to successively create a Malgana map of important places, plants, animals, and the broader activities occurring on and impacting Gathaagudu – Shark Bay.

The four main activities of building and deepening the information represented in the Malgana map were to 1. work together with the right Malgana People; 2. be present as people yarned, share their knowledge and became familiar with the map and how they want to represent information; 3. spend time to reflect on the map between workshops; and then 4. review and add to the map as people collectively started to build their knowledge product.

The mapping of places, plants, animals, and peoples' activities on Country drew together elements of the seasonal calendar, timeline, seasonal movements and events, and areas of concern or risk from actions by non-Malgana people. The map represents seasonal changes to values, values at risk from human activities, values relating to Malgana histories and memories, livelihood and customary practice, and residence. Some of these values are shared with, sit alongside, or are at risk by other value-driven actions in Gathaagudu – Shark Bay.

The mapping exercise was undertaken within a workshop setting (see Table 1) and over the four workshops of phase 2. Mapping began with a base map, a large 2m by 3m canvas map showing a recent high-resolution satellite image of Shark Bay (Landsat, 25m resolution, May 2023). This image shows water depths of up to 40m, highlighting major sand banks and shallow areas – important Shark Bay marine environment components. This map was printed at a scale of 1:100,000, where 1cm on the map equals 1 km on the ground. This scale made measuring distance on the map straightforward. Printing on canvas retained the rich colours of the satellite imagery of Shark Bay and created a visually stunning map to work with. The canvas is durable and is readily displayed on the floor or across several tables. Plastic sheets were thrown on the canvas to protect and allow people to walk on it.

Malgana People at the workshops were invited to add their stories and values to the map (see Figures 5 and 10). The map toolkit included a box of objects to serve as icons on the map, such as shells, strings, buttons, coloured squares, triangles and circles. The Malgana participants were invited to place icons on the map to represent their important places, events and values. Talking about places evoked much discussion about the past, current and enduring impacts on people and Country, the importance of place and Country, the locations of changes over time, and the Malgana values relating to Gathaagudu-Shark Bay. The younger participants placed the icons under the direction of the Elders at times. A legend was created describing the meaning of the icons. At some locations icons were laid one on top of another where values and/or events overlapped.

Photos of the map were taken at the end of the workshop, and locations and icon types were transposed into a digital map. This map was printed on paper, poster size (80 by 120cm) and presented for comment, corrections and editions at the fourth workshop. There was a continual building of the map to the final workshop.

The Malgana values map is a canvas print and digital map that can be accessed and edited using GIS.



Figure 5 Malgana participants mapping places, plants, animals, and activities on Country at the second workshop

Asset change-persistence cycle

The asset change-persistence cycle combines the cascading consequences tool (see Morgan-Bulled et al. 2021, p.27) and the change persist assessment tool in the Climate Change Toolkit for World Heritage Properties in Australia (Lim et al. 2018). The asset change-persistence cycle focuses the assessment on values and responses, such as management actions, that sustain or attend to values that will continue to mobilise cultural resources. A term asset is used a broadly to refer to cultural assets that may be material including places, plants and animals, a practice, or spiritual. The asset change-persistence cycle was introduced in the third workshop. The responses or management actions identified by Malgana People in the asset change-persistence cycle were the basis for developing cultural strategies to honour, sustain, apply, strengthen and share Malgana values in the Shark Bay World Heritage Area Property. Figure 6 provides a template for the asset change-persistence cycle.

The Malgana cultural strategies were developed from the management and honouring loss responses that consistently appeared across the different assets Malgana participants discussed. Once the workshop participants reviewed and agreed on the cultural strategies, the team stepped through a set of questions to begin to understand the type of governance that would mobilise the cultural strategies for Malgana People and their Country. Some cultural strategies were identified in the discussions on individual knowledge-sharing tools.

The first set of assets explored through the asset change-persistence cycle by Malgana workshop participants identified explicit climate-related loss and persistence events and responses. The review of the cycles in the fourth workshop revealed that the main risk and concern for Malgana workshop participants is the potential loss of inter-generational cultural knowledge and practices from the elders and Malgana leaders to the younger generation. Below is a template of the asset change-persistence cycle.

The asset change-persistence cycle begins with a discussion about what is known now about an asset, its attributes, the factors driving change in the environment and how the asset may be affected by the broad elements of change. The conclusion of the discussion is on the future, which was termed 'Coming Later'.

The first set of questions in the boxes aligns with the change and persistence process. The discussion can draw out information that aligns with the following question on significance. The following boxed question focuses on the effect of loss and persistence on peoples' relationship with each other and Country. This section of the cycle focuses on the values people hold for the asset.

The final questions focus on ways to honour what may be or is being lost and responses to build on and mobilise cultural, institutional and relational resources.

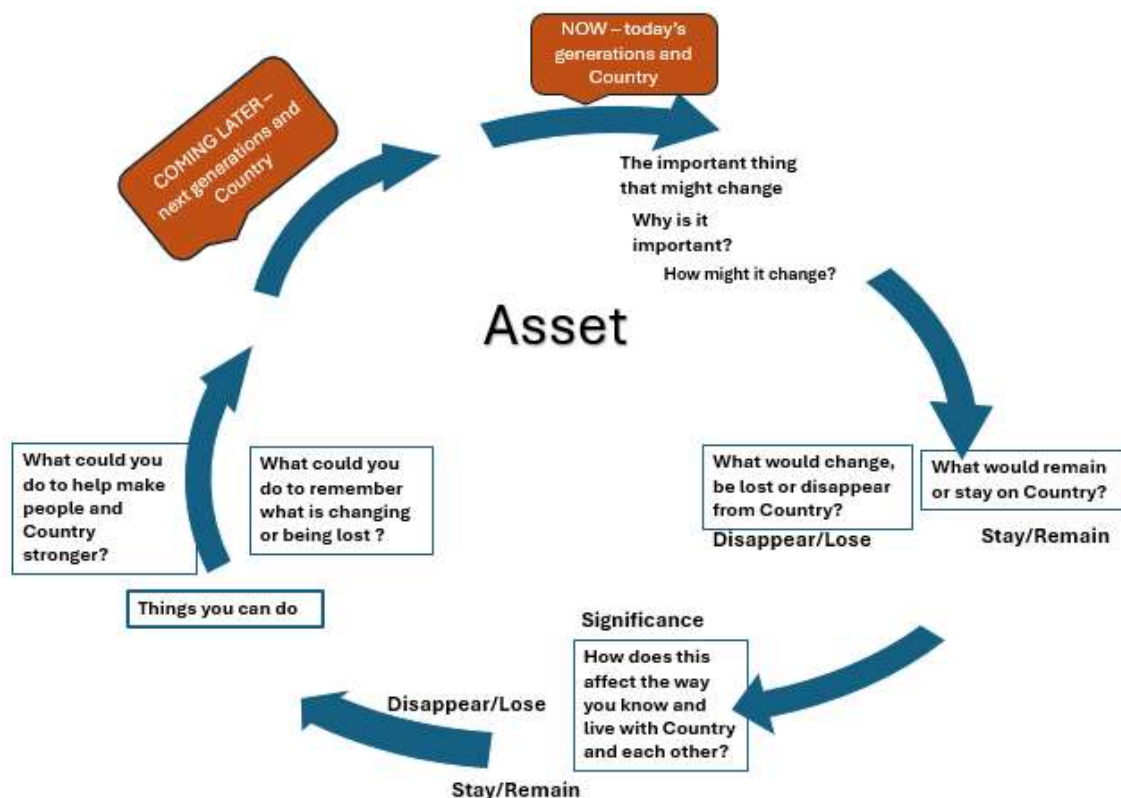


Figure 6 Asset change-persistence cycle

How this project engaged with the Climate Change Toolkit for World Heritage Properties in Australia

The Climate Change Toolkit for World Heritage Properties in Australia (referred to as the world heritage area toolkit) was another publicly available resource for the project. The climate change toolkit was adaptively applied to the way Malgana People wanted to work. Considerations in the application of the toolkit were:

- Malgana People have been engaged in a variety of discussions about climate change and the potential impacts of climate change on Gathaagudu
- Much research has been and continues to be undertaken on the outstanding universal value of the Shark Bay World Heritage Area, some of which involve Malgana People, such as seagrass research
- Adoption of a strengths-based and a collaborative research approach demands that knowledge collaboration begins with tools that are in sync and consistent with Malgana ways of knowing
- Focus on and centering Malgana values across the knowledge sharing tools and in the climate response strategies.

