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Kimberley Saltwater Monitoring Toolbox

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10 Bush Heritage Australia

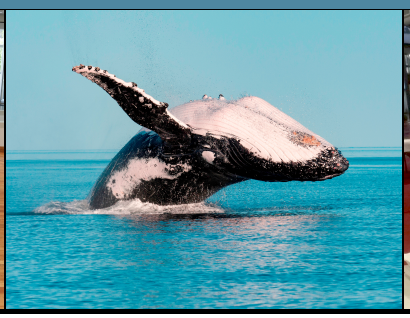
WAMSI Kimberley Marine Research Program

Final Report

Subproject 1.5.5

July 2017



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KARA JARRI RANGERS

BARDI JAWI RANGERS

NYUL NYUL RANGERS

DAMBIMANGARI RANGERS

WUNAMBAL GAAMBERA UUNGUU HEALTHY COUNTRY

BALANGGARRA RANGERS

YAWURU

CHARLES DARWIN UNIVERSITY

THE UNIVERSITY OF WESTERN AUSTRALIA

CSIRO

Kimberley Land Council

Mosaic Environmental

www.mosaicenvironmental.com.au

WAMSI Kimberley Marine Research Program

Initiated with the support of the State Government as part of the Kimberley Science and Conservation Strategy, the Kimberley Marine Research Program is co-invested by the WAMSI partners to provide regional understanding and baseline knowledge about the Kimberley marine environment. The program has been created in response to the extraordinary, unspoilt wilderness value of the Kimberley and increasing pressure for development in this region. The purpose is to provide science based information to support decision making in relation to the Kimberley marine park network, other conservation activities and future development proposals.

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Front cover images (L-R)

Image 1: Satellite image of the Kimberley coastline (Landgate)

Image 2: Indigenous Knowledge Group (L-R) (L-R) WAMSI Kimberley Marine Research Program Node Leader Stuart Field (DBCA), KISSP Project Leader Dean Matthews (Senior Project leader Yawuru for the last five years working closely with the state in developing the Yawuru conservation estate plans and the Yawuru Marine Park Plan), Manager Land and Sea Unit at Nyamba Buru Yawuru Julie Melbourne, report author Dr Rebecca Dobbs (UWA), report author Dr Beau Austin (CDU/CSIRO) and WAMSI Kimberley science coordinator Kelly Waples (DBCA) (Image: WAMSI)

Image 3: Humpback whale breaching (Image: Pam Osborn)

Image 4: Indigenous community representatives from the Karajarri and Yawuru peoples meet in Broome to workshop outcomes of the KISSP project at Notre Dame University Hall June 2016 (Image: WAMSI)

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Contents

Background

The Kimberley Indigenous Saltwater Science Project (KISSP) was a collaboration funded by the Western Australian Marine Science Institute (WAMSI) as part of their Kimberley Marine Research Program (KMRP). The KISSP was developed to improve the way natural and cultural resource management and research, involving Traditional Owners and the science community, is planned, assessed and undertaken on Kimberley Saltwater Country. Saltwater encompasses the traditional lands of saltwater peoples and includes the coastline, islands, and the seabed and marine environment (Lincoln et al, 2017). The KISSP was guided by a Working Group comprised of representatives from seven Kimberley saltwater groups (Balanggarra, Wunambal-Gaambera, Dambimangari, Bardi-Jawi, Nyul Nyul, Yawuru and Karajarri) and a project team, comprised of the University of Western Australia (UWA), Charles Darwin University (CDU), Kimberley Land Council (KLC) and Mosaic Environmental. The KISSP Working Group determined the project team based on their specific skills and capacity, including their experience working with Traditional Owners in the Kimberley Region.

The project objectives were identified by the Working Group to ensure a focus on local priorities and aspirations. The objectives sought to address some of the challenges experienced by researchers, Traditional Owners and Indigenous ranger groups when conducting saltwater research and monitoring activities. Through collaborations with the Kimberley Prescribed Body Corporate, Traditional Owners and Indigenous ranger teams, the KISSP aimed to:

1. Integrate Indigenous ecological knowledge and management practices into Kimberley marine conservation and management,
2. Develop a standard research protocol for land and sea research in the Kimberley,
3. Develop a framework for marine monitoring in the Kimberley, including development of a training package for agreed research targets for rangers.

This report forms part of the KISSP outputs (specifically related to Objective 3) and provides a:

Ranger Saltwater Monitoring Toolbox

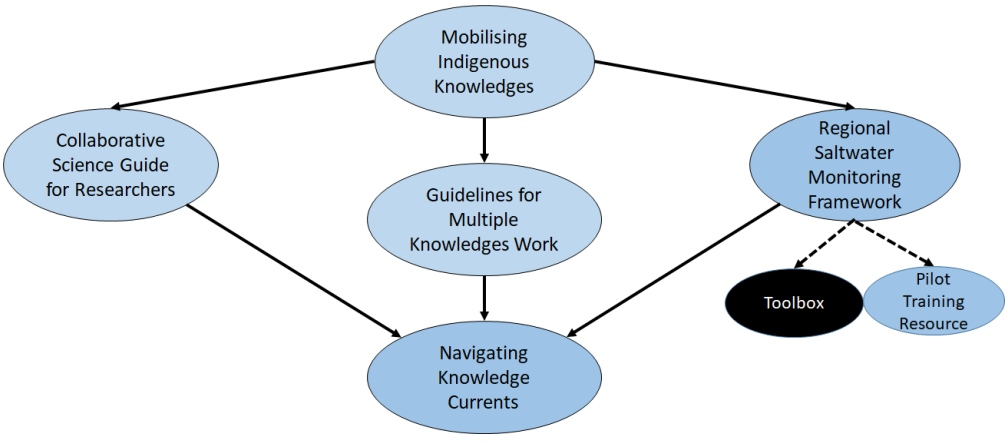


Figure 1 Products developed under KISSP and their alignment

Another two products were developed as part of KISSP Objective 3 and these should be read together with this report:

- *A Regional Framework for Saltwater Monitoring in the Kimberley*
- *Pilot Training Resource: Saltwater Monitoring Fundamentals – Building a Knowledge Base Together*

The work presented in these reports is closely aligned with the products produced for Objective 1 and Objective 2 of the KISSP. A summary of all of the KISSP outputs including insights gathered through the KISSP have been provided in a Navigating Knowledge Currents report, to guide and support the on-going development of collaborative research, management and monitoring in Kimberley Saltwater Country (Austin et al 2017a). All KISSP products can be accessed at: http://www.wamsi.org.au/research-site/indigenous-knowledge.

1. Introduction

Through the WAMSI Kimberley Indigenous Science Project (KISSP), Kimberley saltwater Traditional Owner groups identified a need to look at the current status of monitoring and research, and how this could be brought together to assist in developing a broader regional strategy for planning and management of saltwater country. A strategic national framework for monitoring and capacity building was seen by the KISSP Working Group as valuable for creating a collective voice on issues and a standard comparable approach to monitoring to allow knowledge sharing and robust Traditional Owner (TO) and Western Science (WS) management. In response, a strategic regional monitoring framework (Figure 1) was developed (Dobbs et al 2017) that accounts for the diverse features and challenges in Kimberley Saltwater Country as well as the need to engage both traditional and western science knowledge bases. The framework is based on a common adaptive management approach and relies on the results of local monitoring processes and results being fed into a broader regional planning and management framework (increasing the relevance and benefits).

Figure 2 shows how these two processes (regional and local scale) interact and are acknowledged under the framework, allowing Ranger groups to:

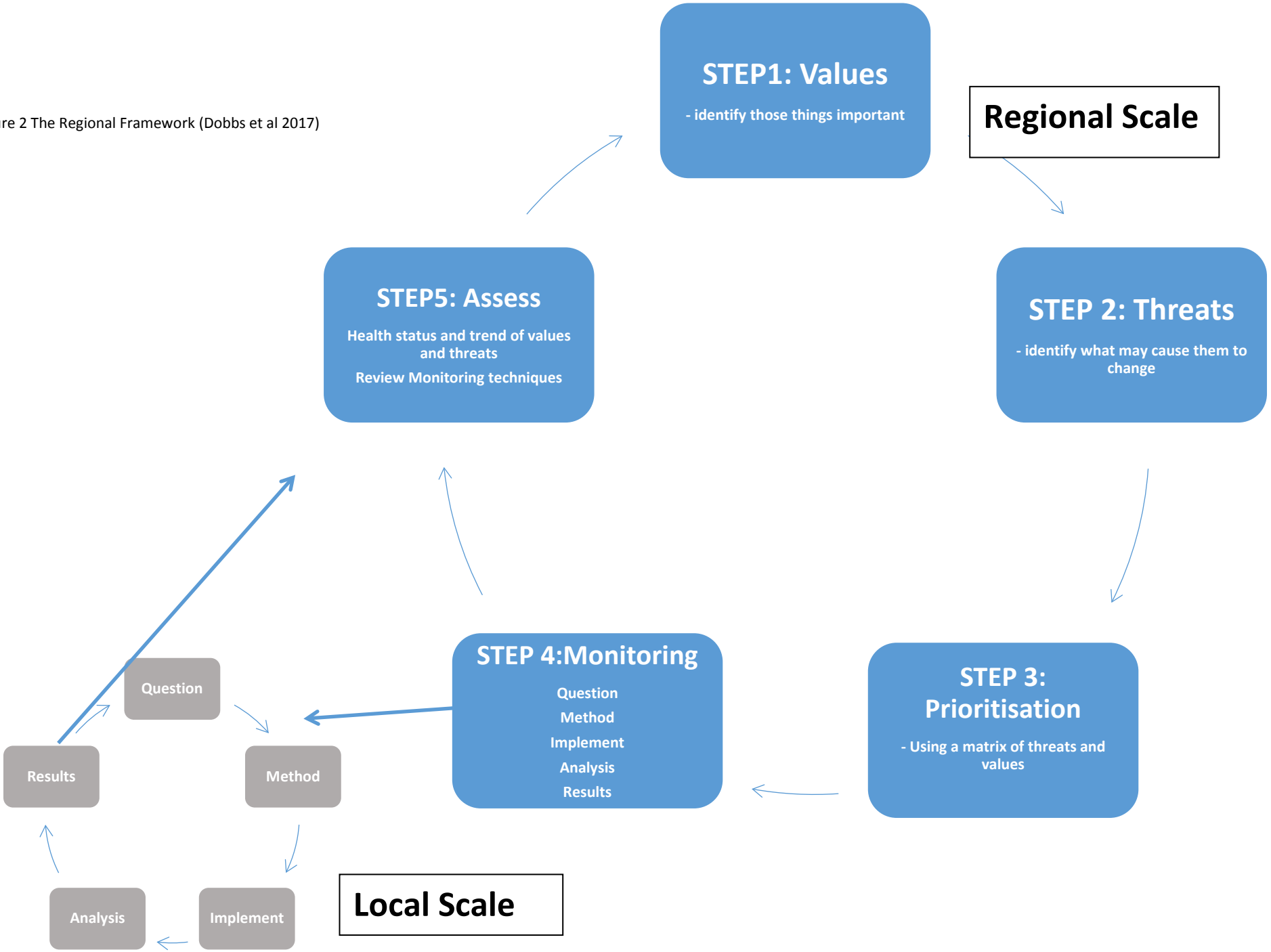
1. Monitor and report at a local scale
2. Inform regional monitoring and priority setting

This approach ensures that the saltwater groups are able to build on existing monitoring without significantly increasing their work load. The approach, integrates the activities groups are currently doing at a local scale and uses this to answer questions at a regional scale.

The framework includes five 'steps' that have been developed to align with a multiple evidence-based approach (e.g. Austin et al. 2017) ensuring that there are opportunities for both western science and Indigenous knowledge to inform the monitoring program. The framework adopts an approach that is sensitive to the local aspirations, obligations and threats to people and country (integrated landscape), rather than an ecosystem approach typical of conservation planning. However, due to the scope of project design by Working Group, a saltwater focus has been necessary.

Following a trial of the framework, and a review of current monitoring and research in the Kimberley (Appendix 1), a number of products were developed and are presented in this report. The report comprises seven 'tools' (Figure 3) one of which is a toolbox of methods to assist in choosing and implementing on-ground monitoring methods. These tools have been compiled to support implementation of the Framework. For more information on how the framework was developed see: *A Regional Framework for Saltwater Monitoring in the Kimberley* (Dobbs et al 2017).

Figure 2 The Regional Framework (Dobbs et al 2017)



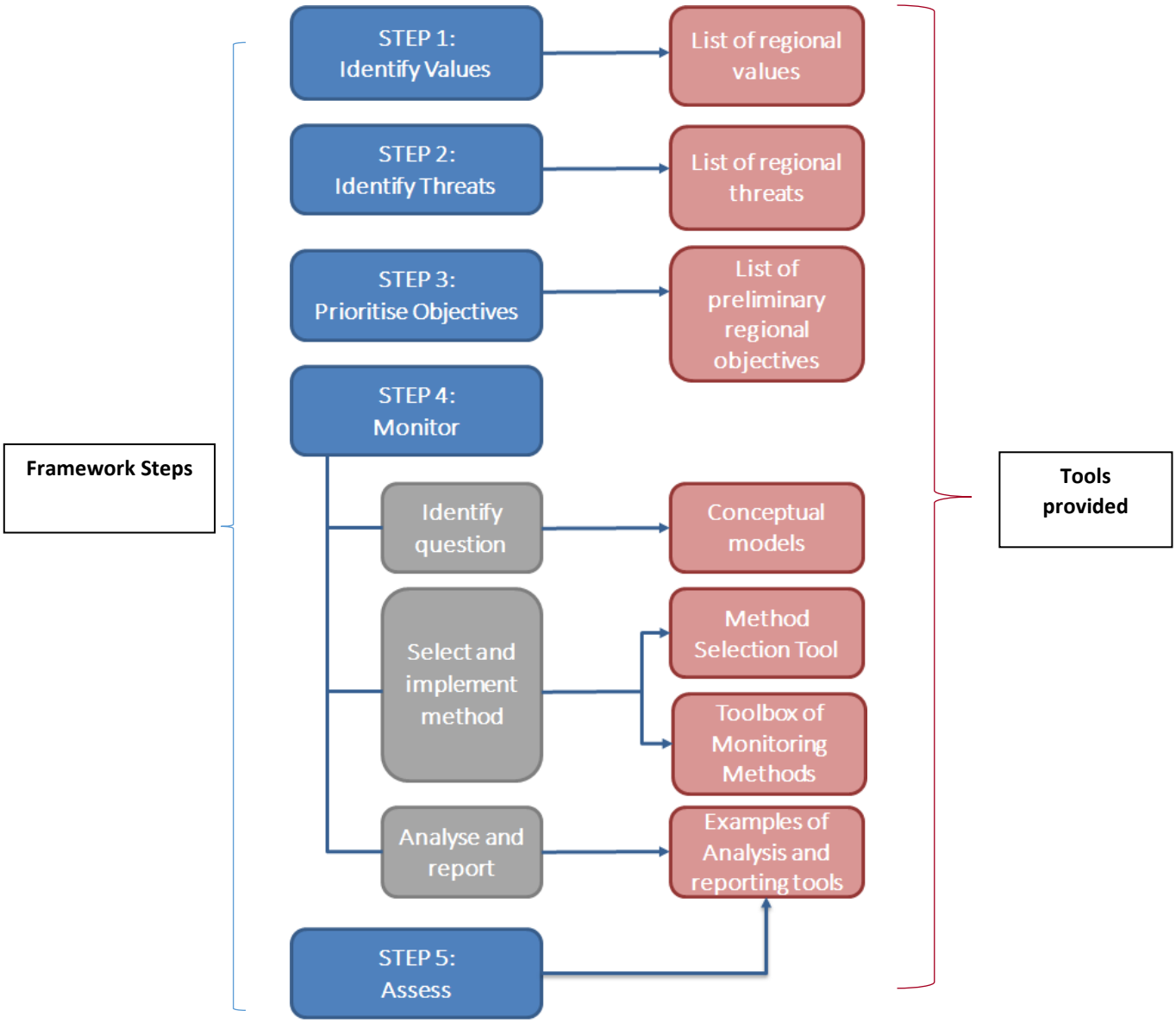
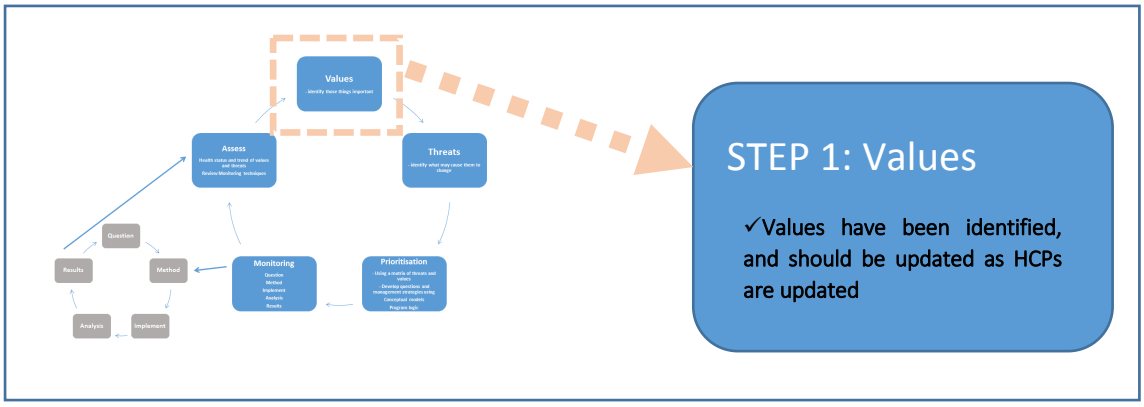


Figure 3 Tools provided to assist with each step of the monitoring framework

2. The Framework

STEP 1 – Identifying Values

Clearly defining regional values (those things important to you) is the first step towards identifying and prioritising the things you may need to monitor and manage at a regional scale.



