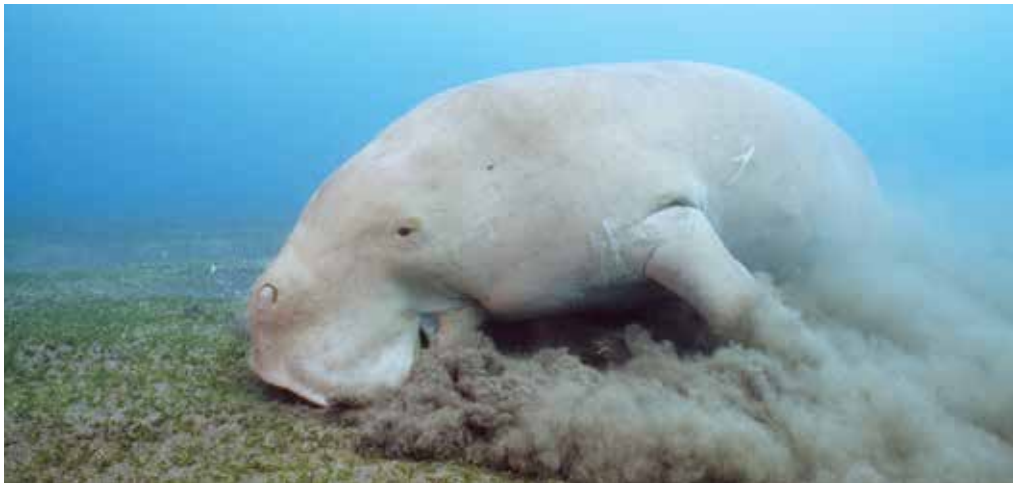
Protecting the Balguja

merging traditional knowledge and science

Arguably one of the world's most endearing and charismatic marine creatures, the dugong has deep cultural value to traditional owners in the State's north-west. A CSIRO study being carried out in partnership with Indigenous rangers in the Kimberley is merging traditional knowledge with science to gain a better understanding of the ecology of this magnificent species to help guide their future management.

by Peter Bayliss, Marlee Hutton, Jo Myers and the Balanggarra, Wunambal Gaambera (Uunguu), Dambimangari and Bardi Jawi North Kimberley ranger groups



The dugongs (*Dugong dugon*) of northern Australia and the Torres Strait have a well-deserved recognition factor: they are an important species in coastal marine ecosystems; have 'iconic' conservation status; and they have high cultural value within Indigenous coastal communities. Despite this, they are listed as 'vulnerable' because populations throughout the world and the seagrass habitats on which they depend have declined due to human impacts.

SCIENCE MEETS TRADITIONAL KNOWLEDGE

'Balguja' – as they're called by the Wunambal Gaambera saltwater people in the North Kimberley – are found in shallow coastal waters in protected bays, nearly always where you find extensive seagrass habitat. All of these suitable dugong areas in the Kimberley occur in 'Sea Country' and, in the north-west of WA generally, within the area that incorporates the North Kimberley (currently excluding intertidal waters), Lalang-garram / Camden Sound, Lalang-garram /Horizontal Falls, Nagulagun / Roebuck Bay, Eighty Mile Beach, Montebello Islands, Ningaloo, and Shark Bay marine parks. In fact, the coastal waters of north-western Australia, spanning from the Kimberley, through the Pilbara to Shark Bay, are home to one of the largest remaining stable populations in the world.

Dugongs have important cultural and social values for Indigenous communities living in coastal areas of the Kimberley and, indeed, right across northern Australia and Torres Strait. While dugong hunting provides a valuable source of protein in isolated regions where fresh food is difficult to obtain, its cultural value is beyond bush tucker. Cultural dugong and marine turtle harvests help maintain family relations and social structure, and they have important deep ceremonial, spiritual and community purposes.

The knowledge held by Indigenous communities about dugongs, including observations about seasonal changes in their distribution, has been gathered over many generations. However, until recently, limited information on the distribution and abundance of dugongs in the Kimberley and their dependent seagrass habitat has been documented in modern science. In an effort to remedy this, and to support current Indigenous management and monitoring of Indigenous Protected Areas (IPAs) and their Healthy Country Planning process, a three-year Western Australian Marine Science Institution (WAMSI) project was started in 2013 by CSIRO researchers to form long-term partnerships with Indigenous rangers in the Kimberley, to share knowledge and skills in the gathering of data on dugong distribution, abundance and movements. This information will help guide future conservation and marine planning efforts as development pressures in the region inevitably increase.