Elements of the climate change toolkit were woven into the discussions that centred on the knowledge sharing tools prioritised by Malgana Peoples that featured Malgana values. The change persistence and management actions tools from the world heritage area toolkit were helpful in focusing discussions on things of importance and the values that Malgana people want to sustain, or to acknowledge change or loss. These tools were adapted by the team to create the asset-change persistence cycle which focused on cascading consequences of change and the effects on values. Below is a summary of the connections with the change persistence, and management actions tools:

- Why is it important
 - To understand the attributes of the asset
- How might it change?
 - To discuss the asset in relation to the factors that may be influencing or driving change, such as weather or seasonal conditions, human activity or policy
- What would change or remain on Country?
 - Two parts to the answer that sit on different sides of the arrow.
 - Engage in a more extended discussion about cascading changes.
- How does this affect the way you know and live with Country and each other?
 - Two parts to the answer that sit on different sides of the arrow
 - Engage in a more extended discussion about values that are sustained or may be diminishing.
- Things you can do?
 - Management actions that honour what is lost or damaged and those that build and renew Malgana values sit on different sides of the arrow to illustrate that these are distinct discussions.

Results and Discussion

This section provides the results of the knowledge collaboration with the Malgana People. Climate-related risks are understood through the particular lens Malgana People brought into the project. Knowledge-sharing tools were utilised to understand and record the values Malgana People hold for their Country, the risks to Malgana relationships to Country, and to develop cultural strategies to respond to the effects of and the drivers of change. The cultural strategies developed by the Malgana People reflect the approaches that deliver meaningful outcomes for them.

Below, we present some of the outputs and key learnings for each knowledge tool from the co-design process.

Western Science

The average temperature and rainfall timelines were utilised to discuss past weather and seasonal events (see Figure 7). Workshop discussions included marine heatwaves, floods, and cold weather and a re-visit of previous conversations about dry and hot days in Gathaagudu - Gathaagudu.

Project CS 2.7 provided a preliminary presentation on a six-month projection for the Shark Bay region. Most participants understood the presentation. A point made in the workshop was that the six-month projections would be more relevant to the rangers who are working on the ground. The six-month projections did not indicate hotter or cooler temperatures nor below or above-average rainfall. No questions or discussions were raised by the workshop participants about the six-month projections presented to the group. Malgana workshop participants expressed interest in ocean currents that move warm seas into Shark Bay.

Feedback about the science language was provided to the NESP team. One of the challenges for the NESP C.S2.7 was delivering the presentation online rather than face-to-face.

The project newsletter to the Malgana Aboriginal Corporation members included elements of the presentation.

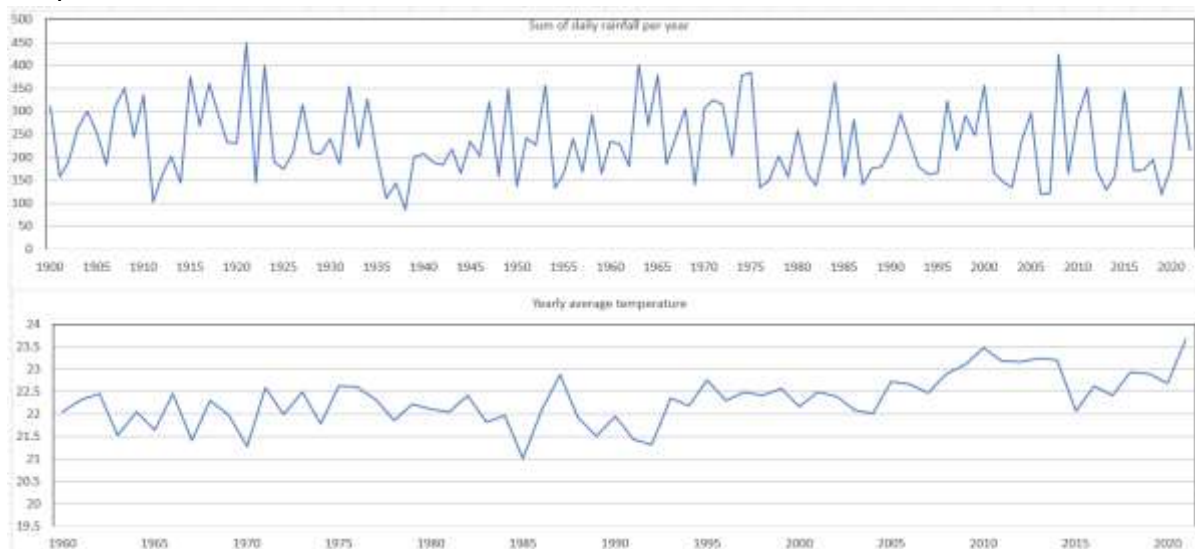


Figure 7 Average yearly recorded rainfall and temperature in Shark Bay

Future uses

There is the possibility of discussing the continued sharing of six-month projection videos or PowerPoint information with Malgana rangers to explore its usefulness for their on-groundwork. Approval would need to be provided by the Malgana Aboriginal Corporation. Beginning with a face-to-face interaction followed by a mix of face-to-face and virtual meetings at six or seven monthly intervals to understand the value of the six-monthly projections and to provide the rangers with an opportunity to ask questions. The interactions may also provide for more targeted conversations about research that can address management concerns as they emerge.

The occurrence of projected extreme weather events could be recorded after the event in the Malgana timeline if this is something Malgana People choose to do.

Building the Timeline

Change has been a constant and consistent presence for Malgana People for millennia. The timeline exercise highlighted that early colonial contact and settlement marked momentous change. Resource extraction, pastoral settlement, roads and townships, industry and the role of the state/Western policies and legislation were some of the significant incursions that brought irrevocable change to the lives of Malgana People. Figures 8 and 9 below depict the timeline developed within the project.

The timeline exercise facilitated a unique recollection, re-connection and re-building of memories about people and Country and the different ways Malgana People remain connected to Country and each other through individual and collective circumstances of change. Timeline discussions facilitated yarns and storytelling by participants around their changing relationship with people and Country. The discussions made visible the ongoing resilience and adaptation of the Malgana People to these early and imposed changes. As

the conversations shifted toward recent historical events, the frequency of change became evident. Changes to Western legislation and policies provide mechanisms for Malgana People to assert their rights and interests in diverse ways - native title, joint management, businesses on Country and signage communicating Malgana Country. Technology changes raised by participants included phones and digital media, powerful motor vehicles including boats and 4WD and fish tracking technology, which make for a more efficient fishing expedition and more frequent brief fishing trips. Other changes mentioned include research partnerships on Country, such as this Climate Systems Hub climate project. The ongoing grief from some of these changes was expressed. The older workshop participants spoke of the hardships their parents and grandparents experienced in the early days. The fisherman spoke of the closure of Useless Loop, once a natural fishery closed to the sea in the 1970s and referred to it as the world's largest fish trap. Some participants grieve the exclusion of Little Lagoon from the Denham town boundary during the World Heritage Area listing in the 1990s.