Regional Values Tool – Regional values, defined following a review of HCPs and workshops with TO's, were systematically grouped into six categories. The categories incorporate ecological, cultural and social values. The values identified within 'Cultural practices' are interconnected and relevant to all other values. This table is the first step in identifying what you may need to manage and monitor at a regional scale and these values should be updated as HCPs are reviewed and updated.

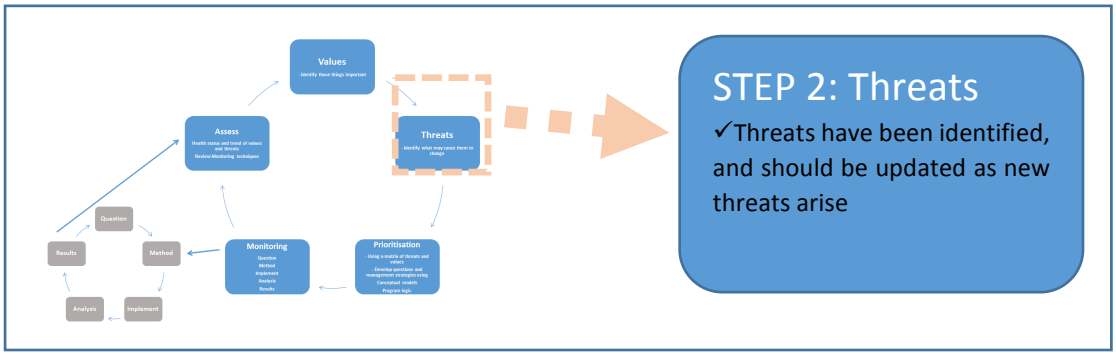
SALTWATER COUNTRY VALUES*		
CULTURAL PRACTICES *Law, ceremony, living on country, customary fishing/hunting, seasonal knowledge, storytelling, enjoyment of country, making hunting tools, language, intergenerational transfer of knowledge, responsibility for country, medicine, protocols, spiritual and physical connections*	**SALTWATER FOOD AND RESOURCES**	*Fish, shellfish, squid and octopus, sharks and rays, turtles, dugongs*
	CONSERVATION TARGETS	*Shorebirds, dolphins, whales*
	SIGNIFICANT AREAS AND PLACES	*Burial, camping, fishing, middens, creation story, seascapes, fossils, maritime heritage, fish traps, law grounds, boundaries and location, tracks, cultural areas*
	LIVELIHOODS SALTWATER	*Land and sea management, nature /cultural based tourism, and commercial, customary, recreational fishing*
	SALTWATER HABITAT	*Saltwater (currents tides and quality), beaches, rocky headlands, intertidal mudflats, freshwater, Submerged springs, mangroves, saltmarsh, reefs, seagrass, deep sea, near shore pools, non-resource or conservation species***

*"Values" are also referred to as "Targets" in some HCPs

**species that do not have a utility or conservation value have been placed under saltwater country

STEP 2 – Identifying Threats

Identifying current and potential threats to your values will assist with prioritising monitoring and management actions that can be undertaken to mitigate threats (and hence protect values)

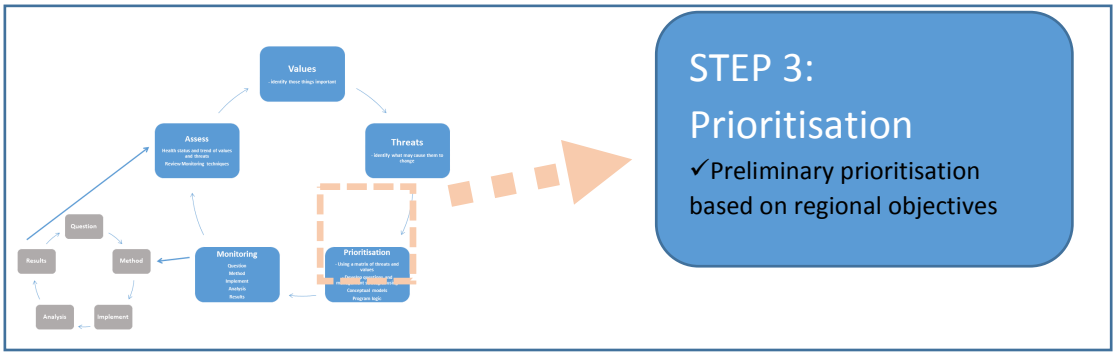


Threat Identification Tool - Regional threats were defined for each of the regional values following a review of HCPs and workshops with TO's. Threats include those more familiar to WS and those related to cultural protocols, connection and obligations to country (i.e. access to country, presence on country).

SALTWATER COUNTRY THREATS		
CULTURAL PRACTICES *Laws/ protocols & advice not being respected, lack of resources to access country reduced practicing of law on country and connections, lack of knowledge transfer (lost knowledge), Government policies (culturally inappropriate), lack of cultural programs in mainstream education*	**SALTWATER FOOD AND RESOURCES**	*Climate change, weeds, pollution, human pressure (overfishing- commercial, recreational and customary fishers, & development), marine pests, unmanaged animals (destroying nests, egg predation)*
	CONSERVATION TARGETS	*Climate change, pollution (oil spills, debris), commercial, recreational and customary fishers (by-catch, boat strikes)*
	SIGNIFICANT AREAS AND PLACES	*Unmanaged visitors (damage, lack of respect), insufficient resources for accessing and managing country, lack of knowledge transfer (lost knowledge)*
	LIVELIHOODS SALTWATER	*Lack of accessibility to country (transport to visit country), lack of cultural knowledge transmission, human pressure (overfishing- commercial recreational and customary fishers, & development)*
	SALTWATER HABITAT	*Development (GW abstraction, pollution), climate change, marine pests & debris, erosion, weeds, inappropriate access (locals and tourists), boats (damage, pollution)*

STEP 3 – Prioritising Monitoring

You can't monitor everything. Time, money and resources are limited and therefore you need to prioritise those things you want to manage and monitor –a matrix of threats and values, can help you decide on those things most important to monitor (and manage)



Prioritisation Tool: Based on a ranking of threats and values in HCP's undertaken by each group, common monitoring objectives and management strategies across the region were identified to define preliminary regional priorities. These common objectives and strategies were refined to five regional objectives that could be achieved through cooperation amongst groups throughout the region.

Objective 1: TO's and Rangers have access to western science, cultural and indigenous knowledge about plants animals and culture (producing and using)

Objective 2: Sustain animal populations (through managing customary harvest, and both human and introduced threats) – (workshops and HCPs indicate that the highest priorities currently being turtles, dugongs and fish)

Objective 3: Maintain biodiversity and habitats (most groups were at the stage of wanting to know more about the range of habitats, and an increasing concern across groups about coral bleaching)

Objective 4: Maintain the health and condition of cultural sites

Objective 5 Maintain cultural practices and meet obligations to country (rules for governing country)

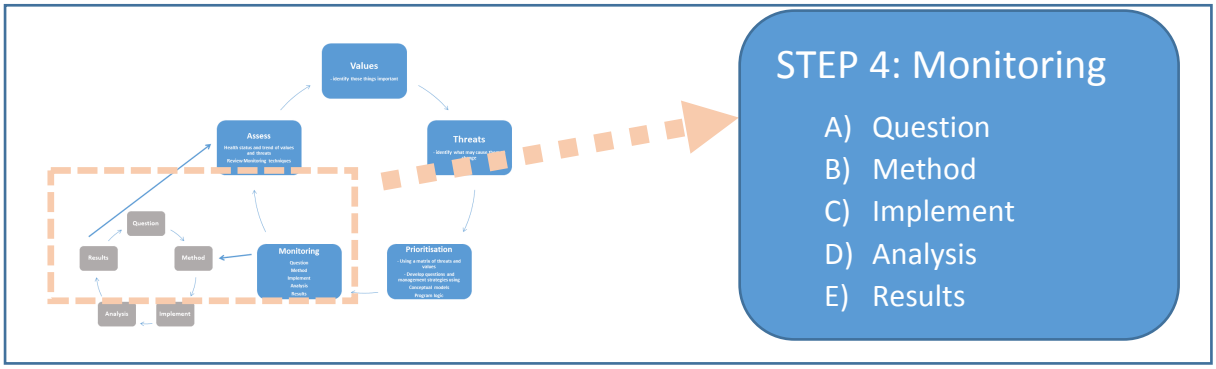
There is currently a strong focus on localised monitoring of values. Figure 4 demonstrates that by focusing on objectives, rather than values, monitoring and management strategies are expected to have positive outcomes for multiple regional values. (i.e. maintaining cultural values is relevant to all six regional value categories). By taking this approach, groups can also chose indicators (which are often values) to answer multiple questions (see example in STEP 4 "Defining the Question" section below).

Figure 4 Regional objectives and the values that they address

	VALUES					
OBJECTIVES	**Saltwater Food and Resources**	**Conservation**	**Significant Areas and Places**	**Livelihoods Saltwater**	**Saltwater Habitat**	**Cultural Practices**
Objective 1: TO's and Rangers have access to western science, cultural and indigenous knowledge about plants animals and culture (producing and using)						
Objective 2: Sustain animal populations (through managing customary harvest, and both human and introduced threats) (priorities turtle, dugong, fish)						
Objective 3: Maintain biodiversity and habitats						
Objective 4: Maintain the health and condition of cultural sites						
Objective 5: Maintain cultural practices and meet obligations to country (rules for governing country)						

STEP 4 – Monitoring

As regional priorities have been derived from local priorities, local monitoring can be used to inform regional monitoring. To ensure that this is effective, local monitoring should be following an adaptive management framework with questions clearly defined, results analysed, and monitoring and management actions evaluated.



Within STEP 4, three tools have been developed to assist with defining the question, choosing and implementing methods, and analysis and interpretation of results. These tools are designed to assist groups to focus on the objectives rather than the values and can be of benefit at both the local and regional scales.

The framework highlights that groups need to define their questions first before implementing monitoring tools. Saltwater monitoring, as a means to measure Ranger management effectiveness, is currently limited. The tools assist groups to focus on objectives, and that way groups can implement strategies to achieve these objectives and monitor values to measure the effectiveness of these strategies. It is important that ranger groups identify whether they are managing local scale threats effectively to ensure that time and resources are being efficiently allocated (adaptive management). Without this, then groups are:

- Less able to demonstrate effectiveness of management actions
- Less able to learn from experience and across projects
- Risk duplicating efforts and reinventing the wheel
- Not able to gauge the extent to which funds are well spent, and ultimately
- Less able to show funding bodies utility in supporting the work (Hockings, 2006; TNC.2005)

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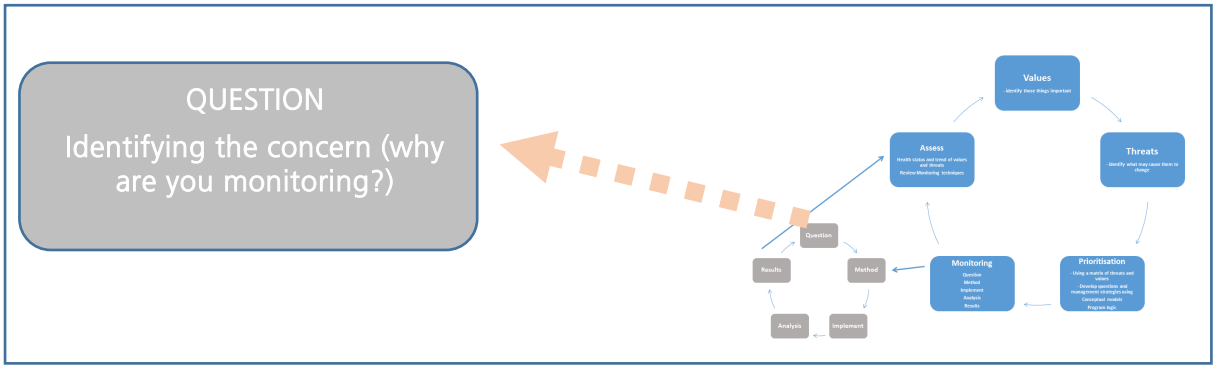
A) Defining the QUESTION

Before starting any monitoring work, make sure it is clear what question you are asking and what type of answer will be most useful to informing how you look after Saltwater Country



Preliminary Conceptual models (diagrams) have been constructed for three of the Regional Objectives (Figure 5, 6 and 7).

- **Objective 2** Sustainability of animals (through managing customary harvest, and both human and introduced threats)
- **Objective 3** Maintaining biodiversity and habitat saltwater country habitats
- **Objective 5** Maintaining the health of cultural practices and meeting obligations to country (rules for governing country)

These models were developed from the regional values, threats and objectives identified in Step 1 to Step 3 of the framework. The models demonstrate the complex interactions between pressures (threats) and the potential impact on values, and provide an opportunity to combine both ecological and cultural attributes and threats. They can be used to identify those things that could be monitored based on the objectives and strategies (rather than focussing on measuring every value in the HCPs), including:

- Which strategies or management actions will have multiple benefits for your values,
- What change you may expect to observe if you reduce the pressure on your value,
- Which values you can use as "indicators" (something you measure that indicates the state or level) to determine if your management strategies are effective

By approaching monitoring in this way groups can consider effectiveness monitoring which addresses the question: "Are our management actions having their intended impact?" and not just status (or baseline) monitoring which focuses solely on answering the questions: "How are the values we care about doing?" and "How are threats to these values changing?" (TNC, 2005).

A key limitation expressed by Ranger coordinators was that time and resources are limited and that Ranger groups require assistance in taking the next step to ensure that their local monitoring plans are directed by objectives and strategies (and include monitoring effectiveness) and monitoring data is assessed. The conceptual models produced for KISSP can be used to develop results chains or program logic, for designing monitoring plans. Results chains are pictures that explain how the work is going to be done to achieve objectives and make values healthier. They help identify the steps along the way that groups need to look at to see if they are doing their work, providing an opportunity to measure progress. They also help to clearly articulate the link between the management action being implementing and the change that is expected in the value. With this approach it is then easy to see what requires monitoring in order to evaluate management effectiveness. There are a number of references (Margoluis 2013; FOS 2007) or computer packages that can assist with this (e.g. Miradi https://www.miradi.org/). It can also be easily achieved by sitting around a large sheet of butchers paper with Traditional Owners and additional stakeholders (including scientists and managers). Table 1 provides one example of how to outline the different monitoring required to ensure that once you decide on your objective, you are monitoring the progress of your work strategies (outputs), the outcome of your strategies and the impact it is having on your value or objective (also see Monitoring and Evaluation Case Study at STEP 5).