WORKING TOGETHER

As a first step, CSIRO scientist Dr Peter Bayliss developed a research partnership with the Balanggarra, Wunambal Gaambera (Uunguu), Dambimangari and Bardi Jawi people in the North Kimberley, who had already articulated their aspirations to better manage dugongs through the merger of scientific and traditional knowledge systems as reflected in the following passage from the *Wunambal Gaambera*

Dugongs

Dugongs are shy in nature but their location is often given away by the plumes of disturbed mud and sand they create as they use their horseshoe-shaped mouth to forage for seagrass. They are primarily herbivores, but when seagrass is scarce they occasionally eat jelly fish and other invertebrates.

They are light brown with a rotund body. Adults can grow up to three metres long and weigh more than 400 kilograms. They have a flattened fluked tail like a dolphin but, unlike dolphins, they do not have a fin on the upper back. They also have paddle-like flippers and a distinctive head shape with a blunt face. Their nostrils are near the front of the head.

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Main Dugong at Shark Bay.
Photo – Jess Hadden

Above Plumes of disturbed mud and sand often indicate the presence of foraging dugongs.
Photo – Kelvin Aitken/MarineThemes.com

Left Dugongs can grow to three metres.
Photo – Karen Willshaw/OceanwideImages.com

Above An intensive aerial survey training course was held for rangers taking part in the study.
Photo – Peter Bayliss, TJ Lawson and Glenn Dunshea/CSIRO

Above right The abundance scale is relative, ranging from zero to the maximum number sighted, with red colours indicating the areas with the highest numbers and the blue colours indicating the lowest.

Right Identifying important dugong areas in the Kimberley using a 'Bayesian' likelihood map of dugong occurrence that combines traditional ecological knowledge (cultural hunting sites), a 'first pass' map of seagrass extent derived from Landsat satellite imagery and the results of the 2015 aerial survey.

Figure 1 Dugong abundance 'hotspots' in the North Kimberley

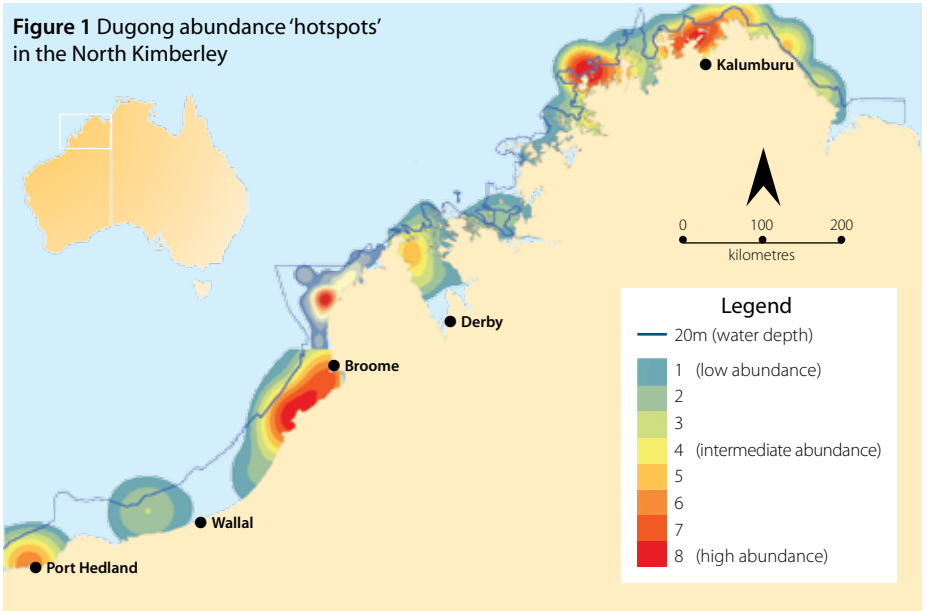
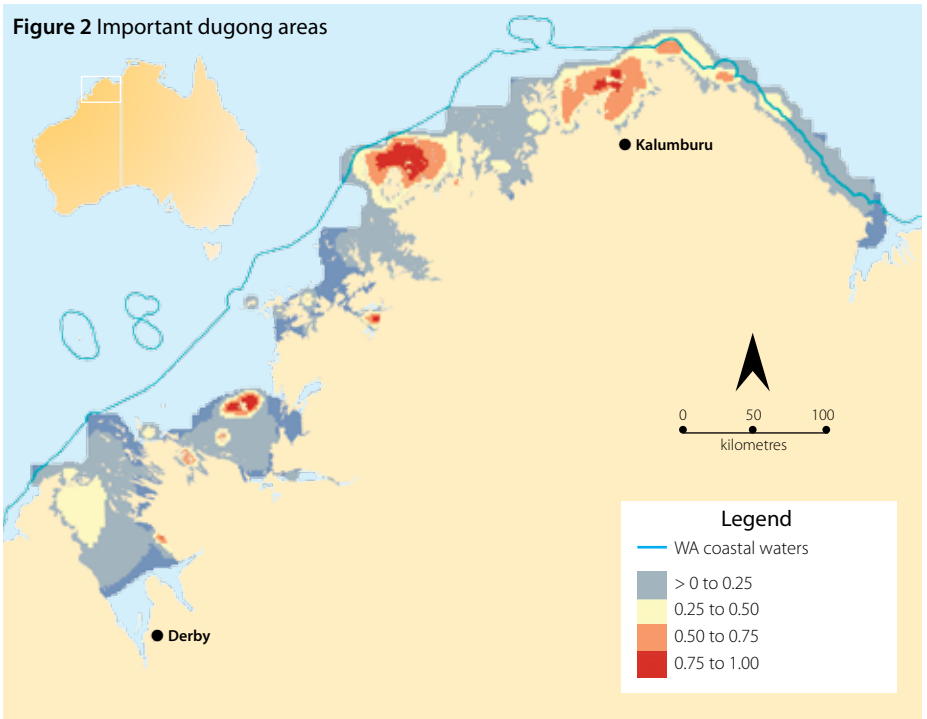