The stories and heritage of Malgana Peoples and Country continue from present to time immemorial. The timeline, which started from recorded data of historical temperatures and rainfall events, developed into a piece where Malgana participants made themselves culturally visible. Connections and relationships with people and Country are ongoing. The timeline can be viewed as a record of change and a way of communicating the Malgana People's cultural visibility through change and the changing nature of their relationship with Western institutions over time. Malgana workshop participants saw the timeline as a tool that they could use to give a fuller story of themselves and what is happening on Malgana Country. The Malgana timeline shows the Malgana People as increasingly active agents of change in the recent history of the timeline.



Figure 9 Timeline mid 1900s to 2025

Future uses of the timeline

A timeline is a simple tool that visually communicates events important to Malgana over different generations. Malgana Traditional Custodians can add to the timeline. Future uses of the timeline can include additions of events that celebrate Malgana successes, unusual weather events such as marine heatwaves, floods or cyclones, or outcomes of the joint management plan or research partnerships. The timeline can also include development-related events. The timeline can be a record and a tool for Malgana People to continue to reassess the drivers of change on their Country. Malgana People can also mark the review and refresh of the Malgana seasonal calendar as part of a continuing building of the resilience of their knowledge and relationship with Country.

Creating the Malgana Seasonal Calendar

The Malgana seasonal calendar shares knowledge of the seasonality of terrestrial and marine life cycles and when fishing, hunting, and foraging occur. The calendar represents Malgana People's relationship with Country at this time and reflects the knowledge and relationships of the elders and leaders who collectively created the calendar. The Malgana calendar will be for Malgana use only.

The three seasons of the Malgana calendar relate to the marine fishing-based practice of the Traditional Custodians. The elders in the workshop drove the development of the Malgana seasonal calendar.

The workshop discussions involved collective re-creation of peoples' experiences in historical events as practitioners, observers and engaged community members. There was deep knowledge in the room where elders were often referred to for clarification or to check on information before agreement was established. The knowledge shared among the Malgana People to create their seasonal calendar was a process of sharing, checking, verification and continual review. The fishermen shared their seasonal knowledge about fishing with the women and younger rangers in the room. Women spoke about foraging and hunting on the coast and in-land, activities they part-took in as children with adult family members, and are still involved in. It was noted that today fewer youth are engaging in these fishing, hunting and foraging activities.

The Malgana seasonal calendar includes some of the commonly caught fish that Malgana People have named, including *Mulgarda* (mullet), *Mulhagadara* (whiting), *Irrumarri* (bream), and *Mardirra* (pink snapper). The calendar also includes native game and plant foods important to Malgana People, such as dugongs, turtles, bird eggs, and bobtails (Sutton A. and Shaw. J, 2020). The Malgana activities and events of Country described in the seasonal calendar relate to specific places and large areas on Gathaagudu – Shark Bay.

While not represented in the seasonal calendar Malgana workshop spoke about the increased development and tourists visiting Shark Bay since the COVID-19 pandemic. They spoke of Denham township, the waters and coasts of Gathaagudu being busy all the time, not only in the tourist season. Malgana fishermen shared their observations of changes in wildlife behaviour and their changing presence as a result of increased marine vehicle traffic. For example, places where bird eggs could previously be collected were no longer places to forage because of high boat noise and human disturbance. Many of the changes observed by Malgana people are recorded on the map.

Gathaagudu – Shark Bay is a popular fishing destination. Malgana People living in and visiting Shark Bay have observed a marked increase in the number of tourists after the COVID-19 shutdown. Since COVID-19, there is little to no quiet period between the peak visitor times. Tourist peak season is associated with the general stores and petrol stations running out of supply and excess demand on limited health professionals.

Access to housing in Denham has also decreased since COVID-19, with increased development of holiday homes and homes for new residences. The accessibility of housing can be an important consideration for Malgana rangers who want to live on Country and for Malgana People who want to spend more time on Gathaagudu – Shark Bay. Malgana People and rangers on Country is critical to future plans and strategies to address the effects of climate change on Malgana ecological and cultural heritage.

Malgana workshop participants created two types of calendars. One was the Malgana cultural calendar, and the second was a general calendar of annual events, such as tourist season. This second calendar, Table 2, shows that peak tourism coincides with Country re-generation, renewal, and movement and it is also an important time of ranger work in

seagrass restoration and rehabilitation. Malgana fishermen also commented that the West Australian Government fishing season closures in the Gathaagudu-Shark Bay did not align with the customary practices of Malgana People. Table 2 shows that there are only four months in the year when tourist numbers are lower in Gathaagudu - Shark Bay.

The seasonal calendar is a tool that Malgana would like to use to guide dialogue and the actions of visitors on Gathaagudu – Shark Bay. The seasonal calendar is one way that Malgana People seek to assert and represent their cultural values and protocols. Malgana people, and elders in particular, were also explicit that the limitation of the season calendar, is that it cannot meaningfully represent the variability of the seasons. The beginning and end of each of the seasons can vary greatly depending on the timing and amount of rain, the full moon and tides, the absence of rain, to name a few environmental indicators of season change.

The seasonal calendar provides a baseline of the cycles of Country for current and future generations, an important source of information that they can re-visit and adapt to changes that happen on Country. In Appendix 1 is a set of questions that may assist Malgana future generations to review their calendar. Malgana People choose to review and refresh their seasonal calendar in the future, the evolution of the seasonal calendar could align with the Malgana cultural strategy of sharing stories, which are stories of change that Malgana People are navigating.

OFFICIAL

October	November	December	January	February	March	April	May	June	July	August	September
Spring		Summer			Autumn			Winter			Spring
			Malgana Seasonal Calendar – Important time when Country is active, moving, and re-grows								
		More tourists arrive and stay over the Christmas break	School holiday tourists and visitors in Shark Bay		Peak tourist and visitor season – Denham food and fuel supply run out. High demand on the health service in the township.						
			Rangers collect and plant seagrass seeds. (seeds from harbour)	Ranger seagrass restoration and recovery activities	Ranger seagrass restoration and recovery activities	Ranger seagrass restoration and recovery activities	Ranger seagrass restoration and recovery activities	Ranger seagrass restoration and recovery activities	Ranger seagrass restoration and recovery activities	Ranger seagrass restoration and recovery activities	
							Fisheries close Eastern Gulf (Monkey Mia) for pink snapper fishing, due to spawning. Fishers come over to Denham side			Fisheries close Freycinet Estuary for pink snapper fishing	
							Fishing Fiesta				
		School holiday – Malgana families on Country	School holiday – Malgana families on Country						Hamelin School Camps		
Shark Bay – Kalbarri Annual softball-football competition		Malgana Determination Day					NAIDOC Reconciliation				

Table 2 Annual and biannual events in Gathaagudu with seasonal cycle for Country

Future uses of the seasonal calendar

The first version of the Malgana calendar will not be publicly available. Malgana People intend to create a calendar for education purposes for the local school, using the first visual representation of their seasons created through this project.

Malgana People are interested in mapping the locations of culturally important species identified in the seasonal calendar. The combination of the seasonal calendar and the map could build the foundations for Malgana Aboriginal Corporation rangers to establish cultural species indicators for monitoring and reporting.