	Output					Output					Output				
	method	**indicator**	**strategy**	**unit**	**who**	**method**	**Indicator**	**strategy**	**Unit**	**who**	**method**	**indicator**	**strategy**	**unit**	**who**
e.g. Strategy about controlling weeds that are impacting nesting success	Weed control on nesting beaches	Weed control undertaken	Weed control	Ranger days	Rangers	Monitoring of weed control effectiveness by weed monitoring	Weed cover on nesting beaches	Quadrants	Weed cover on dunes	Rangers	Nest counts	Turtle nesting success		Successful nesting	Rangers

Table 1 An example of the monitoring required to ensure that you can evaluate both the progress of your work, the outcomes of this work and the impact that it is having on your objective (this process is undertaken once you have chosen an objective and then a strategy to achieve your objective using the conceptual models below)

Figure 5 Preliminary conceptual models demonstrating the complex interactions between pressures, potential Impacts and values for Objective 2.

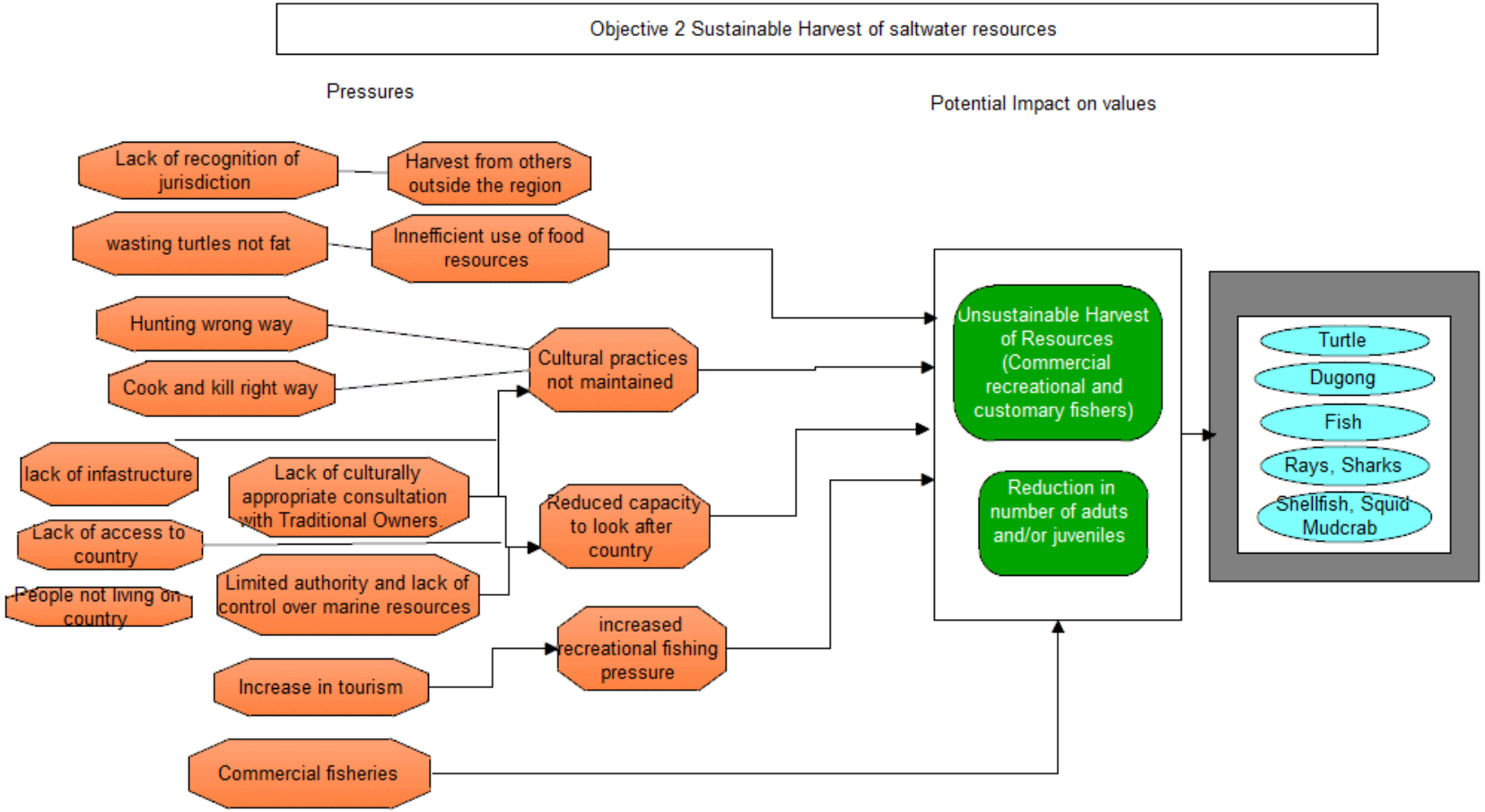


Figure 6 Preliminary conceptual models demonstrating the complex interactions between pressures, potential Impacts and values for Objective 3.

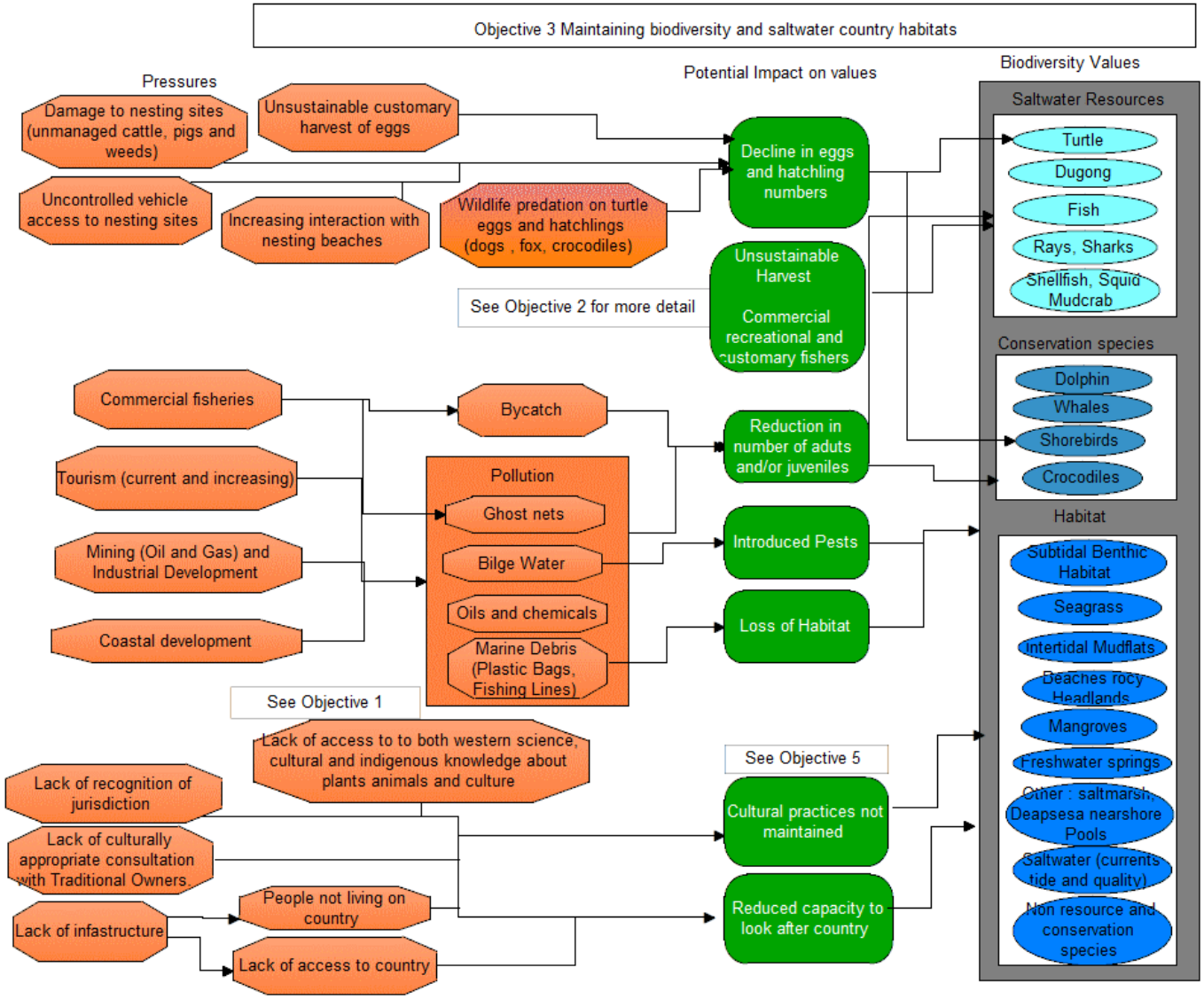
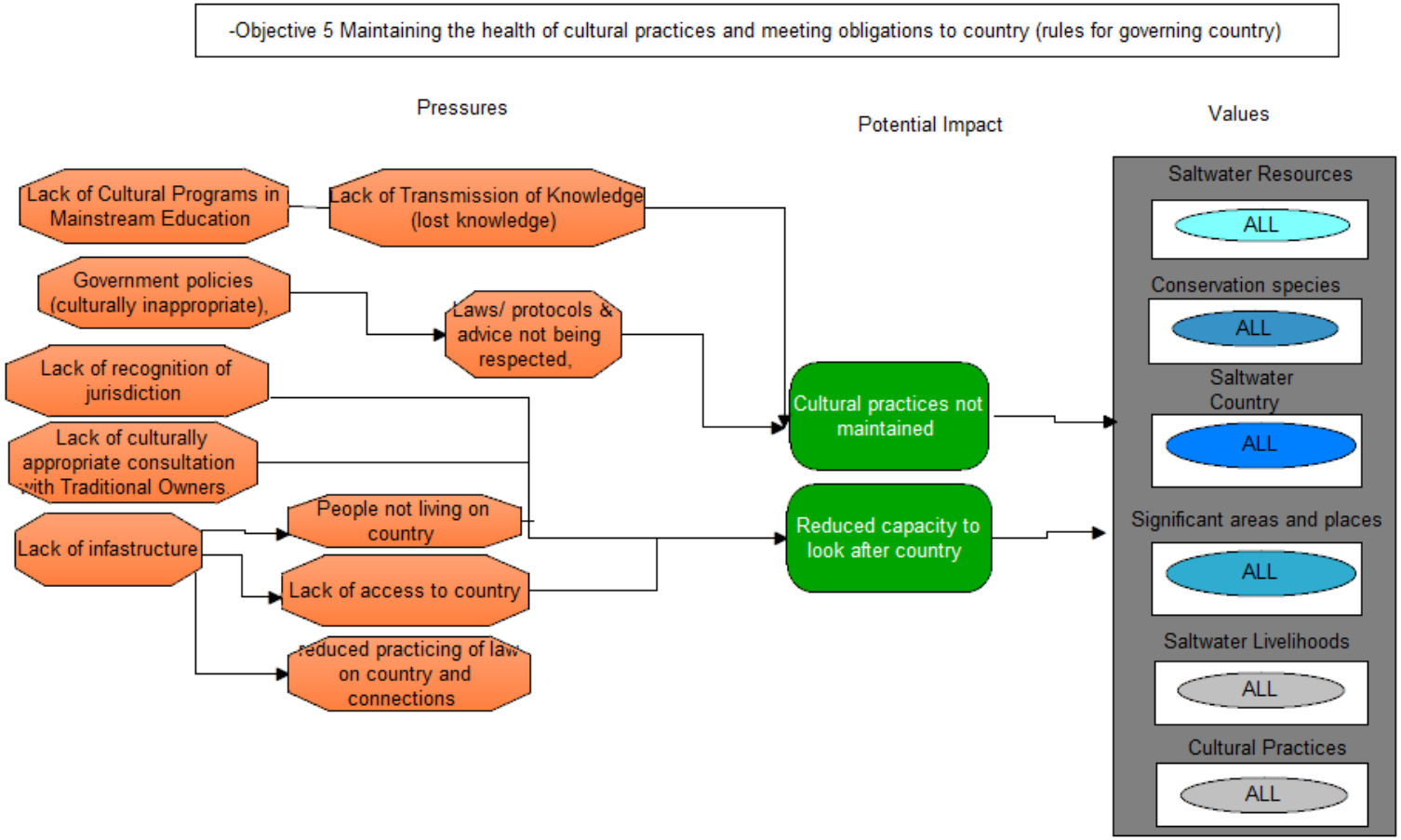
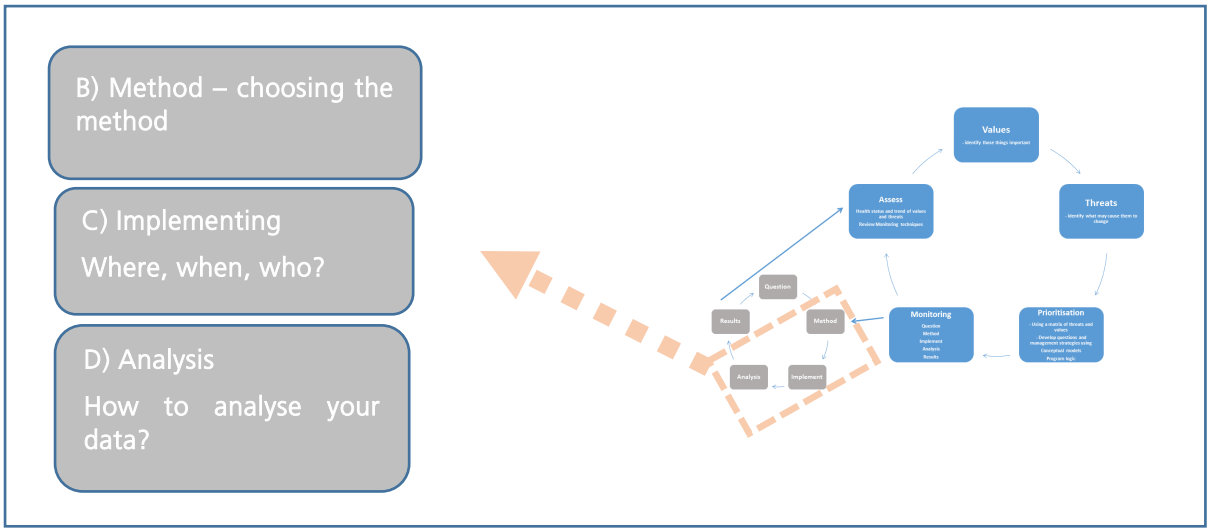


Figure 7 Preliminary conceptual models demonstrating the complex interactions between pressures, potential Impacts and values for Objective 5.