Figure 2 Important dugong areas



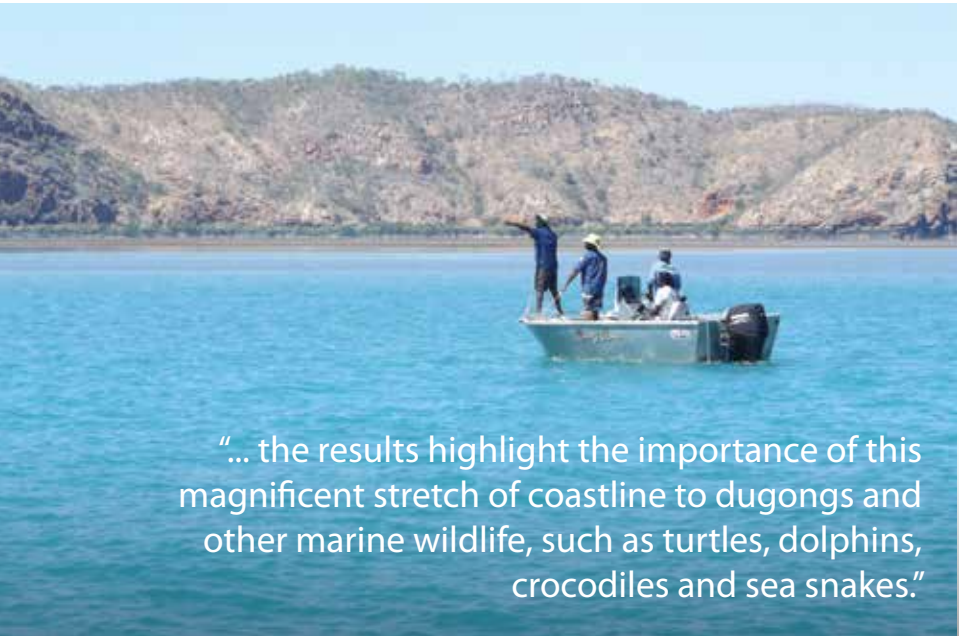
Healthy Country Plan– Looking after Wunambal Gaambera Country 2010–2020:

> *"We need to find out more about mangguru (marine turtles), balguja (dugongs) and other saltwater animals including diigu (birds). We need to know more about where they travel, their habitats in our country and how to look after them. Working together with other saltwater traditional owner groups across northern Australia using our traditional knowledge, doing surveys, tagging and looking after saltwater animals, fish, diigu and their habitats, will help us keep these animals healthy in our country as well as keeping our saltwater traditions strong."*

SEARCHING FOR ANSWERS FROM THE AIR

Aerial surveying is the conventional scientific method used to map and monitor changes in the distribution and abundance of those wildlife species that can be detected, including marine mammals at the water's surface. Aerial surveys were undertaken with Indigenous rangers between September and October 2015, and resulted in the first baseline assessment of the distribution and abundance of dugongs in the North Kimberley using standardised survey methods. Before the start of the survey, an intensive four-day aerial survey training course was run for Kimberley rangers on the survey team at Garmbemirri ranger station, and was hosted by Wunambal Gaambera Aboriginal Corporation. Then cultural maps of important dugong areas were combined with a water depth (bathymetry) map and a map of the extent of seagrass derived from satellite images. This sharing of knowledge enabled the costly survey effort to be focussed on culturally important areas and areas of extensive seagrass most likely to have dugongs.