If Malgana People choose to establish indicators from their seasonal calendars, and to work with western science, Malgana people could consider using scientific names of species to sit alongside the Malgana plant and animal names.

Mapping, places, plants, animals and activities on Country

Bringing Malgana People together on Country to build the Malgana values map facilitated the co-generative retrieval of language, knowledge and memories, some of which may not have been known to others. The group's exchange of ideas and stories triggered memories for others and supported a validation and knowledge co-building process. Some of the places, plants and animals shared by participants were added to the map. The iterative yarning deepened the collective knowledge held by the group each time they met and added to the map. The conversations around the map shared information and generated discussions between men and women and across generations, as well as between the elders, rangers and leaders in the Malgana group.



Figure 10 Malgana workshop participants mapping places on their Country

Building the map over a year through repeated visits established an iterative process where participants could reflect on what was added to the map in previous conversations, what more could be shared with others, and validate knowledge each time. This cycle was recreated four times during this project.

Future Uses of the Map

The two versions of the Malgana values map – the canvas print and digital data – were created to be useable by Malgana People to continue adding to and as a tool to assist with managing Gathaagudu – Shark Bay including the World Heritage Area, based on Malgana values. The canvas map was created as a participatory tool to assist collective knowledge-sharing. The map remains with the Malgana Aboriginal Corporation, and we anticipate the canvas will continue to be used as a discussion tool to map and share knowledge and to communicate values to others beyond the Malgana group.

The digital map is based on the information represented on the canvas map. Information added to the canvas map was digitised and stored within the digital map. The digital map was created in a GIS environment, and the data are available to Malgana, along with some direction and tuition to manage and use these data upon request. Malgana Rangers previously attended and expressed interest in learning GIS and mapping technologies by attending the Indigenous Mapping Workshop – a free in-person annual event focused on Indigenous Rangers across Australia learning mapping technologies and spatial data management. The digital data has been packaged and ready for use in a GIS and is available for download by Malgana at their convenience. The digital map can be used to collect, store, and share the information mapped in the project workshops. The GIS can output editable PDF maps that allow viewers to turn layers on and off within the PDF. These changes allow users to view single layers – the locations of single values or multiple layers – to see the interactions between values and changes in cultural assets over time and space.

Assets Change-Persistence Cycle

The assets-change-persistence cycle focuses on assets of importance and the values associated with the asset.

The assets selected by Malgana workshop participants as part of the exercise were: Mullet, conch shell, a well (a cultural heritage site), green turtles, dugongs, bobtail lizards.

The responses or management actions identified from doing the asset change-persistence cycle have two parts: strengthening values and honouring what is lost. The responses or management actions identified across the assets were collectively analysed to develop cultural strategies. Figure 11 below is an example of the asset cycle mullet created by the workshop participants.

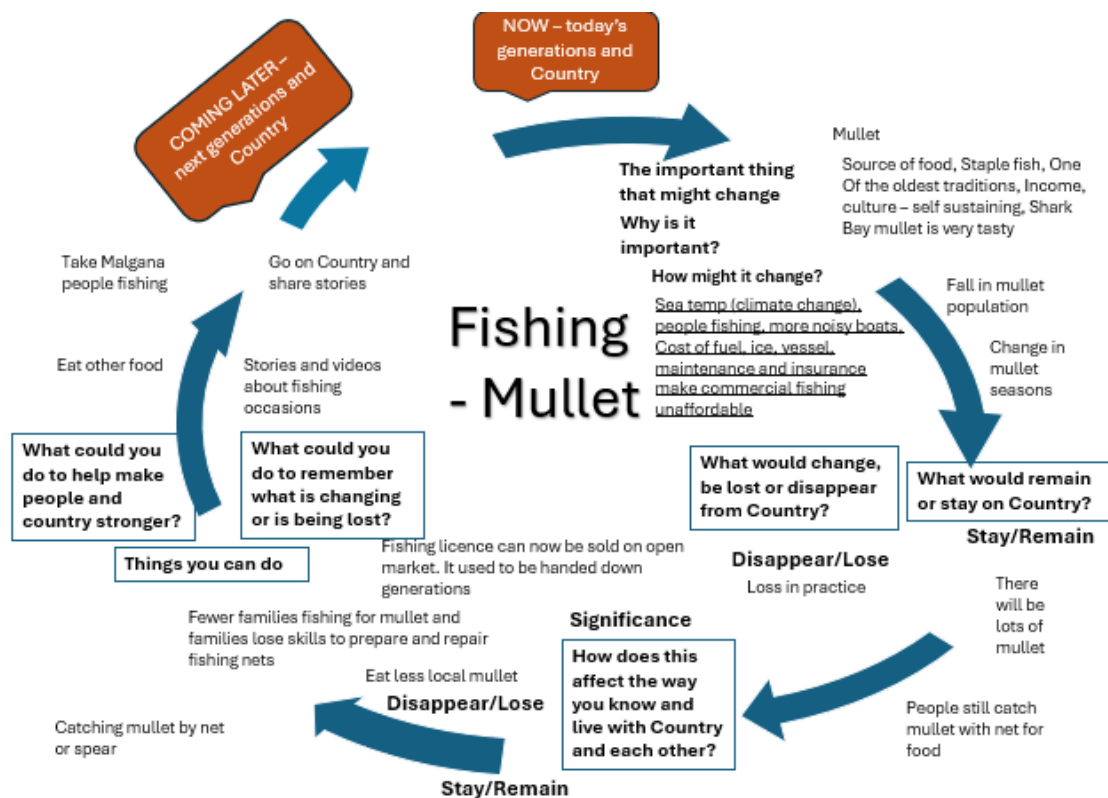


Figure 11 Asset change-persistence cycle for Mullet

Malgana workshop participants identified various factors as driving the change in Peoples' relationships with Country. They were:

- Malgana People are engaging less in customary practices such as hunting, foraging, collecting and food preparation
- Many youth are less interested in on-Country activities and more engaged and distracted by digital media on their phones
- More Malgana People have adopted a conservation mindset and are less likely to hunt traditional food sources such as dugong.
- Visitors collecting shells and trampling on heritage sites
- High number of visitors and fishing parties to Gathaagudu - Shark Bay with no low tourist season after the COVID-19 lockdown
- Higher number of fishing parties and boats in Shark Bay
- Prawn trawling damages conch shells
- Erosion from vehicles and weather conditions
- Fishing boats and jetty lights on the water that attract young turtles to predators
- Species important to Malgana are not funded
- Climate change – sea temperature effect on seagrass.

Emerging and New Changes

- Technology – weather forecasting, fish tracking satellite technology, and powerful vehicles are changing the behaviour of fishing enthusiasts who can make shorter and targeted fishing expeditions.
- Post-COVID-19 – New development in Denham that is making the property market less accessible.
- Town infrastructure, general stores, fuel, and health services haven't been able to cope with peak tourist season.

- Malganan Aboriginal Corporation joint management in the Shark Bay World Heritage Area.

Table 3 below lists the types of management actions identified by Malgana participants across the different assets change-persistence cycles they explored.