-Objective 5 Maintaining the health of cultural practices and meeting obligations to country (rules for governing country)
Pressures
Potential Impact
Values
Lack of Cultural Programs in Mainstream Education
Lack of Transmission of Knowledge (lost knowledge)
Government policies (culturally inappropriate),
Laws/ protocols & advice not being respected,
Lack of recognition of jurisdiction
Lack of culturally appropriate consultation with Traditional Owners
Lack of infastructure
People not living on country
Lack of access to country
Reduced practicing of law on country and connections
Cultural practices not maintained
Reduced capacity to look after country
Saltwater Resources
ALL
Conservation species
ALL
Saltwater Country
ALL
Significant areas and places
ALL
Saltwater Livelihoods
ALL
Cultural Practices
ALL

B) C) D) Choosing and implementing the Method, and Analysing the Results



A toolbox of monitoring methods has been developed to provide groups with a summary of techniques and tools available for monitoring of saltwater country and how to access information on these techniques (including data recording, analysis tools etc). The advantages of this Toolbox approach include that it:

1. Provides an opportunity for groups to share techniques and tools
2. Supports standardisation of techniques across the region by increasing the likelihood that groups will adopt techniques that align with others (rather than reinventing monitoring approaches and techniques)
3. Assists groups with monitoring at both the local and regional scale
4. Provides an opportunity to incorporate both WS and IK monitoring to support decision making (i.e. aligns with the multiple evidence based approach (Austin et al 2017))
5. Provides information on where tools are required and where researchers can assist in developing new tools

It is important that Ranger groups recognize that choosing a method is only one step in the monitoring process (Figure 2) and needs to be incorporated in an adaptive management framework with questions clearly defined, results analysed, and monitoring and management actions evaluated. This toolbox of methods should therefore be used with caution, with monitoring techniques developed and/or chosen with a clear understanding of why groups are monitoring (Dobbs eta l 2017). (See the conceptual models and examples in the previous section A) Defining the Question, for tools to assist with defining the question and assessing the Results).

3.1 Summary Information on how to use the toolbox

- **Based on the questions you want to answer (developed from step A above), chose a MONITORING TOOL using Table 1.**

- **The table is colour coded to distinguished between the tools that measure ecological and cultural attributes and also those tools considered research monitoring (currently used to answer a specific research question) or appropriate for longer-term status and effectiveness monitoring**

Ecological Attributes (Long Term Monitoring)
Ecological Attributes (Research Monitoring)
Cultural Attributes

- **The table highlights which tools are available and which groups are using the techniques.**

Regional Value - Saltwater Resources

Specific Value - Turtles

SALTWATER TOOLBOX TABLE 1: CHOSE A MONITORING TOOL (BASED ON YOUR QUESTION)

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL
SALTWATER RESOURCES			
TURTLES	What is the status of turtle population numbers?	BOAT BASED SURVEYS (transects)	WG, Dambi, Bardi
		CUSTOMARY HARVESTS	NN. Dambi, Bardi
		PARTICPATORY RANKING	-
		PARTICIPATORY MAPPING	-
	Are populations genetically different?	GENETICS	Bardi, NN
	Is Indigenous knowledge for turtles being used?	PARTICPATORY RANKING	-

Information about what tool can help you to answer your question and who is using the tool

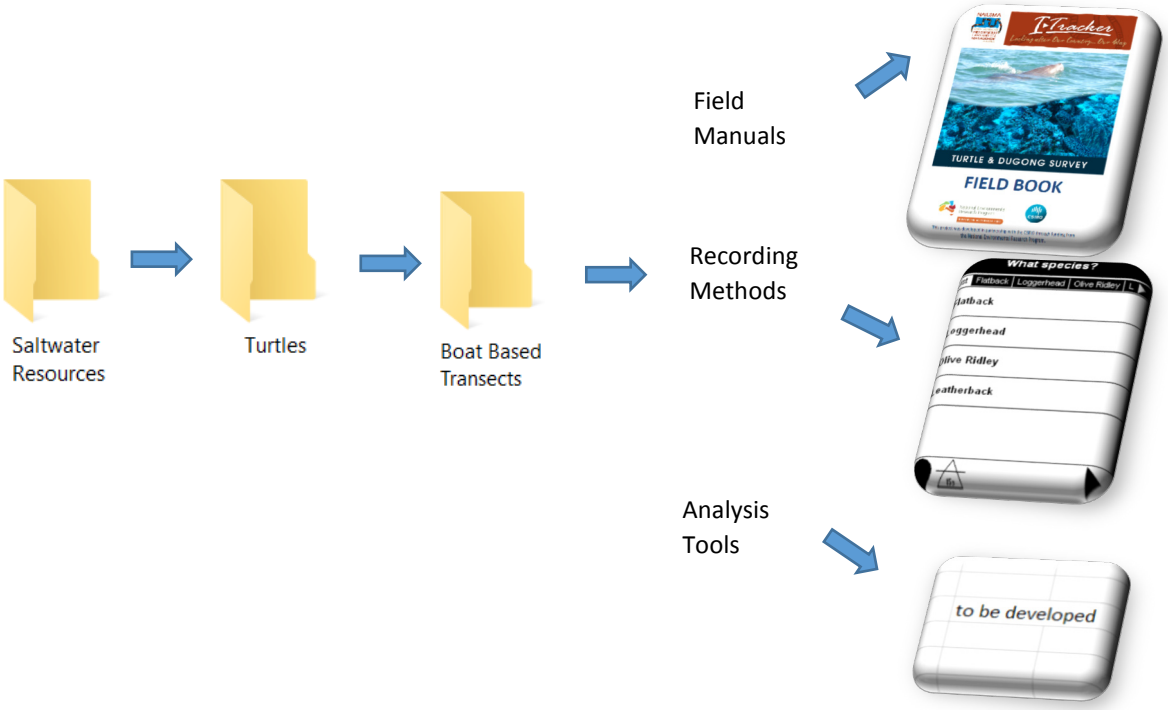
- **"The Toolbox" of methods (Table 2) assists groups in choosing which monitoring tool to adopt. For each tool it provides a summary of the knowledge systems incorporated, the recording method, information on trials and development and also if tools are available to assist with analysing the monitoring results.**

SALTWATER TOOLBOX TABLE 2: WHAT INFORMATION IS CURRENTLY AVAILABLE FOR EACH TOOL

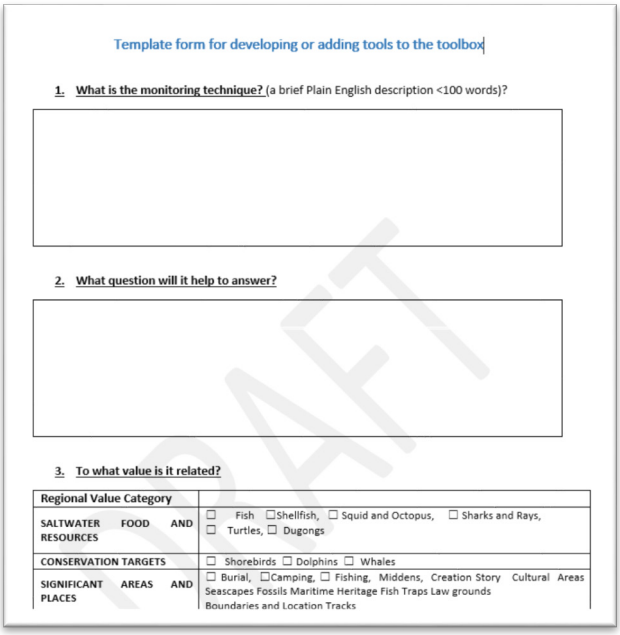
VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS
TURLTES	BOAT BASED SURVEYS (transects)	IK/WSK	Changes in adult and juvenile turtle numbers at selected sites	**I-tracker** - Turtle and Dugong Survey application NAILSMA (2015) - Field Manual	Developed by NAILSMA and CSIRO and trialled with WG Uunguu Rangers and Dambi Rangers NAILSMA (2013) - Field Trials Jackson et al (2015) - Field Trip Report	Analysis spreadsheet currently developed for WG (would require adapting for use by other groups) **Main Contact - Peter Bayliss CSIRO**

- **Participatory techniques that haven't been trialled in Saltwater monitoring have been included in the toolbox, providing an opportunity to incorporate both WS and IK monitoring to support decision making (i.e. aligns with the multiple evidence based approach (Austin et al 2017)).**

- **"The Toolbox" (Table 2) is linked to an electronic copy of files and folders where you can access the information/tools that are available**



- **A template has also been developed to assist researchers with the steps and information they need to consider when developing and adding tools to the toolbox**



Template form for developing or adding tools to the toolbox

1. **What is the monitoring technique?** (a brief Plain English description <100 words)?

2. **What question will it help to answer?**

3. **To what value is it related?**

Regional Value Category	
SALTWATER FOOD AND RESOURCES	☐ Fish ☐Shellfish, ☐ Squid and Octopus, ☐ Sharks and Rays, ☐ Turtles, ☐ Dugongs
CONSERVATION TARGETS	☐ Shorebirds ☐ Dolphins ☐ Whales
SIGNIFICANT AREAS AND PLACES	☐ Burial, ☐Camping, ☐ Fishing, Middens, Creation Story Cultural Areas Seascapes Fossils Maritime Heritage Fish Traps Law grounds Boundaries and Location Tracks

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SALTWATER TOOLBOX TABLE 1: CHOSE A MONITORING TOOL (BASED ON YOUR QUESTION)

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
SALTWATER FOOD AND RESOURCES			
TURTLES	What is the status of turtle population numbers?	BOAT BASED SURVEYS (transects) CUSTOMARY HARVESTS PARTICPATORY RANKING PARTICIPATORY MAPPING	WG, Dambi, Bardi NN, Dambi, Bardi - -
	Is customary harvest of turtles sustainable?	BOAT BASED SURVEYS (transects) CUSTOMARY HARVESTS PARTICPATORY RANKING	WG, Dambi, Bardi NN. Dambi, Bardi -
	What is the status of turtle nesting?	SALTWATER PATROL PARTICPATORY RANKING PARTICIPATORY MAPPING	NN Kar, Balan - -
	Are pressures on turtle populations changing?	VISITOR ACCESS PASS RANGER COASTAL PATROLS CUSTOMARY HARVESTS NAQS PATROL and TANGAROA BLUE PARTICPATORY RANKING	WG, Dambi, Kar NN, Dambi, Bardi NN. Dambi, Bardi WG, Kar, Balan, NN, Dambi, Bardi -
	Are populations genetically different?	GENETICS SAMPLING	Bardi, NN, WG, Balan, Dambi, Bardi, nn, Yaw, Kar
	What are their nesting habits and distribution?	TURTLE NEST and TRACK SURVEYS PARTICIPATORY MAPPING CUSTOMARY HARVESTS ART STORIES	ALL - - - -
	What is the movement of Turtles, and where do turtles come from?	SATELLITE TAGGING PARTICIPATORY MAPPING ART STORIES	Bardi, Dambi - - -
	Are adult turtles healthy?	VIRUS SAMPLING CUSTOMARY HARVEST INDIGENOUS INDICATORS OF HEALTH	Bardi - -
	What are the potential impacts of climate change on turtle nesting?	NEST SURVEYS	Dambi, WG, Yaw, Kar, Balan, NN, Bardi
	Are the right people making decisions about the management of turtles?	INTERVIEWS FOCUS GROUP DISCUSSIONS PARTICPATORY RANKING CUSTOMARY HARVESTS	- - - -

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
TURTLES	Is Indigenous knowledge for turtles being used?	KNOWLEDGE HOLDER INTERVIEWS	-
	Is Indigenous knowledge for turtles being passed on?	KNOWLEDGE HOLDER INTERVIEWS	-
	Do the right people have access for hunting turtles?	PARTICIPATORY MAPPING INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
	Are local Indigenous people sharing turtle resources in the right way?	KNOWLEDGE HOLDER INTERVIEWS INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
	Are turtles being consumed in the right way?	KNOWLEDGE HOLDER INTERVIEWS INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
DUGONG	How do I refine my Dugong research questions and select monitoring techniques to answer them?	DUGONG & SEAGRASS RESEARCH TOOLKIT	-
	What is the status of dugong population numbers?	BOAT BASED SURVEYS (transects) CUSTOMARY HARVESTS AERIAL SURVEYS PARTICPATORY RANKING SALTWATER PATROL	WG, Dambi, NN. Dambi, Bardi WG, Dambi, Balan - NN
	Is customary harvest of dugong sustainable?	BOAT BASED SURVEYS (transects) CUSTOMARY HARVESTS AERIAL SURVEYS PARTICPATORY RANKING KNOWLEDGE HOLDER INTERVIEWS FOCUS GROUP DISCUSSIONS	WG, Dambi, Bardi NN. Dambi, Bardi - - - -
	Are pressures on dugong populations changing?	VISITOR ACCESS PASS RANGER COASTAL PATROLS CUSTOMARY HARVESTS NAQS PATROL and TANGAROA BLUE PARTICPATORY RANKING	WG, Dambi NN, Dambi, Bardi NN. Dambi, Bardi WG, Kar, Balan, NN, Dambi, Bardi -
	What is the status of Dugong habitat (seagrass)?	SEAGRASS WATCH TRANSECTS SEAGRASS BOAT BASED TRANSECTS PARTICPATORY RANKING KNOWLEDGE HOLDER INTERVIEWS	Yaw, Bardi, Kar, NN WG, Bardi - -

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
DUGONG	What is the movement and behaviour of Dugongs, and where do Dugongs come from?	SATELLITE TAGGING	Bardi
		SALTWATER PATROLS	-
		PARTICIPATORY MAPPING	-
		CUSTOMARY HARVESTS	-
		ART	-
		STORIES	-
	Are the right people making decisions about the management of dugong?	INTERVIEWS	-
		FOCUS GROUP DISCUSSIONS	-
		PARTICPATORY RANKING	-
		CUSTOMARY HARVESTS	-
	Is Indigenous knowledge for dugong being used?	KNOWLEDGE HOLDER INTERVIEWS	-
	Is Indigenous knowledge for dugong being passed on?	KNOWLEDGE HOLDER INTERVIEWS	-
	Do the right people have access for hunting dugong?	PARTICIPATORY MAPPING	-
		INTERVIEWS	-
		FOCUS GROUP DISCUSSIONS	-
	Are local Indigenous people sharing dugong resources in the right way?	KNOWLEDGE HOLDER INTERVIEWS	-
		INTERVIEWS	-
		FOCUS GROUP DISCUSSIONS	-
FISH	What is the status of fish population numbers?	CUSTOMARY HARVESTS	-
		DROP DOWN CAMERAS	Dambi
	And	BAITED/UNBAITED REMOTE UNDERWATER VIDEO SYSTEM (BRUVS)	Bardi
	Where are the fish nursery grounds and biodiversity hotspots?	PARTICIPATORY MAPPING	-
	Are the pressures on fish changing?	VISITOR ACCESS PASS	WG, Dambi
		RANGER COASTAL PATROLS	NN, Dambi, Bardi
		CUSTOMARY HARVESTS	NN. Dambi, Bardi
		NAQS PATROL and TANGAROA BLUE	WG, Kar, Balan, NN, Dambi, Bardi
		RECREATIONAL FISHING	Balan, Dambi
		RANGER PATROLS OF FISH KILLS	NN
	What is the behaviour and movement of fish?	GENETICS SAMPLING	-
		TAGGING (ACOUSTIC)	Bardi
		BAITED/UNBAITED REMOTE UNDERWATER VIDEO SYSTEM (BRUVS)	-
	Are the right people making decisions about the management of fish?	INTERVIEWS	-
		FOCUS GROUP DISCUSSIONS	-

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
		PARTICPATORY RANKING CUSTOMARY HARVESTS	- -
FISH	Is Indigenous knowledge for fish being used?	KNOWLEDGE HOLDER INTERVIEWS	-
	Is Indigenous knowledge for fish being passed on?	KNOWLEDGE HOLDER INTERVIEWS	-
	Do the right people have access for customary fishing?	PARTICIPATORY MAPPING INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
	Are local Indigenous people sharing fishing resources in the right way?	KNOWLEDGE HOLDER INTERVIEWS INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
SHELLFISH	What is the status and distribution of blood cockles?	BENTHIC INVERTEBRATE QUADRATS	Yaw
	Are Trochus populations discreet?	GENETIC SAMPLING	-
	Are pressures on Throchus populations changing?	HARVEST LICENSES (SHELL TONNAGE REMOVED)	-
SALTWATER HABITATS			
BENTHIC_CORAL_INTERTIDAL	What is the distribution of intertidal habitats and are they changing? What is the distribution of nearshore benthic (bottom) habitats and are they changing?	DROP DOWN CAMERA (BOAT BASED) DROP DOWN CAMERA TRIPOD INTERTIDAL REEF QUADRATS TRANSECTS	Dambi, WG - Kar NN
	Are there any pollutants in sediments?	SEDIMENT SAMPLING	Dambi, WG, Nyul Nyul (Trials)
	What is the underwater habitat composed of?	DROP DOWN CAMERA (BOAT BASED) PARTICIPATORY MAPPING	Dambi, WG, Nyul Nyul (Trials) -
	Are the distribution and proportion of invertebrates on mud flats changing?	BENTHIC INVERTEBRATE MAPPING	Yaw, Kar
	What is the extent of coral Bleaching	DROP DOWN CAMERA (BOAT BASED)	Dambi, WG
SEAGRASS	What is the status of seagrass?	SEAGRASS WATCH TRANSECTS BOAT BASED TRANSECTS PARTICPATORY RANKING	Yaw, Bardi, Kar, NN WG, Bardi -