The results of this survey showed that dugong abundance was very patchy across



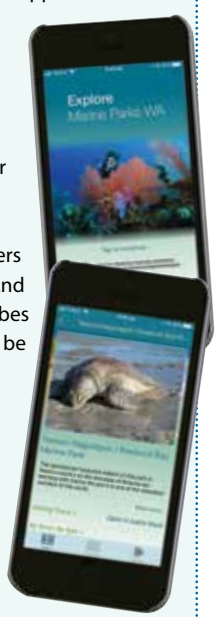
"... the results highlight the importance of this magnificent stretch of coastline to dugongs and other marine wildlife, such as turtles, dolphins, crocodiles and sea snakes."

Above Lalang-garram / Horizontal Falls Marine Park, Talbot Bay, Dambimangari sea country.

Above right Researchers bring the dugong to the side of the boat to measure and tag it. *Photos – Jarrad Holmes*

Explore

For more information about dugongs and other marine species, download Parks and Wildlife Service's *Marine Parks WA* app. This handy app includes a section on how to 'Explore Marine Parks' where users can toggle between the app and Apple Maps to plan their routes and check their locations. Information about zones enables users to plan their activities. And a 'wildlife' section describes the key species that can be found in each area.



Marine Parks WA was developed with support from the Department of Primary Industries and Regional Development Fisheries Division and Exxon Mobil Australia, and is available for free for iPhones and iPads. Search for 'Marine Parks WA' on the app store.

the North Kimberley, with distinct areas of high ('hotspots') and low ('coldspots') abundances (see Figure 1, see page 43). The overall density estimates found were similar to those in other regions of northern Australia that also have large areas of seagrass habitat in clear shallow coastal waters, generally less than 20 metres deep. A very strong relationship was found between estimates of dugong abundance and the extent of seagrass, which can be used to assess the future health of both dugong populations and their seagrass habitats.

With a study like this, it is necessary for researchers to adjust the results to correct the inevitable underestimation errors that occur by using the best available scientific knowledge obtained over decades of research. In a nutshell, no matter how good your eyesight, it's physically impossible to detect all dugongs at the waters' surface when flying as fast as 100 knots and as high as 500 feet altitude, and then there are those under the water that you just cannot see. Nevertheless, through rigorous standardisation of surveys, the counts are ideal as an indication of actual numbers because they can be used to reliably monitor trends, such as whether or not numbers are increasing, decreasing or remaining the same.

While aerial surveys provide much-needed data over large areas rapidly, the information represents only a snap shot in time. Collecting animal observation data over a short timeframe, even when using standardised science-based methods, can still result in uncertainties due to differences in seasonal conditions at the time and how these may affect how many animals are seen where and when. As such, combining Indigenous knowledge of dugong ecology accumulated over millennial time-scales across all seasonal conditions with scientific survey data paints a more comprehensive picture. This approach, which is known as a 'Bayesian' approach, recognises alternative knowledge domains and also allows for continual knowledge updates necessary to underpin adaptive management programs. Figure 2 (see page 43) illustrates a combined knowledge map that serves to highlight important dugong areas in the North Kimberley.

PAINTING A BIGGER PICTURE

The 2015 aerial survey targeted areas where the least information on dugong populations was available in the North Kimberley – the coastal waters between the north and east of Dampier Peninsula (including King Sound) to the NT border. Dampier Peninsula and Roebuck Bay had already been surveyed by Woodside Pty Ltd in 2009, and the Shark Bay–Ningaloo–Exmouth Gulf regions in north-western Australia had been previously surveyed many times by government and industry

between 2004 and 2016. Until May 2017, however, the coastal waters between Broome and Port Hedland, which encompass Eighty Mile Beach Marine Park, was the only section of coastline not surveyed from the air. So the WAMSI dugong project was extended to fill that survey gap, and also to re-survey Roebuck Bay. The results of this survey have recently been analysed. Figure 1 shows that while dugongs occurred along Eighty Mile Beach Marine Park, there were not as many as at Roebuck Bay and the rest of the North Kimberley. Most likely this is because there are no deep bays and hence no shelter from storms along this entire stretch of coastline. Nevertheless, the results highlight the importance of this magnificent stretch of coastline to dugongs and other marine wildlife, such as turtles, dolphins, crocodiles and sea snakes.