Responses to make people and Country stronger	Responses to remember and honour what is lost
Plotting and mapping sites for rangers to monitor	Passing on knowledge through storytelling on Country
Monitoring important places and species through joint management (joint monitoring and research with universities)	Passing on knowledge through film and digital images
Feral animal management	Registering cultural sites
Functions as a time for people to participate in customary hunting, food preparation and sharing meals of traditional foods.	Create space, time and resources for people to experience and participate in customary activities (e.g. joint hunting and food preparation events)
Ranger program (e.g. managing visitor activities for seasonal changes like protecting turtle hatchlings)	Visiting important places such as sacred sites.
Eat other food when culturally important species becomes scarce	
Restrict access and movement to certain places on Gathaagudu	
Rangers hold cultural compliance within joint management	
Rubbish management throughout Gathaagudu with a particular focus on highly visited places.	
Seagrass restoration and rehabilitation (different marine animals rely on different types of seagrasses)	
Environmental markets - economic benefits through potential blue carbon and other ecosystem services or nature positive programs can protect cultural species	

Table 3 Management actions identified by Malgana workshop participants from the asset change-persistence activity

The Malgana Cultural Strategies

Malgana workshop participants developed a set of cultural strategies that will assist Malgana People to protect, uphold and strengthen the current and future generations' relationship and ability to thrive with Country. Most of the cultural strategies Malgana participants developed were from the asset change-persistence cycles. Several were established from discussions on the individual tools.

Governance – What decisions need to be made for the cultural strategies

A total of ten cultural strategies were identified and explored by the Malgana workshop participants. The cultural strategies identified were:

- Rangers with cultural compliance (manage the actions and impacts of others)
 - Rangers to have the cultural authority to stop harmful actions on Country (e.g. 4WD vehicles in prohibited places or preventing people from collecting shells).
- Rangers monitoring and managing Country
 - Malgana Aboriginal Corporation rangers have its own data and information to assist with management.
 - Restrict camping and mooring near turtle sites.
 - Rubbish management, particularly at Steep Point and Monkey Mia.
 - Monitoring undertaken through joint management (e.g. green turtles).
 - Monitoring sites and places to ensure sites are cared for.
 - Research collaboration, such as turtle tagging.
- Rangers sustaining customary practices
 - Rangers manage fishing, hunting or foraging and food preparation expeditions involving elders and younger generations (e.g. hunting dugongs).
- Malgana Traditional Owners collectively forage, collect and hunt on Country on special occasions.
 - All Malgana People can fish, collect, forage and hunt on Country, and the time and space are made for them to participate.
 - While on Country, people observe the health of and any changes to Country.
- Sharing stories
 - Storytelling, in person with audio, digital recordings and images, used among families to share knowledge and sustain customary practices and relationships with Country (e.g. stories of hunting dugong).
- Protecting sites and places (e.g. sites of importance for plants, animals, and Malgana People)
 - Rangers are involved in joint management to protect places of importance.
 - Protection of cultural sites from 4WD enthusiasts.
 - Protection of places from 4WD damaging places.
- Register sites (include documenting and monitoring)
 - Registering Malgana sites with the WA government is one avenue of protecting physical heritage, but this can be a long process involving much evidence collection.
- Research Partnerships with FPIC that are based on Malgana Protocols
 - Research partnerships to bring western science into Malgana practices (e.g. dugong and seagrass research)
 - Research partnerships to follow Malgana protocols
 - Malgana Aboriginal Corporation board and elders' council want to ensure that Malgana People benefit from research on Gathaagudu
 - Malgana Aboriginal Corporation board and elders' council would like to know and understand the types of research being undertaken on Gathaagudu and be able to access the results.

- Secure consent, access and benefits from the collection and uses of biological materials collected from Malgana Country (e.g. future use of materials for commercial opportunities).
- Biological samples collected from Malgana Country are tagged in research repositories as owned by Malgana Peoples, and Malgana consent is required in any other future use of materials (e.g. samples of stromatolites taken from Malgana Country).
- Partnerships with industry - Malgana People to engage in, negotiate and agree on types of mutual benefits that can be achieved with industry
 - Tourism is one of the primary industry pathways for Malgana, and it is identified in the Malgana strategic plan. Young Malgana People have been given internships with a local tourism provider.
- Malgana culture seen as a central feature of Shark Bay
 - Management of Gathaagudu incorporates Malgana values and is visible to those visiting and living in Gathaagudu.

Protocol considerations for species translocation

Active translocation of animal or plant species to or from Gathaagudu-Shark Bay, through research requires the consent of the Malgana Traditional Owners. For example, the translocation and return of Mulgaras to Dirk Hartog Island/ Wirruwana from Martu Country, after its eradication by feral cats, involved cultural protocols and rangers as well as western science researchers. The Martu People continue to visit the Mulgaras on Dirk Hartog Island/ Wirruwana .

Workshop participants were clear that they would not hunt species of cultural importance on other Traditional Owner lands and waters.

The workshop participants decided that the Elders Advisory Council would take leadership of the cultural strategies which will be guided by Malgana cultural protocols (see Figure 12). The Malgana Aboriginal Corporation board will provide management and logistical support to the Elders Advisory Council, which will make recommendations to the Malgana Aboriginal Corporation board. Future steps for Malgana Aboriginal Corporation are to establish the structure and funding to support the Malgana elders.

As noted in the list of cultural strategies above, the rangers have a key role across the Malgana cultural strategies, evidenced by the number of strategies with ranger involvement. The protection and continued building of Malgana peoples' relationships with Country and the inclusion of Malgana values in looking after Gathaagudu – Shark Bay are embedded across all the strategies.



Figure 12 Malgana cultural strategies

Once the strategies were agreed to by Malgana People, the following governance questions were asked of each of them:

- Who should be involved?
- Who makes the decisions?
- What types of decisions do they need to make?
- What capability do they need?
- What resources do they need?
- What arrangements are needed to achieve the cultural strategy (partnership, collaboration, access benefit agreement, consultation, contract, legislation/policy, memorandum of understanding)?

A table of the group’s response to each of the questions for each strategy was created. Table 4 below presents the responses to the questions for the cultural strategy ‘Research: Collection of Biological Samples’. The responses show that Malgana People want to collaborate and partner with research and have been and are sharing biological resources with research institutions. Malgana People also have many questions that relate to current and future risks and benefits from the collection and future use of materials collected from their Country. This cultural strategy is newer, where Malgana People are generating new thinking about their research partnerships. Each of the 10 cultural strategies is presented in a similar tabulated form.

Five of the strategies are external facing:

- Malgana Aboriginal Corporation to explore co-benefit opportunities from industry in the region.
- Malgana secures consent, access and future benefits from biological materials collected from Country.
- Register sites (including documenting and monitoring).
- Rangers – Cultural compliance (managing the actions and impacts of others).
- Malgana culture seen as a central feature of Gathaagudu – Shark Bay.

Five of the strategies are internal facing, they focus directly on Malgana building internal capability through the ranger program and to ensure the sharing of stories is sustained:

- Stories
- Rangers monitoring and managing Country
- Rangers sustaining customary practices
- Protecting sites and places
- Malgana People foraging and collecting food on Country for special occasions

Governance Questions	Cultural Strategy – Research: Collection of biological samples
Who should be involved?	Malgana Elders Advisory Council – guidance on accountability, research institution, Malgana Aboriginal Corporation board
Who makes the decisions?	Malgana Aboriginal Corporation board
What types of decisions?	<p>Is the research beneficial? Does the research provide biodiversity benefits in Gathaagudu and other places or other Country? Is there a financial value now or in the future? If so, will this require a different way of making decisions (‘this is a different ball game’)? Will the work benefit many people (Malgana supports benefits to society to many people)? Does the research benefit people on earth?</p> <p>What are the accountability measures in place for research?</p> <p>Does the research support Malgana culture and work with Malgana protocols?</p> <p>Is the research agreement accountable and transparent? How will accountability be managed?</p>

	Will the Malgana cultural values be linked to any materials or samples taken from Malgana country, and will Malgana People be identified as the rightful owners and custodians? Will Malgana People be involved in future decision-making about how samples will be used, shared, and stored?
What capability is needed to make the decisions?	Research to work through MAC first. Research to collaborate with the Malgana Aboriginal Corporation to determine the kind of support the Malgana Aboriginal Corporation needs to ensure free, prior, informed consent is achieved and fair and equitable arrangement is established (e.g. where will materials be stored, who will have access, how people will know materials belong to the Malgana Aboriginal Corporation, how to ensure people understand ownership remains with the Malgana Aboriginal Corporation and needs the Malgana Aboriginal Corporation consent in the future, how materials could potentially be used in the future?) Legal expertise, Cultural Knowledge
What resources are needed?	Funds to ensure Malgana can access capability to establish strong agreements.
What arrangement?	Agreements or contracts that ensure Malgana consent is continuously acquired, and Malgana People share in future benefits (e.g. access-benefit agreement).