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
	What is the growth rate and productivity of seagrass?	SEAGRASS GROWTH AND PRODUCTIVITY RESEARCH	Bardi
	What is grazing on (eating) seagrass?	BLOOD SAMPLES AND PHOTOGRAPHY TO DETERMINE SEAGRASS GRAZING	Bardi
FRESH-WATER	What is the health of freshwater habitats?	VEGETATION TRANSECTS KNOWLEDGE HOLDER INTERVIEWS	NN NN, Bardi
ALL SALTWATER HABITATS	Are there any pollutants in the water?	WATER QUALITY SAMPLING	Dambi, WG, NN (Trial)
	Are the pressures on conservation species changing?	VISITOR ACCESS PASS RANGER COASTAL PATROLS NAQS PATROL and TANGAROA BLUE	WG, Dambi NN, Dambi, Bardi WG, Kar, Balan, NN, Dambi, Bardi
	Are the right people making decisions about the management of saltwater habitats?	INTERVIEWS FOCUS GROUP DISCUSSIONS PARTICPATORY RANKING CUSTOMARY HARVESTS	- - - -
	Is Indigenous knowledge for saltwater habitats being used?	KNOWLEDGE HOLDER INTERVIEWS	-
	Is Indigenous knowledge for saltwater habitats being passed on?	KNOWLEDGE HOLDER INTERVIEWS	-
	Do the right people have access to saltwater habitats?	PARTICIPATORY MAPPING INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
CONSERVATION			
SHOREBIRDS	What is the status of shorebird population numbers?	SHOREBIRD SURVEYS	Kar, Yaw
	What are the pressures on shorebirds?	LOCAL PRESSURES MONITORED	NN
DOLPHINS	What is the status of Dolphin population numbers?	BOAT BASED SURVEYS SALTWATER PATROL	Yaw, Dambi, Balan -
	Are populations genetically different?	GENETIC SAMPLING	Yaw
WHALES	What is the status of whale population numbers and distribution?	BOAT BASED SURVEYS SHORE SURVEYS PARTICIPATORY MAPPING PARTICIPATORY RANKING	Dambi NN - -

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
CROCODILES	What is the status (numbers and distribution) of crocodile populations?	SHORE BASED SPOTLIGHT SURVEYS BOAT BASED SPOTLIGHT SURVEYS	NN, Yaw, Dambi Dambi
	Where are problem crocodiles located?	SALTWATER PATROL LOCAL SIGHTING FORMS	Bardi Dambi
ALL CONSERVATION SPECIES	Are pressures on conservation species changing?	VISITOR ACCESS PASS RANGER COASTAL PATROLS NAQS PATROL and TANGAROA BLUE	WG, Dambi NN, Dambi, Bardi WG, Kar, Balan, NN, Dambi, Bardi
	Is Indigenous knowledge for conservation species being used?	KNOWLEDGE HOLDER INTERVIEWS	-
	Is Indigenous knowledge for conservation species being passed on?	KNOWLEDGE HOLDER INTERVIEWS	-
SIGNIFICANT AREAS AND PLACES			
BURIAL, CAMPING, FISHING, MIDDENS, CREATION STORY, SEASCAPES, FOSSILS, MARITIME HERITAGE, FISH TRAPS, LAW GROUNDS, BOUNDARIES AND LOCATION, TRACKS, CULTURAL AREAS	What is the health status of cultural sites?	RANGER SALTWATER PATROLS PARTICPATORY RANKING KNOWLEDGE HOLDER INTERVIEWS	Balan, Yaw, Kar NN -
	Are pressures on cultural sites changing?	VISITOR ACCESS PASS RANGER COASTAL PATROLS NAQS PATROL and TANGAROA BLUE INTERVIEWS FOCUS GROUP DISCUSSIONS	WG, Dambi NN, Dambi, Bardi WG, Kar, Balan, NN, Dambi, Bardi - -
	What is the distribution of cultural sites?	MAPPING- SALTWATER PATROL MAPPING PARTICIPATORY MAPPING	NN, Dambi, Yawu -
	Do the right people have access to significant areas and places?	KNOWLEDGE HOLDER INTERVIEWS PARTICIPATORY MAPPING	-
	Do enough right people know about significant areas and places?	KNOWLEDGE HOLDER INTERVIEWS PARTICPATORY RANKING	-
	Are enough visits being undertaken to significant places by traditional owners and/or rangers	RANGER WOC & IPA REPORTING INTERVIEWS FOCUS GROUP DISCUSSIONS PARTICPATORY RANKING	- - - -
	Are significant areas and places being looked after according to law?	KNOWLEDGE HOLDER INTERVIEWS PARTICIPATORY MAPPING PARTICPATORY RANKING	- - -

VALUE	QUESTION	MONITORING TOOL	GROUPS USING TOOL*
	Are significant places and knowledge being recorded, made accessible, and passed on?	RANGER WOC & IPA REPORTING KNOWLEDGE HOLDER INTERVIEWS PARTICPATORY RANKING	ALL - -
CULTURAL PRACTICES			
LAW, CEREMONY, LIVING ON COUNTRY, CUSTOMARY FISHING/HUNTING, SEASONAL KNOWLEDGE, STORYTELLING, ENJOYMENT OF COUNTRY, MAKING HUNTING TOOLS, LANGUAGE, INTERGENERATIONAL TRANSFER OF KNOWLEDGE, RESPONSIBILITY FOR COUNTRY, MEDICINE, PROTOCOLS, SPIRITUAL AND PHYSICAL CONNECTIONS	What is the health of cultural practices?	PARTICPATORY RANKING KNOWLEDGE HOLDER INTERVIEWS INTERVIEWS FOCUS GROUP DISCUSSIONS	All (HCPS) - - -
	Is traditional knowledge on saltwater being recorded, saved and made accessible to TO's?	WOC & IPA REPORTING KNOWLEDGE HOLDER INTERVIEWS	ALL -
	Are people accessing, living and learning on country?	PARTICIPATORY MAPPING INTERVIEWS FOCUS GROUP DISCUSSIONS PARTICPATORY RANKING	- - - -
	Are people following customary protocols?	KNOWLEDGE HOLDER INTERVIEWS INTERVIEWS FOCUS GROUP DISCUSSIONS	- - -
	Is traditional dance being practiced and performed?	KNOWLEDGE HOLDER INTERVIEWS INTERVIEWS FOCUS GROUP DISCUSSIONS	- - - -
	What is the prevalence of language speakers?	INTERVIEWS FOCUS GROUP DISCUSSIONS PARTICPATORY RANKING	- - -
	The number of cultural events held on country?	WOC & IPA REPORTING PARTICPATORY RANKING	- -
	How many back to country trips are being undertaken?	WOC & IPA REPORTING PARTICPATORY RANKING	ALL -
	Are back to country trips involving young children?	INTERVIEWS FOCUS GROUP DISCUSSIONS	- -
SALTWATER LIVELIHOODS			
	A Lot of this monitoring is most likely undertaken at the PBC level, rather than at the Ranger level, and therefore not picked up in the Ranger monitoring surveys or workshops		

***NN** = Nyul Nyul**, Dambi =** Dambimangari, **Balan =** Balanggarra, **WG** = Wunambal-Gaambera, **Bardi** = Bardi-Jawi, **Yaw** = Yawuru and **Kar** =Karajarri

SALTWATER TOOLBOX TABLE 2: WHAT INFORMATION IS CURRENTLY AVAILABLE FOR EACH TOOL (Including WS and Participatory techniques)

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
SALTWATER RESOURCES						
TURTLES	**BOAT BASED SURVEYS (transects)**	IK/WSK	Changes in adult and juvenile turtle numbers at selected sites	I-Tracker - Turtle and Dugong Survey application NAILSMA (2015) - Field Manual	Developed by NAILSMA and CSIRO and trialled with WG Uunguu Rangers and Dambi Rangers NAILSMA (2013) - Field Trials Jackson et al (2015) - Field Trip Report	Analysis spreadsheet currently developed for WG (would require adapting for use by other groups) Main Contact - Peter Bayliss CSIRO
	CUSTOMARY HARVESTS	IK	Information on customary harvest	Participatory Ranger Interviews with hunters	Individual groups have developed their own recording sheets including: date, time, hunter, location and fat content	Not developed*
	SALTWATER PATROL	IK	Beach nesting surveys, Adult and juvenile turtle sightings, (sex, size, species and behaviour, injuries) Pressures including Ghost nets, animal deaths and feral animals	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Analysis tools within I-Tracker to map sightings
	VISITOR ACCESS PASS	WSK	Pressures: Visitor access numbers and location	Not developed	Various groups implementing or developing (WG, Karajarri and Dambi)	Not developed*
	RANGER COASTAL PATROLS	IK	Pressures: Visitor Access locations	Not developed	Not developed	Not developed*
	NAQS PATROL	WSK	Pressures: Marine Debris and Pests	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Not developed* Data provided fee for service
	TANGAROA BLUE	WSK	Pressures: Marine Debris	Tangaroa Blue Data Sheets	Tangaroa Blue (2012) Identification Manual	Not developed* Data provided fee for service
	GENETIC SAMPLING	WSK	Skin samples taken to determine the genetics of turtle populations	Data sheets or the I-Tracker – Saltwater Country Patrol	WAMSI 1.2.2 Project	Through partnership with researchers **Main Contact: Scott Whiting/DPaW**

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	TRACK SURVEYS	WSK	The number of tracks on beaches across locations and time using Aerial Photography or On-ground Counts	Researcher Data sheets or the I-Tracker – Saltwater Country Patrol	WAMSI 1.2.2 Project	Through partnership with researchers **Main Contact: Scott Whiting/DPaW**
TURTLES	**NEST SURVEYS**	WSK	The location and temperature of nesting sites	Data sheets or the I-Tracker – Saltwater Country Patrol	WAMSI 1.2.2 Some techniques could be turned into long term monitoring	**Main Contact: Scott Whiting (DBCA)**
	SATELLITE TAGGING	WSK	Movement and behaviour of turtles	Satellite Tracking and Analysis Tool (STAT) I-Tracker – Saltwater Country Patrol	Partnership between CSIRO, Bardi Jawi and DPAW Coyne et al (2005) – Paper on STAT	Through partnership with researchers **Main Contacts: Mat Vanderklift (CSIRO)**
	VIRUS SAMPLING	WSK	Turtles with virus and type of virus	Samples	Bardi undertaking sampling	Through partnership with researchers
	INDIGENOUS INDICATORS OF HEALTH	IK	Health of turtles	Data sheet	-	Not trialled*
	ART	IK	Nesting habits and distribution	Artwork	Examples in Kimberley include Mahood (2014) Fire Scar Mapping	Not trialled*
	PARTICIPATORY RANKING	IK	Population Health, Sustainability of Harvest, Health of cultural attributes associated with turtles, Changes in Pressures	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The status of turtle populations The distribution of turtle populations Nesting Habits and distributions	Drawings Topographic maps Digital maps GIS	Some mapping done under WAMSI 1.2.2 Scott Whiting (not specifically monitoring but information combined with other techniques to give a broader picture (ie MEB approach)	Not developed
	STORIES	IK	Many aspects of turtles and their habitats	Audio, video, drawings	See Vernes WWF (2016) Bilbies Paruku for an example	Not trialled*
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of turtles and their habitats held and maintained by knowledge holders	Written, video, audio	-	Not trialled*

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	INTERVIEWS	IK/WSK	Knowledge of turtles and their habitats	Written, video, audio	-	Not trialled*
	FOCUS GROUP DISCUSSIONS	IK/WSK	Knowledge of turtles and their habitats	Written, video, audio	-	Not trialled*
DUGONG	**DUGONG & SEAGRASS RESEARCH TOOLKIT**	WSK	Helps by guiding you to the techniques and tools most suitable to your team capacity, budget and timeline	N/A	The toolkit is available at http://www.conservation.tools/	N/A
	BOAT BASED SURVEYS (transects)	IK/WSK	Changes in adult and juvenile dugong numbers at selected sites	I-Tracker - Turtle and Dugong Survey application NAILSMA (2015) - Field Manual	Developed by NAILSMA and CSIRO and trialled with WG Uunguu Rangers and Dambi Rangers (Not enough animals for some groups to adopt this technique) NAILSMA 2013 - Field Trials Jackson et al 2015 - Field Trip Report	Analysis spreadsheet currently developed for WG (would require adapting for use by other groups) **Main Contact - Peter Bayliss CSIRO**
	CUSTOMARY HARVESTS	IK	Recording information on customary Harvest	Participatory Ranger Interviews with hunters	Individual groups have developed their own recording sheets including: date, time, hunter, location	Not developed*
	SALTWATER PATROL	WSK	Sightings (behaviour, size, numbers, sex)	I-Tracker – Saltwater Country Patrol	NAILSMA 2014 – Factsheet on V6 updates	Analysis tools within I-Tracker to map sightings
	SEAGRASS WATCH TRANSECTS	WSK	Intertidal Seagrass status (Photographs, samples, and estimates of seagrass cover, canopy height and composition)	Seagrass Watch Data Sheets	Training needs to be undertaken and monitoring overseen by western scientist. EK (2014) – Factsheet Mckenzie and Yoshida (2014) – Information on Seagrass Watch in Kimberley	Data analysed by Seagrass Watch **Main Contact – Environs Kimberley**
	SEAGRASS BOAT BASED TRANSECTS	WSK	Subtidal seagrass monitoring	Gopro or dropdown camera I-Tracker - *Seagrass Mapping & Monitoring* application	National Environmental Research Program (NERP) project collaboration NAILSMA, Wunambal Gaambera and CSIRO Field Manual – Subtidal methods and ID booklet NAILSMA	Post processing of photos recorded onto I-Tracker application (Opportunity in future to develop automated counting of imagery)

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	VISITOR ACCESS PASS	WSK	Pressures: Visitor access numbers and location	Not developed	Various groups implementing or developing (WG, Karajarri and Dambi)	Not developed*
	RANGER COASTAL PATROLS	IK	Pressures: Visitor Access locations	Not developed	Not developed	Not developed*
	NAQS PATROL	WSK	Pressures: Marine Debris	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Not developed* Data provided fee for service
DUGONG	**TANGAROA BLUE**	WSK	Pressures: Marine Debris	Tangaroa Blue Data Sheets	Tangaroa Blue (2012) Identification Manual	Not developed* Data provided fee for service
	AERIAL SURVEYS	IK/WSK	Distribution and abundance of dugongs	Aerial Counts	WAMSI project 1.2.5 Rangers trained in technique Developed and refined based on IK Trials suggest that ongoing monitoring plan for dugongs needs to incorporate multiple tools (MEB approach)	Through partnership with researchers **Main Contact - Peter Bayliss CSIRO**
	SATTELITE TAGGING	WSK	Dugong seasonal movement patterns in relation to sea grass habitat and behaviour (i.e. diving depths, breeding)	Satellite and audio tracking devices	WAMSI project 1.2.5	**Main Contact - Peter Bayliss CSIRO**
	ART	IK	Distribution	Art	Examples in Kimberley include Mahood (2014) Fire Scar Mapping	Not trialled*
	PARTICIPATORY RANKING	IK	The health of dugong populations The health of cultural attributes associated with dugongs	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The distribution of dugong populations	Mapping	Participatory mapping with Peter Bayliss WAMSI project 1.2.5 (cultural maps of dugong hunting areas with three Ranger groups)	Not developed*
	STORIES	IK	Many aspects of dugongs and their habitats	Audio, video, drawings	See Vernes WWF (2016) Bilbies Paruku for an example	Not trialled*