MOVEMENT STUDY USING SATELLITE TAGS

An understanding of the seasonal movement patterns of dugongs in relation to the condition of their seagrass habitat, and the secrets of their long-distance movements, are essential for managing them both on and off conservation reserves and sea country. Insights are required into how big an area is needed to maintain healthy and resilient populations; their seasonal use of different habitats; their foraging, diving and breeding behaviours in relation to seagrass condition; their dispersal patterns when environmental conditions get good or bad; and to what extent Indigenous groups and other jurisdictions share the same dugongs, which has implications for regional-scale management versus more local management. CSIRO scientists teamed up with the Bardi Jawi and Dambimangari Indigenous rangers to carry out a long-term movement and diving behaviour study in their sea country, which included the Lalang-garram / Horizontal Falls Marine Park. Bardi Jawi rangers undertook the very first satellite tracking study of dugongs in the Kimberley in 2010, and were keen to share their knowledge and skills with other researchers and Indigenous ranger groups.

As part of the CSIRO study, five dugongs – one adult female (in Talbot Bay, Lalang-garram / Horizontal Falls Marine Parks) and four adult males (all on the Dampier Peninsula just north of Pender Bay) – were caught and tagged with satellite transmitters in August 2016. Daily GPS (latitude and longitude) locations and dive data (time under the water and number of dives every six hours) were downloaded from the ARGOS satellite. Results show that the tag of one male dugong transmitted data for five months (167 days) before its battery ran out, while one tag detached from a male dugong after just two weeks but drifted around with the currents near Timor Leste until its battery ran out after five months. Three tags detached at various times and have since been retrieved for re-use.

Unfortunately, most of the location and dive data are short-term (one to five months) because the tags detached earlier than expected. Nevertheless, the results are fascinating as they reveal that all tagged dugongs moved large distances over very short periods of time. One young male moved more than 100 kilometres down the Dampier Peninsula from his capture site just north of Pender Bay Bardi Jawi sea country (Figure 3, see page 46). He accumulated 1,160 kilometres in his travels over 78 days, moving backwards and forwards between offshore patches of seagrass to forage. The adult female (without a calf) that was caught in Talbot Bay Dambimangari sea country moved 75 kilometres in a straight line distance from her capture point over 14 days, and ended

Above left The satellite transmitter (white floating buoy with short antenna) is fitted to a 1.5-metre tether line that is attached a harness or belt around the dugongs' tail. Its head is kept above water with a swimming pool noodle so it can breathe.
Photo – Jarrad Holmes

Above Mother and calf dugong.
Photo – Bob Halstead/OceanwideImages.com

Figure 3 Tracking of a young male dugong

up in a large bay opposite Montgomery Reef. She travelled 325 kilometres before her tag detached in mangroves – an average of 23.2 kilometres per day. The 1.5-metre tether line attached to the tail harness of the dugong at one end and the transmitter buoy at the other, has an intentionally weak link that breaks to release the tracking gear should it become entangled in mangrove roots or reef, preventing the dugong from drowning.

Continuing movement studies in sea country and jointly managed marine parks is possible by recycling retrieved transmitters and replacing lost ones, and will provide valuable long-term data on seasonal movement and activity patterns, particularly in relation to the condition of seagrass habitat and other environmental conditions.

POSITIVE BEGINNINGS

These results are providing a fascinating insight into the lives of dugongs. Combining this data with knowledge held by Indigenous people, which has been collected over eons, has enabled the identification of key 'hotspot' areas for future monitoring and assessment purposes. This information is critical to better understanding future changes in dugong populations and how they respond to a range of potential pressures, such as climate change, increased coastal development and human activity, and sustainable Indigenous harvests.

Researchers are optimistic that the trialled partnership model has a great future because the Indigenous rangers have long championed the critical two-way learning process. And, while this joint venture has only just started, it has already produced some exciting new insights into dugongs at both the individual and regional population levels.

Above Rangers measuring and attaching a satellite transmitter to the dugong's tailstock before releasing it 15 minutes later in good health.
Photo – Jarrad Holmes

Above left (Figure 3) A young male dugong was tracked for 78 days in August 2016 in Bardi Jawi sea country (just north of Pender Bay on the Dampier Peninsula).

Below Dugong at Monkey Mia.
Photo – Emily Hamley

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If you would like to know more about CSIRO's research in the Kimberley visit www.csiro.au.

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This dugong study was made possible through a collaborative approach to conservation in the Kimberley in partnership with WAMSI and CSIRO and with support from the traditional owners of the Kimberly.