Table 4 Cultural strategy for research and the collection of biological material from Gathaagudu

Multiple tenures sit over the land and sea Country of Gathaagudu – Shark Bay. The cultural strategies reveal that successful outcomes for Malgana People will involve diverse parties and negotiations. These parties include the West Australian Government in joint management and broader resource management, the Shire of Shark Bay, mining lease holders, fishing licence holders, Carnarvon Port, which manages the shipping channel, tourism, and other business owners. Establishing a well-resourced and operating Malgana Aboriginal Corporation with a CEO and support staff will be critical to Malgana People achieving the full complement of outcomes from their cultural strategies.

Other issues raised

Workshop participants raised their concern that Government and the Ministerial offices do not notify the Malgana Aboriginal Corporation when they are going to be or are on Malgana Country. These communications are important in acknowledging the Traditional Custodians of Gathaagudu – Shark Bay and can provide Malgana People with an opportunity to share their culture and heritage.

The frustration expressed related to the detailed and complex legal processes that Malgana People have stepped through in order to gain native title recognition under western law, which they now have. Despite this, high level government offices are not engaging appropriately with the native title body and Malgana people on occasions that Ministers are on the ground. As was stated in the work, that ‘it is not the Malgana Aboriginal Corporation’s or Malgana Peoples’ responsibility to educate the government about engagement. The Malgana Aboriginal Corporation has been established under western legislation, and it is the Minister’s office’s responsibility to notify the Malgana Aboriginal Corporation they are coming (on to Gathaagudu – Shark Bay)’.

Learnings about co-design

Through co-design with Malgana People, the team came to realise their role in supporting collective knowledge creation in the project and into the future by delivering tools that can continue to be added to and refreshed. In the post-workshop reflections, the team members critically questioned their roles and actions. Team members asked how they could do things

differently for the next workshop, and how to participate to deliver a meaningful outcome for Malgana People within the boundaries of their research questions and project timeline.

The co-design approach was established in the first workshop. The research team defined and refined their role throughout the project to facilitate the building of the tools, check in on the research process and the relevance and usefulness of the project outputs, support the summarising of discussions, and test potential interactions with western science.

Co-design in this project inherently had tensions of delivering multiple outcomes, securing free, prior informed consent within the limited timeframe, working with the Malgana Aboriginal Corporation as it navigated western governance alongside customary ways of working, and incorporating western science in a way that supports the dialogue and knowledge building Malgana People wanted to achieve.

The team learnt that in engaging in multiple knowledge sharing processes, the time needed to support free, prior, informed consent processes to create communication products was limited. However, the co-design project created Malgana knowledge products and strengthened collective knowledge, both of which can assist Malgana People in their joint management of Gathaagudu.

The Malgana cultural strategies developed in the project address the capability to respond to climate change and changes happening in and around Gathaagudu, rather than specific climate responses. Accordingly, the cultural strategies were developed through a Malgana defined process where the Malgana Aboriginal Corporation selection of workshop participants secured diverse Malgana capability which also ensured accountability to customary relationships. Collective knowledge sharing and capability building emerged as the two Malgana priorities for managing change. All the tools developed in the co-design project were designed to work alongside and interact with on-ground and other knowledge sharing and creation processes of the Malgana People.

Co-design in this project involved the project team re-negotiating the project deadlines with NESP to align with the governance capability and timing of Malgana Aboriginal Corporation. Co-design also needed the right people from both the customary and western Malgana Aboriginal Corporation institutions and the rangers to be involved in the workshop. Co-design from an outsider perspective involved learning of and being aware of the wider accountability of Malgana People. To secure accountability, the team sought additional funding outside of NESP Climate Systems Hub to ensure the right people, as identified by Malgana board members, participated in the workshop and that the opportunity to share knowledge was shared among Malgana People, some people attended only one or two workshops. Accountability also involved producing two project newsletters to be shared with wider Malgana membership who didn't attend the workshop.

The nature of co-design means it evolves with partners' capabilities at a particular time and the institutional arrangements into which the outcomes of co-design outcomes can flow. The confluence of the project timing with the joint management planning process between the Malgana Aboriginal Corporation and WA Department of Biodiversity, Conservation and Attractions facilitated the consideration of the project outputs in the ongoing discussion between the Malgana Aboriginal Corporation and department. The knowledge products will

be available for the Malgana Aboriginal Corporation to use in its joint management of the Shark Bay World Heritage Area.

Only some of the outputs from a co-design process will be made public, as is the nature of Free Prior Informed Consent and in safeguarding Indigenous Cultural Intellectual Property. These conditions can make the communication of the successful delivery of a project challenging. In this project, more time was needed to properly discuss and build understanding of the risks and benefits of sharing information from the co-design project and the conditions for consent. It is possible that if the project collaboration worked with fewer knowledge sharing tools, more time could have been invested in the Free Prior Informed Consent process to support the sharing of greater information from the collaboration.

Considerations for Adapting Seasonal Calendar in the Future

Indigenous Peoples are observing and expressing changes to their seasons, including changes to the timing synchronicity and intensity of seasonal events (for examples see Carmichael, B. et al., 2017, Hill, R. et al., 2020, Lyons et al., 2020, Nursey-Bray, M. et al., 2019, Petheram, L. et al. 2010). These changes are yet to be incorporated into published calendars.

This project provides a set of guiding questions, based on Prober et al. (2021), to assist Indigenous Peoples to review their seasonal indicators and seasonal cycles in a 10-15 year cycle, or when People deem it appropriate to refresh their seasonal calendar (the set of questions will form part of a future project endeavour of the team). The questions refer to plants, animals, insects and to changes to their presence and absence, as can be seen below.

What changes have you seen in:

- Birds, butterflies or other insects appearing earlier or later than you expected?
- Fish, turtles, dugongs, whales, shellfish or other migrating marine animals appearing earlier or later than usual?
- Unusual number of plants or animals – a lot more or a lot less?
- Unusual numbers of plants or animals dying?
- Plants flowering, fruiting or growing at unusual times?
- The number of new trees or shrubs?
- Plant or animal species disappearing from the area on land and at sea?
- Plant or animal species arriving in the area on land and at sea?
- Unusually high levels of pests or diseases in plants or animals?

The set of broad questions are designed to assist groups to consider the particular animals and plants that are part of their seasonal calendar and other significant changes they are observing on Country (see Appendix A).

Reflections on the collaborative co-design and connections with the climate change toolkit for World Heritage properties in Australia

Malgana People hold a variety of perspectives about climate change and the appropriate actions and pathways to manage the drivers and impacts of change. There is deep experience and knowledge within the Malgana group of people who have lived through seasonal variations, extreme weather events and environmental recovery. The project team did not seek to convince people or reach an agreement about climate change or the effects

of climate change. The team shared information on the potential effects of climate change and worked to hold the different perspectives about climate change among Malgana People, while progressing to establish strategies that address Malgana perspectives of risk to their values and relationship to Gathaagudu.