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of dugongs and their habitats held and maintained by knowledge holders	Written, video, audio	Some Interviews conducted for WAMSI project 1.2.5 to inform Dugong Research	Not trialled*
	INTERVIEWS	IK/WSK	Knowledge of dugong and their habitats	Written, video, audio	-	Not trialled*
	FOCUS GROUP DISCUSSIONS	IK/WSK	Knowledge of dugongs and their habitats	Written, video, audio	-	Not trialled*
FISH	**CUSTOMARY HARVESTS**	IK	Information on customary harvest	Participatory Ranger Interviews with fishers	Not developed	Not developed*
	DROP DOWN CAMERAS	WSK	Change in fish species and numbers	Underwater Video/Photography	Fisheries and Dambi have undertaken some drop down camera work	Not developed*
	RECREATIONAL FISHING	WS	Information on recreational catch	Not recorded	Individual groups survey recreational fisherman for catch (species and number)	Not developed*
	RANGER PATROLS OF FISH KILLS	IK	Pressures : Location and extent of fish kills	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Information provided to fisheries
	VISITOR ACCESS PASS	WSK	Pressures: Visitor access numbers and location	Not developed	Various groups implementing or developing (WG, Karajarri and Dambi)	Not developed*
	RANGER COASTAL PATROLS	IK	Pressures: Visitor Access locations	Not developed	Not developed	Not developed*
	NAQS PATROL	WSK	Pressures: Marine Debris	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Not developed* Data provided fee for service

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	TANGAROA BLUE	WSK	Pressures: Marine Debris	Tangaroa Blue Data Sheets	Tangaroa Blue (2012) Identification Manual	Not developed* Data provided fee for service
	GENETICS SAMPLING	WSK	The size of populations, how far they move and do they ever mix	Genetics samples of fish	WAMIS 1.1.3 project KISSP presentation and July Notes – summary of findings	**Main contact – Jim Underwood (AIMS) and Mike Travers (Fisheries)**
	BAITED/UNBAITED REMOTE UNDERWATER VIDEO SYSTEM (BRUVS)	WSK	Changes in number and species)of juveniles and adults) across time and place, location of diversity hotspots	Underwater video units deployed from vessel	Method instructions in "Listening to Sea Country: A monitoring manual for Indigenous Marine Rangers" and instructional YouTube videos at https://www.youtube.com/playlist?list=PLufe8MtwBUoXldWPJQlEVvnd--aeSXtWx	**Main Contact – Martial Depczynski (AIMS)**
FISH	**TAGGING (ACOUSTIC)**	WSK	Fish movement	Acoustic Tagging	Bardi developing this with Fisheries (including otilith sampling)	**Main Contact: Mike Travers (Fisheries)**
	PARTICIPATORY RANKING	IK	The health of fish populations The health of cultural attributes associated with fish	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled* **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The distribution of fish populations, location of fish hotspots and important nursery grounds	Group workshop mapping	Method instructions in "Listening to Sea Country: A monitoring manual for Indigenous Marine Rangers" Developed by AIMS and trialled with Anindilyakwa Land & Sea Rangers (Groote Island NT),	**Main contact: Martial Depczynski (AIMS)**
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of fish and their habitats held and maintained by knowledge holders	Written, video, audio	-	Not trialled*
	INTERVIEWS	IK/WSK	Knowledge of fish and their habitats	Written, video, audio	-	Not trialled*
	FOCUS GROUP DISCUSSIONS	IK/WSK	Knowledge of fish and their habitats	Written, video, audio	-	Not trialled*

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
SHELLFISH	**BENTHIC INVERTEBRATE QUADRATS**	WSK	The distribution of cockles in Roebuck Bay	Researcher datasheets	Mud samples and cores sieved and species identified (see AnnRoeBIM16, Piersma et al 2016)	**Analysis by researchers**
	GENETIC SAMPLING	WSK	The size of populations, how far they move and do they ever mix	Genetics samples of fish	WAMIS 1.1.3 project KISSP WG presentation and July Notes – summary of findings	**Main contact – Oliver Berry (CSIRO)**
	HARVEST LICENSES	WS	Pressures: The tonnage of trochus removed by industry	Licenses	-	**Fisheries**
SALTWATER HABITATS						
BENTHIC_CORAL_INTERTIDAL	**DROP DOWN CAMERA TRANSECTS (Boat Based)**	WSK	Habitat distribution and mapping & characterisation of underwater habitats (could be used in long term to look at change) coral bleaching	Underwater camera units from vessel	Methods refined by Dambi and WG Method instructions in "Listening to Sea Country: A monitoring manual for Indigenous Marine Rangers".	Photos currently sent for analysis Local analysis could be developed **Main Contact: Andrew Heyward (AIMS)**
	TRANSECTS	WSK	Transects adapted using NERP freshwater vegetation technique	Data sheets	Method adopted by Nyul Nyul adapted from NERP Freshwater quadrats	Not developed*
	DROP DOWN CAMERA TRIPOD	WSK	Shallow nearshore habitat (could be used in long term to look at change) Extent of coral bleaching	Underwater Photographs	Tripods developed and some training undertaken with groups	Not developed*, require partnership with researcher **Contact: Andrew Heyward (AIMS)**
	PARTICIPATORY MAPPING	IK	Location of habitat types	Group workshop mapping	Trialled by AIMS researchers with Anindilyakwa Land & Sea Rangers (Groote Island NT)	**Main contact: Martial Depczynski (AIMS)**
	SEDIMENT SAMPLING	WSK	Detection of physical, chemical or biological pollutants in sediments	Sediment samples & analysis	Method instructions in "Listening to Sea Country: A monitoring manual for Indigenous Marine Rangers" Developed by AIMS and trialled with Kimberley Groups	**Main contact: Martial Depczynski (AIMS)**

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	BENTHIC INVERTEBRATE MAPPING	WSK	The distribution and proportion of invertebrates on mudflats using grid sampling (1mm sieve sample)	Researcher datasheets	Mud samples and cores sieved and species identified (see AnnRoeBIM16, Piersma et al 2016)	Analysis by researchers
	INTERTIDAL REEF – QUADRATS	IK/WSK	Quadrats of intertidal reef and interviews with TOs	Being developed	Developing Method with Jane Prince UWA to start long term monitoring	Not developed* **Main Contact – Jane Prince (UWA)**
SEAGRASS	**SEAGRASS WATCH TRANSECTS**	WSK	Intertidal Seagrass status (Photographs, samples, and estimates of seagrass cover, canopy height and composition)	Seagrass Watch Data Sheets	EK (2014) – Factsheet Mckenzie and Yoshida (2014) Requires Training and monitoring overseen by western scientist (some groups have found too labour intensive when limited volunteers)	Data analysed by Seagrass Watch **Main Contact – Environs Kimberley**
	SEAGRASS BOAT BASED TRANSECTS	WSK	Subtidal seagrass monitoring (also intertidal seagrass, seagrass mapping)	Gopro or Dropdown Camera Recorded on I-Tracker - *Seagrass Mapping & Monitoring* application	National Environmental Research Program (NERP) - NAILSMA, WG and CSIRO Field Manual – Subtidal methods (Would need to modify the different seagrass techniques to make comparable – yet to be done)	Post processing of photos recorded onto I-Tracker application (Opportunity in future to develop automated counting of imagery)
	SEAGRASS TRANSECTS	WSK	Seagrass	Data Sheets	Seagrass technique adapted from Seagrass Watch specifically for Bardi Rangers	Not developed*
	SEAGRASS GROWTH and PRODUCTIVITY	WSK	Seagrass Biomass and Productivity using hole punch technique (Data on growth rates of seagrass is more valuable than biomass measurements alone)	Data sheets used by researchers	Research undertaken Bardi Jawi and CSIRO/UWA/ECU WAMSI project 2.2.4 The hole-punch technique could be developed for use by Rangers, and combine with reproduction (ie whether they are in bud or flowering) and seed bank.	**Main Contact: Gary Kendrick (UWA)**
	BLOOD SAMPLES AND PHOTOGRAPHY	WSK	Seagrass Grazing	Blood samples of turtles and Photography of Seagrass	Research undertaken Bardi Jawi and CSIRO/UWA/ECU WAMSI project 2.2.4	**Main Contact: Gary Kendrick (UWA)**
FRESHWATER	**VEGETATION TRANSECTS**	WSK	Riparian Vegetation Transects	I-Tracker Kimberley Wetland Monitoring Application	National Environmental Research Program (NERP) project	Analysis spreadsheet available **Main contact – Rebecca Dobbs (UWA)**
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of freshwater systems and management held and maintained by knowledge holders	Written, video, audio	Michelle Pyke PhD thesis in collaboration with Bardi and Nyul Nyul	In partnership with researcher **Main contact – Michelle Pyke (UWA)**

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
WATER QUALITY	**WATER QUALITY SAMPLING**	WSK	Detection of physical, chemical or biological pollutants in water	Oceanographic instruments & water samples & analysis	Method instructions in "Listening to Sea Country: A monitoring manual for Indigenous Marine Rangers" Developed by AIMS and trialled with Kimberley Groups	**Main contact: Martial Depczynski (AIMS)**
SALTWATER HABITATS	**PARTICIPATORY RANKING**	IK	The health of saltwater habitats Changes in Pressures	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The status of saltwater habitats The distribution of saltwater habitats	Mapping	-	Not trialled*
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of saltwater habitats held and maintained by knowledge holders	Written, video, audio	-	Not trialled*
	INTERVIEWS	IK/WSK	Knowledge of saltwater habitats	Written, video, audio	-	Not trialled*
	FOCUS GROUP DISCUSSIONS	IK/WSK	Knowledge of saltwater habitats	Written, video, audio	-	Not trialled*
CONSERVATION						
SHOREBIRDS	**SHOREBIRD SURVEYS COUNTS/IDENTIFICATION**	WSK	Land based bird surveys Broome Bird Observatory trapping and monitoring procedure	Monitoring sheets	Broome Bird Observatory with Yawuru Also WAMSI 1.2.6 Developing effective and efficient long term monitoring methods	Not developed*
	LOCAL PRESSURES ON SHOREBIRDS	WSK	Local Pressures on shorebirds	Monitoring sheets	WAMSI 1.2.6 Developing effective and efficient monitoring methods that can be conducted over the long-term	**Main Contact :Danny Rogers (AWSG)**
DOLPHINS	**BOAT BASED SURVEYS**	WSK	Population Health (Abundance of populations)	Researcher designed	WAMSI project 1.2.4 Dolphins Brown et al (2014) Brown et al (2017)	By researcher **Main Contact: Alexander Brown (Murdoch)**
	SALTWATER PATROLS	WSK	Sightings of marine mammals	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Mapping in I-Tracker

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	GENETIC SAMPLING	WSK	Skin samples taken to determine the genetics of dolphin populations	Data sheets or the I-Tracker – Saltwater Country Patrol	WAMSI project 1.2.4	**Main Contact: Alexander Brown (Murdoch)**
WHALES	**BOAT BASED SURVEYS**	WSK	Whale visitor numbers and type Species/numbers	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Fee for service
	SHORE BASED SURVEYS/SALTWATER PATROLS	WSK	Whale visitor numbers and type Species/numbers	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Fee for service
CROCODILES	**SPOTLIGHT SURVEYS SHORE BASED**	WSK	Location and abundance of crocodiles	Data Sheets	DBAC	Not developed*
	SPOTLIGHT SURVEYS BOAT BASED	WSK	Location and abundance of crocodiles	Data Sheets	WAMSI project 1.2.3 DBAC	**Main Contact: Andy Halford (DBCA)**
	SALTWATER PATROL	IK/WSK	Sightings of Crocodiles and Tracks - Location	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Mapping in I-Tracker
	LOCAL SIGHTING FORMS	IK/WSK	Location of Crocodiles (to reduce human interaction)	Data sheets entered into I-Tracker – Saltwater Country Patrol	Data sheets developed by DAMBI	Mapping in I-Tracker
	GENETIC SAMPLING	WSK	Skin samples taken to determine the genetics of crocodiles populations	Data sheets or the I-Tracker – Saltwater Country Patrol	Biopsy sampling method refined for Ranger use by WAMSI project 1.2.3	**Main Contact: Andy Halford (DBCA)**
CONSERVATION SPECIES	**KNOWLEDGE HOLDER INTERVIEWS**	IK	Specific knowledge of species and their habitats held and maintained by knowledge holders	Written, video, audio	-	Not trialled*
	PARTICIPATORY RANKING	IK	The Status of Conservation Species and Changes in Pressures	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The status of conversation species The distribution of conservation species	Mapping	-	Not trialled*

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	NAQS PATROL	WSK	Pressures: Marine Debris	I-Tracker – Saltwater Country Patrol	https://www.nailsma.org.au/hub/programs/I-Tracker.html NAILSMA 2014 – Factsheet on V6 updates	Not developed* Data provided fee for service
	TANGAROA BLUE	**WSK**	Pressures: Marine Debris	Tangaroa Blue Data Sheets	Tangaroa Blue (2012) Identification Manual	Not developed* Data provided fee for service
SIGNIFICANT AREAS AND PLACES						
SIGNIFICANT AREAS AND PLACES	**SALTWATER PATROLS**	IK/WSK	Mapping of Cultural sites, Fish traps, Middens, Coastal wells along the beach line, Landmarks for stories, Artefacts or remains,	I-Tracker Saltwater Patrol Cultural Heritage Sequence	https://www.nailsma.org.au/hub/programs/I-Tracker.html	Not developed*
	RANGER PATROLS	IK/WSK	- Site condition, number of tourists accessing sites, rubbish, damage	FULCRUM or Datasheets	Karajarri using FULCRUM to record work and monitoring undertaken at sites	Not developed*
	VISITOR ACCESS PASS	WSK	Pressures: Visitor access numbers and location	Not developed	Various groups implementing or developing (WG, Karajarri and Dambi)	Not developed*
	PARTICIPATORY RANKING	IK	The health of significant areas and places, Changes in Pressures	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The status of saltwater habitats The distribution of saltwater habitats	Mapping	-	Not trialled*
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of significant areas and places held and maintained by knowledge holders	Written, video, audio	-	Not trialled*
	INTERVIEWS	IK/WSK	Knowledge of significant areas and places	Written, video, audio	-	Not trialled*
SIGNIFICANT AREAS AND PLACES	**FOCUS GROUP DISCUSSIONS**	IK/WSK	Knowledge of significant areas and places	Written, video, audio	-	Not trialled*

VALUE	MONITORING TOOL	Knowledge systems	What is measured/monitored/recorded	RECORDING METHOD	TRIALS AND DEVELOPMENT	ANALYSIS / COMMENTS*
	RANGER WOC & IPA REPORTING	IK/WSK	Jobs, income, etc. All inputs for WOC and IPA work	Reporting templates MERI	All groups using for reporting purposes, but limited use for monitoring	Not developed*
CULTURAL PRACTICES						
CULTURAL PRACTICES	**PARTICIPATORY RANKING**	IK	The health of significant areas and places, Changes in Pressures	Counters Data Sheets	Used by WG in HCP evaluation (Austin et al. 2017)	Not trialled **Contact: Beau Austin (CDU)**
	PARTICIPATORY MAPPING	IK OR IK/WSK	The status of saltwater habitats The distribution of saltwater habitats	Mapping	-	Not trialled*
	KNOWLEDGE HOLDER INTERVIEWS	IK	Specific knowledge of significant areas and places held and maintained by knowledge holders	Written, video, audio	-	Not trialled*
	INTERVIEWS	IK/WSK	Knowledge of significant areas and places	Written, video, audio	-	Not trialled*
	FOCUS GROUP DISCUSSIONS	IK/WSK	Knowledge of significant areas and places	Written, video, audio	-	Not trialled*
	RANGER WOC & IPA REPORTING	IK/WSK	Jobs, income, etc. All inputs for WOC and IPA work	Reporting templates MERIT	All groups using for reporting purposes, but limited use for monitoring	Not trialled*
LIVELIHOODS						
	RANGER WOC & IPA REPORTING	IK/WSK	Jobs, income, etc. All inputs for WOC and IPA work	Reporting templates MERIT	All groups using for reporting purposes, but limited use for monitoring	Not trialled*