The project attended to inter-dependent values and relationships of Malgana People with their Country within the Shark Bay World Heritage Area property. This project did not focus on the Shark Bay outstanding universal value, but Malgana values through the knowledge sharing tools - seasonal calendar, mapping of places and activities on Country, a timeline that included events on Gathaagudu, weather, Malgana-related actions and other externally driven actions. Knowledge sharing through the Malgana seasonal calendar, yarning about changes and events on Country, the mapping of Country and the discussion about things that are of importance in the asset- change-persistence cycle, collectively provide the canvas for discussion about relational values and risk management responses. The asset change-persistence cycle combines the discussions about change and persistence and cascading consequences and centralise relational values – to people, ancestor, future generations, and Country. The Malgana cultural strategies focused on building capability within the Malgana group to address and to be ready to respond to the impacts of a changing climate and to development.

Collectively the knowledge sharing tools supported a holistic approach, to record information that more appropriately reflect peoples' relationships, to assist the collective recovery, retention and practice of Indigenous knowledge and to establish knowledge tools that are appropriate to the way Malgana choose to work together. The Malgana seasonal calendar, map and timeline can sit alongside western science and tools in dialogue to develop response strategies in a changing environment and climate, which was how they were applied in this project. The asset change-persistence cycle can be utilised and adapted by Malgana or by their research and joint management partners to identify values-focused management actions.

Workshop participants mainly spoke of significant changes relating to increased tourism and development that have reduced access to places in Shark Bay and increased damage to Country. A potential knowledge gap on climate information and data in the Shark Bay World Heritage Area is the cumulative effects of climate change on the effects of recreational and fishing, which are already a concern to Malgana Traditional Custodians.

Conclusion

This project took a strengths-based and knowledge-building approach. Three foundation-setting knowledge-sharing tools, a timeline, seasonal calendar, and country mapping, were adopted; Malgana Traditional Owners identified the latter two. The timeline evolved from a timeline of recorded average temperatures and rainfall. An asset change-persistence cycle, adapted from the change-persistence tool in the World Heritage Area Tool Kit, assisted the team in facilitating a discussion about changes to or persistence of values and identifying values-focused management actions.

The Malgana timeline and cultural map show that Malgana People have lived through and are managing multiple changes on Country. Some of these changes continue to directly and

immediately affect access to Country, such as new development interest in Denham. Others are a continuing and ongoing concern, such as the salt mine and the increasing number of 4WDs and boats on Gathaagudu – Shark Bay, which potentially have a cumulative consequence on the health of Country, and the effects of European settlement. The environmental impact of a changing climate, such as marine heatwaves, exacerbates and adds to the existing challenges, as well as decisions about where to invest and direct limited Malgana resources and capabilities. The Malgana seasonal calendar and map offer two knowledge resources that can assist Malgana in their joint management of the Shark Bay World Heritage Area.

The research question for this project was, *"How, why, and under what conditions does the approach of Indigenous-led tools for two-way sharing of Western and Indigenous knowledge of climate risk improve the participation of Indigenous peoples in understanding and using climate information for Indigenous-led adaptation planning?"* We answer this question below.

Climate-related risks for Malgana People first relate to strengthening their cultural, on-ground, institutional, and organisational capabilities to secure their priorities and values in the Shark Bay World Heritage Area joint management. Climate information can be useful in Malgana-led planning when Malgana knowledge, governance, and resources are mobilised through its institutions to work alongside Western science knowledge. This relationship necessitates sustaining and strengthening Malgana Peoples' way of knowing and knowledge-building. The project co-created tools that facilitated Malgana Peoples' knowledge revival, retention, sharing, and practice. The tools can continue to be developed by Malgana People to mobilise Malgana cultural knowledge for joint decision-making.

The tools link to the cosmological context of Malgana knowledge and support the holistic nature of Malgana customary practice. The knowledge tools and products created under this project can continue to be mobilised under the cultural strategies developed by the Malgana People and the guidance of the Malgana protocols.

This project's second phase coincided with the negotiation and establishment of the joint management agreement between the West Australian Government and the Malgana Aboriginal Corporation. The project results could be considered within the joint management and agreement-making arrangement that recognises and supports the inclusion of Malgana values, priorities, customary rights, and interests in the management of the Shark Bay World Heritage Area.

This project was undertaken when other climate-related projects were underway. One is the ongoing seagrass research project, which involves a long-term relationship with the Malgana Rangers. This important research has both ecological and cultural significance. The seagrass project builds local capability. In addition, this project introduced six-month projections, within the context of longer-term historical and projected changes in Gathaagudu - Shark Bay. This project demonstrated through its approach that climate information is useful when it can be meaningfully adopted within an Indigenous lens of Country-based planning - that is holistic, takes into account the relationships of people who need to be part of knowledge building and the related customary obligations and responsibilities, building capability to assist people to address the multiple causes of change that are their ability to care for their customary lands and seas, potential economic

partnerships and it considers the different ways that group members engage with the concept of climate change and their experiences of seasonal change.

APPENDIX A – Questions to aid the review and record change in the Malgana Seasonal Calendar

1. What changes have you seen in birds, butterflies or other insects appearing earlier or later than you expected?												
What appears (<u>write</u> type in box – different colours)	Birds				Butterflies				Other insects			
Appeared EARLIER than expected												
Appeared LATER than expected												
DID NOT appear at all												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When do they normally appear?												
When do they appear now?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

1. What changes have you seen in birds, butterflies or other insects appearing earlier or later than you expected?												
What appears (<u>write</u> type in box – different colours)	Birds				Butterflies				Other insects			
Appeared EARLIER than expected												
Appeared LATER than expected												
DID NOT appear at all												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When do they normally appear?												
When do they appear now?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

2. What changes have you seen in fish, turtles, dugongs, whales, shellfish or other migrating marine animals appearing earlier or later than you expected?												
What appears (<u>write</u> type in box – different colours)	Appeared EARLIER				Appeared LATER				DID NOT appear at all			
Fish												
Turtles												
Dugongs												
Whales												
Other migrating marine <u>animal</u>												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When do they normally appear?												
When do they appear now?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

3. What unusual changes have you seen in the number of animals?												
More	Less				Both more and less							
Are these animals native to Shark Bay?	Native				Non-native				Don't know			
List of animals increasing												
List of animals decreasing												
List of animals both increasing and decreasing												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When did the changes occur?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

4. What unusual numbers of plants or animals dying have you seen?												
More deaths	Less deaths						More and less for different species at different times or places					
Are these animals native to Shark Bay?	Native			Non-native			Don't know					
List of animals dying more												
List of animals dying less												
List of animals dying more and less												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When do they normally die?												
When are they dying now?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

5. What plants flowering, fruiting or growing at unusual times have you seen?												
Are these plants native to Shark Bay?	Native			Non-native			Don't know					
List of plants Use different colour for each plant												
	MILD			MODERATE			STRONG					
How severe was the change												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Normally flowers												
Flowers now												
Normally fruits												
Fruits now												
Normally grows												
Grows now												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

6. What changes have you see in the number of new trees or shrubs?												
Are these plants native to Shark Bay?	Native				Non-native				Don't know			
List of plants Use different colour for each plant												
How severe were these changes	MILD				MODERATE				STRONG			
More than expected new trees (T) or shrubs (S) appeared												
Less than expected new trees (T) or shrubs (S) appeared												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When do they normally appear												
When do they appear now												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

7. What changes have you seen in plants dying ?												
Are these plants native to Shark Bay?	Native				Non-native				Don't know			
List of plants Use different colour for each plant												
How severe were these changes?	MILD				MODERATE				STRONG			
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When did they die?												
If they normally die off when does this usually happen?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

8. What plants or animals disappearing from the area have you seen?												
Are these plants/animals native to Shark Bay?	Native				Non-native				Don't know			
List of plants/animals Use different colour for each plant												
	MILD				MODERATE				STRONG			
How severe were these changes?												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When do you normally see them												
When was the last time you saw them												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

9. What different plants or animals arriving in the area have you seen?												
Are these plants/animals native to Shark Bay?	Native				Non-native				Don't know			
List of plants/animals Use different colour for each plant												
	MILD				MODERATE				STRONG			
How severe were these changes?												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When did they arrive?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

10. What unusually high or low levels of pests or diseases have you seen?												
Are these pests or diseases native to Shark Bay?	Yes				No				Don't know			
List of pests and diseases												
	MILD				MODERATE				STRONG			
How severe is the infestation?												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When did it/ does it occur?												
What do you think caused changed the change?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

11. What changes in the seasons have you seen?												
	Yes				No				Don't know			
Have you seen the seasons change over the last 10 years?												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
When did the rain occur in the past?												
When does the rain occur now?												
What was the hottest time in the past?												
When is the hottest time now?												
When did the storms occur in the past?												
When do the storms occur now?												
How did this change impact Malgana people?												
Did this change affect any other plants or animals?												
Comments:												

References

- Australian Bureau of Statistics website. [Denham 2021 Census All persons QuickStats](#) accessed 25 November 2024.
- Carmichael, B., Wilson, G., Namarnyilk, I., Nadji, S., Brockwell, S., Webb, B., Hunter, F. & Bird, D. 2017. Local and Indigenous management of climate change risks to archaeological sites. *Mitigation and Adaptation Strategies for Global Change*, 23, 231-255.
- Federal Court of Australia (2018) Oxenham on behalf of the Malgana People v State of Western Australia [2018] Federal Court of Australia. 91 pp.
- Fogarty, W., Lovell, M., Langenberg, J., & Heron, M.-J. (2018). Deficit discourse and strengths-based approaches: Changing the narrative of Aboriginal and Torres Strait Islander health and wellbeing, viii.
- Heron, S.F., Day, J.C., Cowell, C., Scott, P.R., Walker, D., & Shaw, J. (2020). *Application of the Climate Vulnerability Index for Shark Bay, Western Australia*. Western Australian Marine Science Institution. <https://wamsi.org.au/cvi-shark-bay>
- Hill, R., Walsh, F. J., Davies, J., Sparrow, A., Mooney, M., Council, C. L., Wiser, R. M. & Tengo, M. 2020b. Knowledge co-production for Indigenous adaptation pathways: Transform post-colonial articulation complexes to empower local decision-making. *Global Environmental Change-Human and Policy Dimensions*, 65.
- Lyons, I., Hill, R., Deshong, S., Mooney, G. & Turpin, G. 2020. Protecting what is left after colonisation: embedding climate adaptation planning in traditional owner narratives. *Geographical Research*, 58.
- Mahood, Kim. 2011 Mapping outside the square: cultural mapping in the south-east Kimberley. *Aboriginal History* 30:1.
- Mooney, Meg; Walsh, Fiona; Hill, Ro; Davies, Jocelyn; Sparrow, Ashley; Central Land Council, undefined; Ltyentye Apurte Rangers, undefined. Climate Change: Learning about what is happening with the weather in central Australia. Alice Springs: CSIRO; 2014. csiro:EP143572. <https://doi.org/10.25919/v5qh-n91>
- McNamara, K., Westoby, R. and Parnell, K. (2010) Elders' and Aunties' Experiences of Climate on Erub Island, Torres Strait. Final Project Report to the Marine and Tropical Sciences Research Facility. Published online by the Reef and Rainforest Research Centre Limited, Cairns (24pp.)
- Morgan-Bulled D, McNear B, Delaney D, Deshong S, Gilbert J, Mosby H, Neal DP, Puntoriero J, Wilson J, Fourmile G, Singleton G, Bullio R, Hill R, Hopkins M, Pearce K, Schmidt S, Sheppard M, Austral B, Baldwin L, Bell N, Bligh P, Bonython-Ericson S, Bradley C, Brandy S, Butler L, Carlise M, Carter M, Catt G, Clohessy S, Clubb R, Clubb T, Cooper S, Cowen T, Ewart A, Fitzpatrick N, Flugge K, Fourmile J, Fraser J, Gardner D, Gould J, Green J, Hapke C, Hooper B, Hughes Z, Hunter B, Hunter C, Joesph D, Kaddy C, Kerinauia M, Ketchell J, King T, Langworthy L, Lawrence M, Lee L, Locke J, Long C, Longcaric H, Longcaric P, Ludwick H, Maluwapi W, Mann N, Markham R, , McGuire O, McNear N, Morgan A, Morgan D, Muller S, Mummery A, Murray P, Neal J, Neal M, Ramsay H, Rattling Leaf Snr R, Rose E, Shelton G, ShovellorSesar W, Singleton T, Smith J, Syme L, Talbot A, Talbot L, Tamu K, Tanna R, Taylor S, Telford A, Villaflor S, Webb T, Williams K, Wingfield G,

Woosup J, Wren L, Canadell P, Chand S, Chung C, Evans J, Holbrook N, Karoly D, Kirono D, Marsland S, McInnes K, O'Grady J, Graham, LM, Jackson G, Pirzl R, van Velden J, Williams R. 2021. National First Peoples Gathering on Climate Change: Workshop Report. Earth Systems and Climate Change Hub Report No. 29. Earth Systems Climate Change Hub, Australia. Published. June, 2021

Nursey-Bray, M., Palmer, R., Smith, T. F. & Rist, P. 2019. Old ways for new days: Australian Indigenous peoples and climate change. *Local Environment*, 24, 473-486.

Petheram, L., Zander, K. K., Campbell, B. M., High, C. & Stacey, N. 2010. 'Strange changes': Indigenous perspectives of climate change and adaptation in NE Arnhem Land (Australia). *Global Environmental Change*, 20, 681-692.

Prober, S. M., Raisbeck-Brown, N., Porter, N. B., Williams, K. J., Leviston, Z., & Dickson, F. (2019). Recent climate-driven ecological change across a continent as perceived through local ecological knowledge. *PLoS ONE*, 14(11).
<https://doi.org/10.1371/journal.pone.0224625>

Prehn, J. (2024). "An Indigenous Strengths-based Theoretical Framework." *Australian Social Work*.

Shire of Shark Bay website. <https://www.sharkbay.wa.gov.au/> accessed 01 December 2024.

Sinclair, E., Statton, J., Austin, R., Breed, M., Cross, R., Dodd, A., Kendrick, A., Siegfried, L., Krauss, L., McNeair, B., McNeair, N., McNeair, S., Oakley, M., Oakley, P., Oxenham, T., Pedrocchi, N., Roelofs, T., Wear, L., and Kendrick, A. 2024. Healing country together: A seagrass restoration case study from Gathaagudu (Shark Bay). *Ocean & Coastal Management*, 256. <https://doi.org/10.1016/j.ocecoaman.2024.107274>

Sutton, A.L. & Shaw, J.L. (2020) *A Snapshot of Marine Research in Shark Bay (Gathaagudu): Literature Review and Metadata Collation (1949-2020)*. Western Australian Marine Science Institution. <https://wamsi.org.au/shark-bay-literature-review>

For more information



www.nesp2climate.com.au



info@nesp2climate.com.au