*Techniques have been recorded in the table as “not developed” if ranger groups are collecting data but there is no tool developed to analyse the data and “not trialled” if there are techniques that have not been trialled for saltwater monitoring

3.2 Template form for developing or adding tools to the toolbox

1. What is the monitoring technique? (a brief Plain English description <100 words)?

2. What question will it help to answer?

3. To what value is it related?

Regional Value Category	Individual Values
SALTWATER FOOD AND RESOURCES	☐ Fish ☐Shellfish, ☐ Squid and Octopus, ☐ Sharks and Rays, ☐ Turtles, ☐ Dugongs
CONSERVATION TARGETS	☐ Shorebirds ☐ Dolphins ☐ Whales
SIGNIFICANT AREAS AND PLACES	☐ Burial, ☐Camping, ☐ Fishing, Middens, Creation Story Cultural Areas Seascapes Fossils Maritime Heritage Fish Traps Law grounds Boundaries and Location Tracks
LIVELIHOODS SALTWATER	
SALTWATER COUNTRY	

4. What Knowledge bases are incorporated

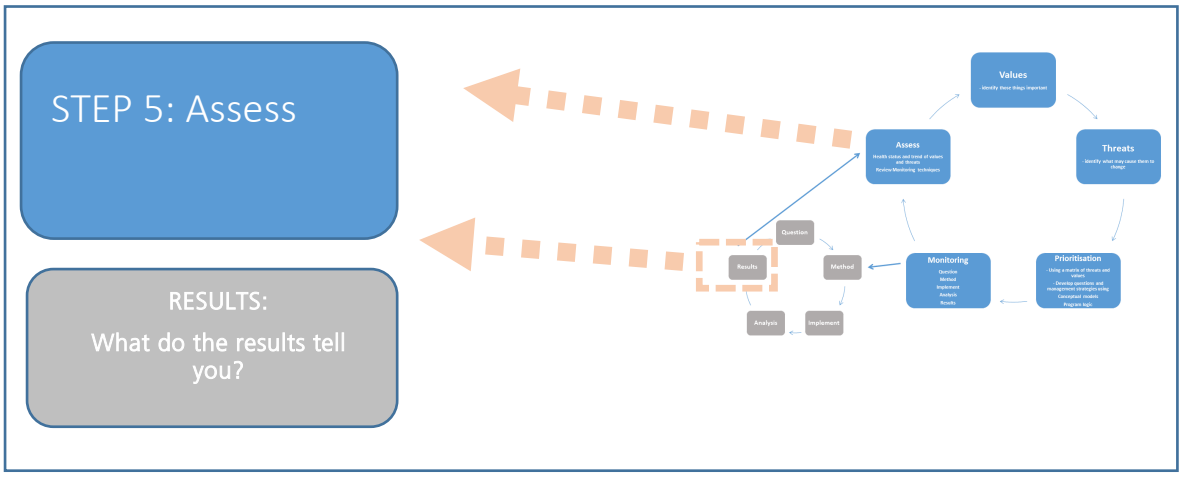
☐ Western Science Knowledge,
☐ Indigenous Knowledge,
☐ Both

5. What has been developed for this monitoring tool?

Questions	Please provide copies of any information (or website or contact of where to access this information)
What is the Recording Method?	
Who did you trials and develop the tool with?	
How do groups analyse the monitoring data collected? Have you developed any analysis Tools	

STEP 4 (E) and STEP 5 Assessing the monitoring Results

When looking at the results remember to always keep in mind why you have collected the data. All monitoring should be reviewed to inform and improve management (plan, do, review). What changes to management will come out of this?



The assessment phase is one of the most important steps of the Framework – to come together and compare information, consider the health status of regional values and whether you're monitoring is successfully informing management effectiveness. Without this step then time and resources may be inefficiently allocated and monitoring efforts could end up being unproductive.

A key limitation to current monitoring is the capacity (including time and resources) that Ranger groups have to analyse data, interpret results and evaluate their monitoring and management. Case studies have been provided demonstrating tools and processes that could assist groups at this step of the framework. Firstly the toolbox provides a case study of a Kimberley based participatory monitoring and evaluation assessment, as lessons can be learnt from groups that have undertaken monitoring and evaluation (having had the capacity and access to resources to do so). Clearly articulating monitoring results is important at both the local and regional scale. Two case studies have been provided to firstly demonstrate how analysis tools can assist groups to independently analyse and interpret ecological data and secondly how colour coding techniques may be useful at a regional scale enable groups to share information (and incorporate cultural attributes) without handing over raw data which can often be considered sensitive.

3. Monitoring and Evaluation Case Study

This case study demonstrates how one Traditional Owner group in the Kimberley has developed an evaluation committee that includes researchers that will assist and independently audit the monitoring and evaluation process. Although this case study provides a best practice process, even without additional resources and funding, groups could benefit from using a similar approach on a smaller scale (see Moorcroft et al. 2012, Austin et al. 2017 for more information).

Monitoring and Evaluation Case Study (from: Austin et al. 2017)

The Wunambal Gaambera people have established an innovative, possibly unique, intercultural committee to provide strategic advice on operational, M&E and governance matters concerning the Wunambal Gaambera HCP. Known as the Uunguu Monitoring and Evaluation Committee (UMEC), this panel of experts enhances the capacity of Wunambal Gaambera Traditional Owners to make decisions about Country, without undermining their authority, by integrating knowledge to construct an 'enriched picture' of the status and trends of HCP targets and work. UMEC representation consists of a subcommittee of the WGAC Directors and the Head Uunguu Ranger, as well as non-Indigenous ecologists, anthropologists and planning experts, plus key investors in the HCP. The UMEC has been meeting on Wunambal Gaambera Country bi-annually since 2012.

The UMEC reviews and recommends to the WGAC if the HCP is:

- being used for management of Wunambal Gaambera Country:
- working to achieve the Wunambal Gaambera vision;
- using the best Traditional and Western Knowledge and practice in implementation and monitoring; and
- is being effectively reported on to WGAC.

The UMEC workshops themselves have undertaken important Healthy Country Planning tasks such as target and threat review and developing results chains to assist in the implementation of objectives and strategies.

The UMEC provides a good example of how to successfully implement an adaptive management cycle. Other groups may be able to learn from this approach to monitoring and evaluating saltwater Country.

Key points:

- The UMEC consists of 4 Directors of Wunambal Gaambera Aboriginal Corporation (including the head Uunguu ranger), plus four outside experts and HCP partners (including anthropologists, ecologists and funders).
- The 'Healthy Country work' (action plans developed under the HCP) has been organised into 10 operations with clear work programs to make monitoring and evaluation more manageable (Right Way Fire; Pest Species Management; Visitor Management; Culture Programs; Monitoring, Evaluation, Research and Information Management; Partnership and Communications; Sustainable Finances; Workforce and Training; and Getting Back to Country).
- Results chains have been developed (using the software programme Miradi https://www.miradi.org/) with a focus on implementing objectives and strategies (not targets).
- The UMEC sits once or twice a year, depending on the needs of the HCP, to assess both the change in status of the HCP targets and the effectiveness of management activities undertaken.
- The Healthy Country team reports annually to UMEC providing evidence of progress against objectives (% complete), strategies and actions.

Benefits of this approach

- The UMEC plays a key role in making recommendations to decision-makers (i.e. Traditional Owners and Directors of WGAC) and helps them adjust strategies and priorities. Importantly, the UMEC is not a decision-making body themselves. It exists to empower Traditional Owners, not undermine their authority.
- Using this model, Traditional Owner-generated knowledge has equal legitimacy to that of western science and by combining these two sets of knowledge it provides an 'enriched picture' of the Wunambal Gaambera HCP and Country. It is a practical way of implementing an MEB approach.
- Using this approach ensures that time is allocated for monitoring and evaluation and there is accountability for work plans and the effectiveness of land and sea management activities.
- Fundamentally, the UMEC provides Wunambal Gaambera people with an increased ability to detect change (positive or negative) and improve and implement new strategies to look after Country in the right way.

4. Data analysis Case Studies

Examples of tools that have been used or developed to assist Rangers and Traditional owners in representing, analysing and interpreting results are highlighted in the following case studies:

Ecological Assessment Tool (see: Dobbs et al. 2016)

A collaborative research project between Nyul Nyul Rangers, Traditional Owners, the University of Western Australia and NAILSMA, was undertaken to develop tools with the aim to facilitate Ranger-led management and monitoring of wetlands, with less reliance on external support. A customised I-Tracker application was developed to allow rangers to digitally record, manage and map aquatic ecosystems. Monitoring methods included in the application were chosen to address the needs of the Nyul Nyul Rangers to monitor local threats and concerns and assess the efficacy of local management actions. The methods and the application were trialled and tested in the field, and iteratively amended until a product suitable for successful implementation by rangers was finalised.

Monitoring tools were designed to build the capacity of Indigenous ranger groups to engage in research, monitoring and management of wetlands. To assist the Nyul Nyul Rangers in data interpretation and adaptive management, an analysis tool was developed to automatically calculate riparian and aquatic vegetation scores and generate visual representations of these scores (Fig. 8). This tool supports groups to analyse complex monitoring data, with the final results interpreted using colour coding and graphing.

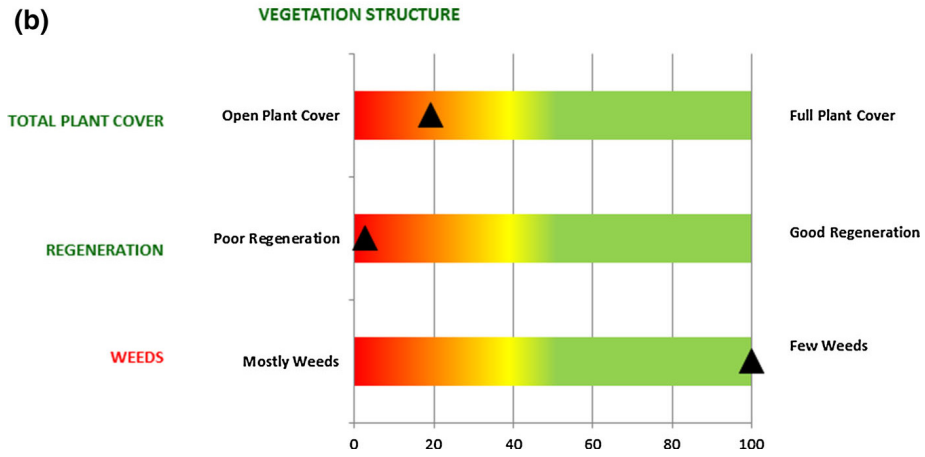


Figure 8 Dobbs et al. (2016) Example of template produced for data analysis (colour coded graphs are automatically generated when data entered into spreadsheets)

Benefits of this approach

- Monitoring tools developed in collaboration with Traditional Owners and Rangers are locally relevant, can incorporate IK, and can assist groups in monitoring both the health of values and management effectiveness
- The data analysis tools developed support Rangers and Traditional Owners to analyse and interpret results and inform management decisions without relying on external input

Participatory Ranking Tool (from: Izurieta et al. 2011)

Izurieta et al. (2011) used a colour coded system for monitoring and evaluation (PME) of jointly managed parks and reserves in the Northern Territory (Figure 9). A similar approach is used during the HCP process, where the health of targets are rated "poor", "fair", "good" or "very good". (TNC, 2007).

Defining the assessment scale for scoring indicators

One useful way of measuring how well joint management is working for each of the indicators is to use a colour-based assessment scale. This includes a scoring scheme where each indicator is scored with a colour based on four levels: bad, not so good, good and very good (Figure 3).

The condition of this indicator is VERY GOOD/ or the indicator shows a VERY GOOD way of doing things together
The condition of this indicator is GOOD/ or the indicator shows a GOOD way of doing things together
The condition of this indicator is NOT SO GOOD/ or the indicator shows a NOT SO GOOD way of doing things together
The condition of this indicator is BAD / or the indicator shows a BAD way of doing things together

Figure 4: Colour-based rating scale for assessing indicators

Partners can choose any colours to represent each level. For example, at Watarrka National Park, partners chose to use blue instead of yellow for the 'good level'.

If preferred, partners can use an assessment scale with numbers instead of colours (Figure 5). Replacing colours with equivalent number values does not change the meaning of the assessment or the results but allows partners to do simple calculations to work out how far they are from achieving the highest expected value for an indicator. We provide further explanation and examples of indicator ratings in Phase 3 where we discuss assessing results (see Section 6 below).

We found it best to stick to a four level assessment scale as the even number discourages assessors from choosing a medium value too frequently (e.g. good in a 3 level system of bad, good and very good).

The condition of this indicator is VERY GOOD/ or the indicator shows a VERY GOOD way of doing things together	**3**
The condition of this indicator is GOOD/ or the indicator shows a GOOD way of doing things together	**2**
The condition of this indicator is NOT SO GOOD/ or the indicator shows a NOT SO GOOD way of doing things together	**1**
The condition of this indicator is BAD/ or the indicator shows a BAD way of doing things together	**0**

Figure 5: Numerical assessment of indicators

Figure 9 Izurieta et al. (2011) Defining assessment scale for scoring indicators

Benefits of this approach

- Colour coding is one technique that has been used in participatory ranking, the assessment of cultural attributes, and also to represent complex ecological data. This approach would enable groups to share information without handing over raw data which can often be considered sensitive.

5. References

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6. Appendices

Appendix 1 Current Saltwater Monitoring and Research

Ranger research and monitoring activities were mapped out to assist in categorising the types of saltwater monitoring across the region.

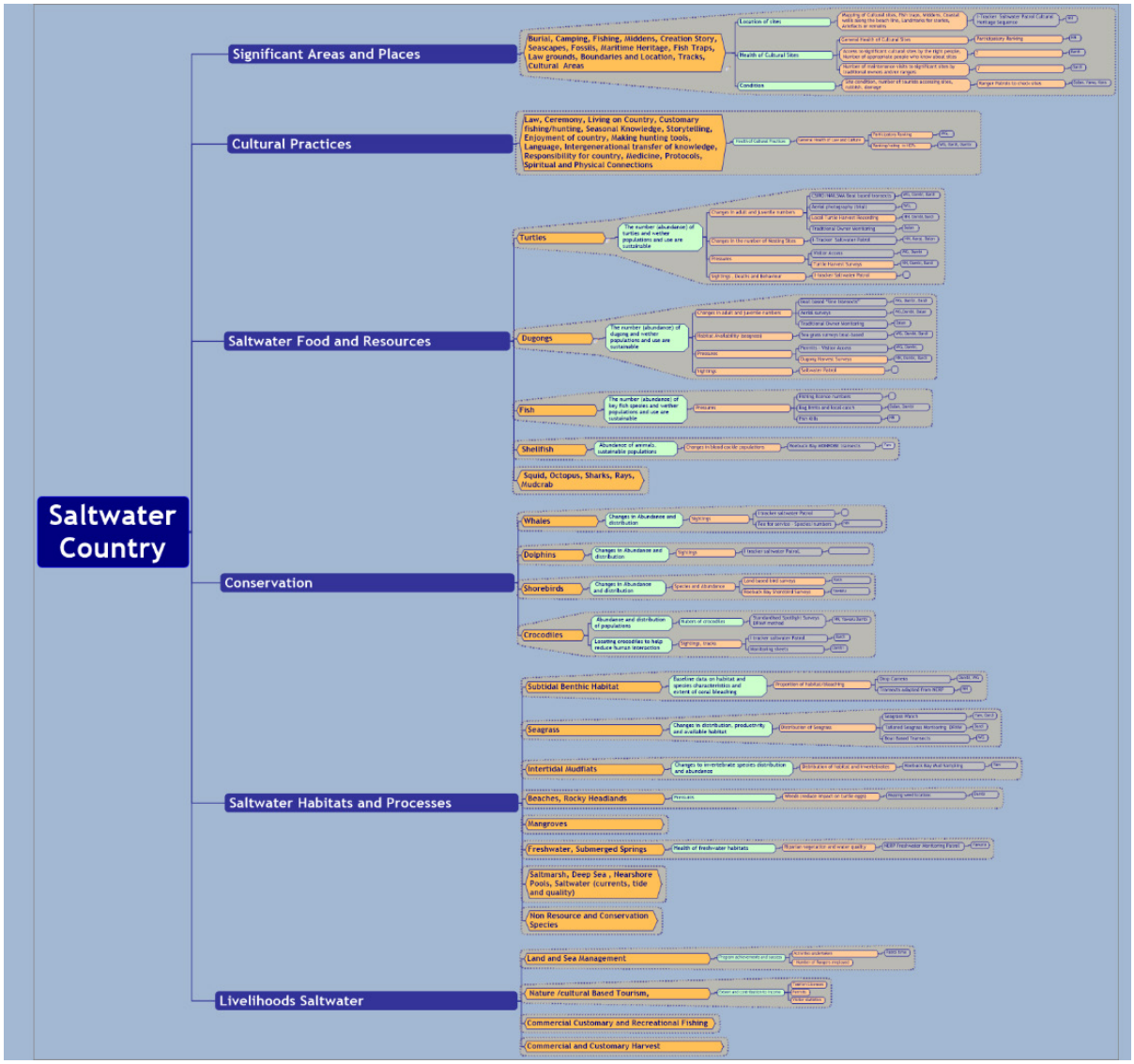

Figure A Monitoring and Research of Saltwater Country in 2017 (see figures B to F for detail)

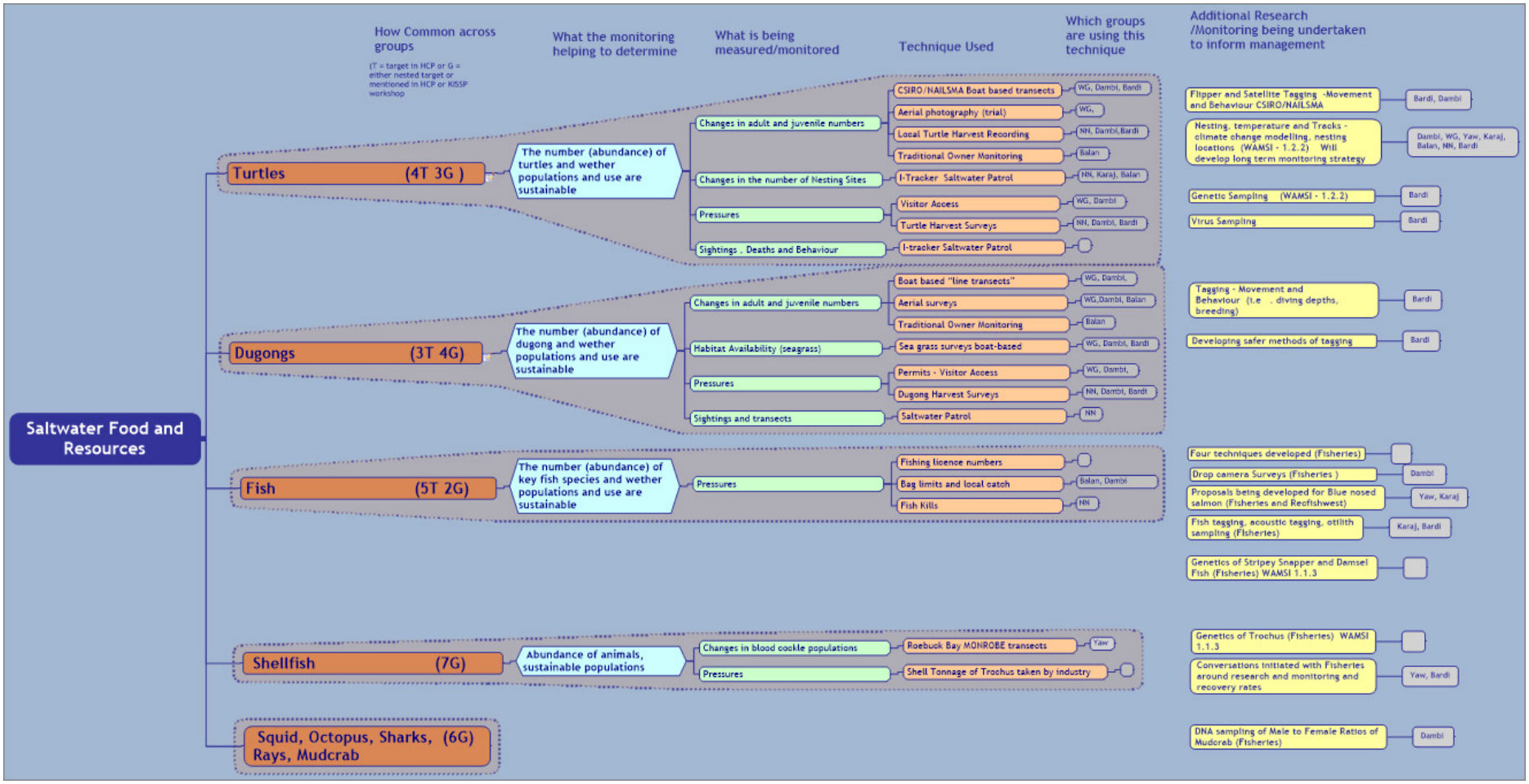

Figure B Summary of Saltwater Food and Resources Monitoring and Research 2017

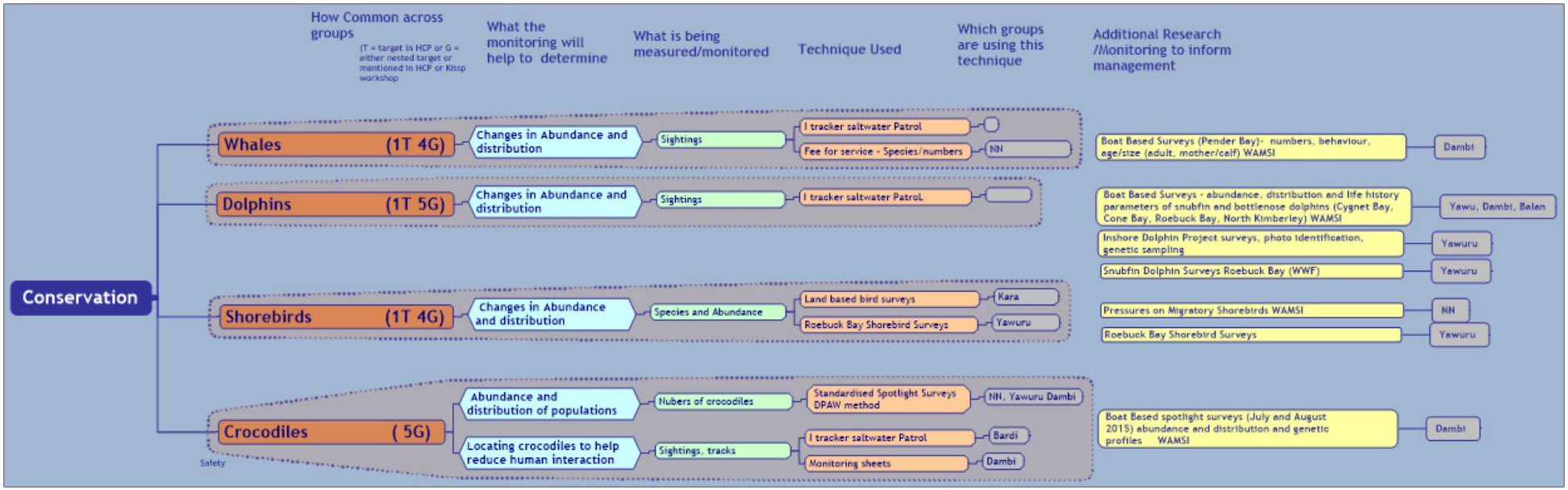

Figure C Summary of Conservation Monitoring and Research 2017

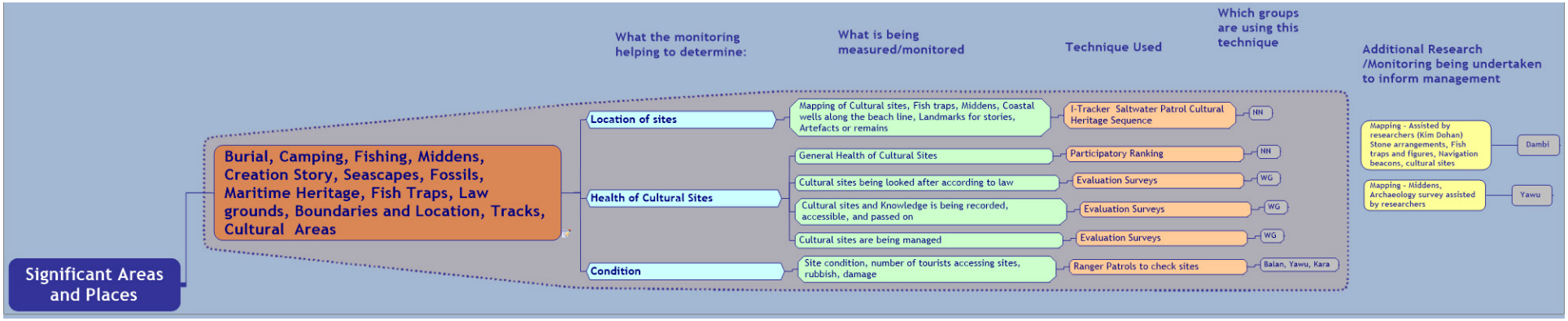

Figure D Summary of Significant Areas and Places Monitoring and Research 2017

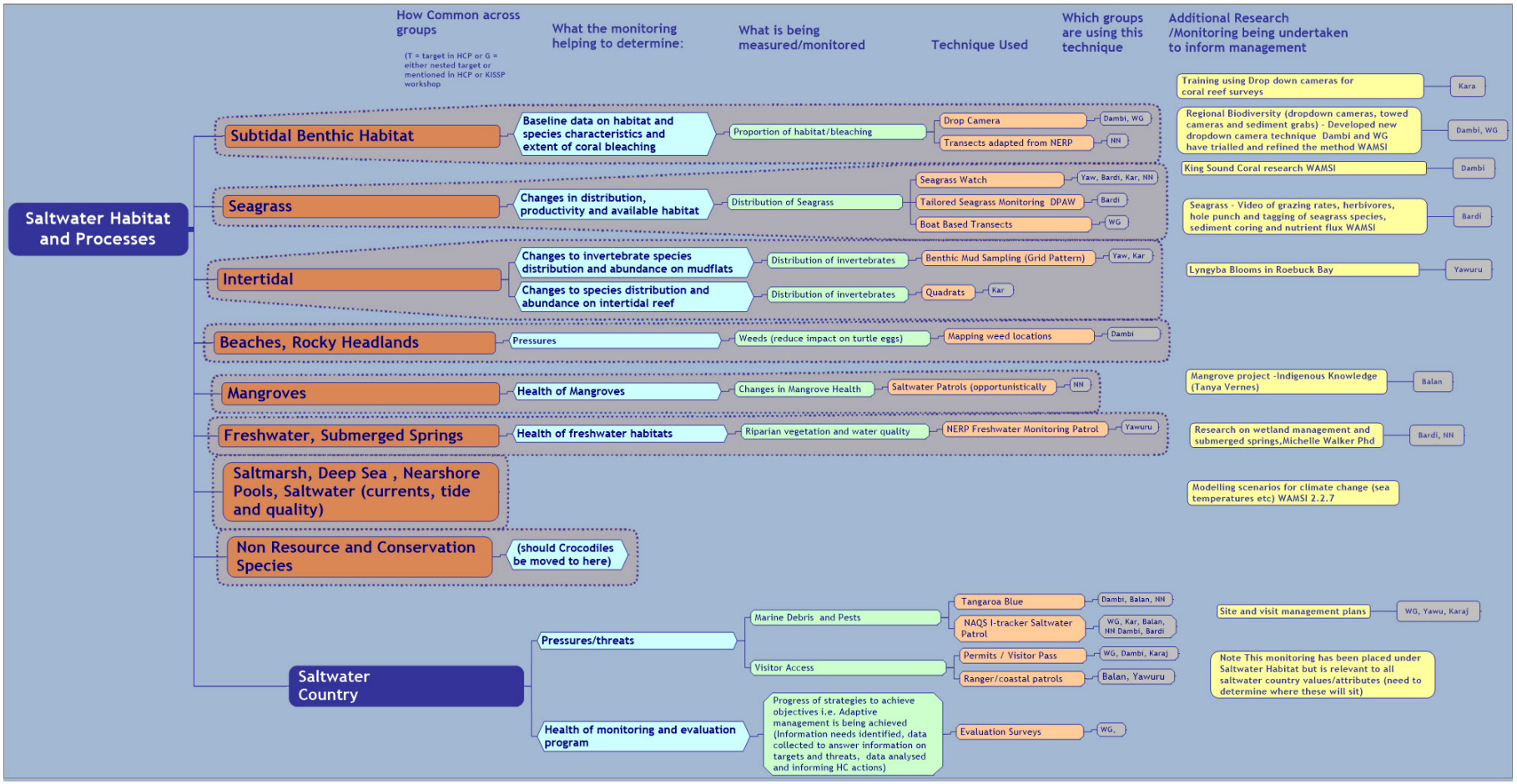

Figure E Saltwater Habitat and Processes Monitoring and Research 2017

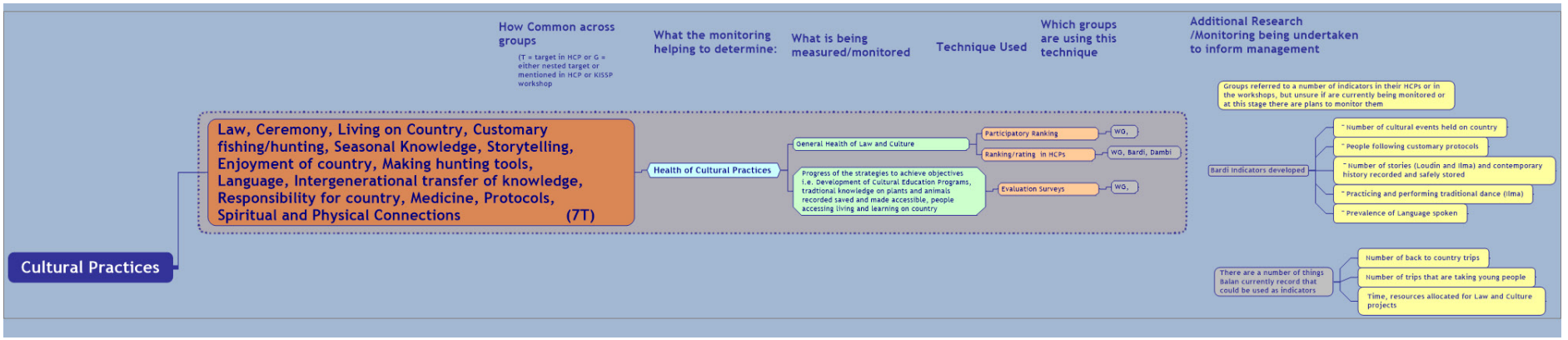

Figure F Cultural Practices Monitoring and Research 2017

Appendix 2 Pilot Training Package

Indigenous Knowledge_ Pilot training package: Monitoring for Management – A Learning Package for Kimberley Indigenous Rangers__WAMSI KMRP Project 1.5_6_Lincoln et al_2018

All reports, tools and packages for the Indigenous Knowledge project of the WAMSI Kimberley Marine Research Program can be found at www.wamsi.org.au/indigenous-knowledge