North Australian Indigenous Land & Sea Management Alliance

Dugong and Marine Turtle Knowledge Handbook

Indigenous and scientific knowledge of dugong and marine turtles in northern Australia

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Tropical Savannas CRC
Cooperative Research Centre for Tropical Savannas Management

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

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The sources of all Figures (maps, photographs, diagrams and graphs) are acknowledged in footnotes throughout the document and we thank those individuals and organisations for allowing us to use their material.

WARNING: This document contains some names of deceased Indigenous people.

CONTENTS

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Figures

Tables

Boxes

INTRODUCTION

Preparation of the *Handbook* is part of a program coordinated by the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) to support Indigenous groups, communities and organisations across northern Australia in their management of dugong and marine turtles, including continued sustainable hunting.

The scope and content of the Handbook was broadly determined at the initial Dugong and Marine Turtle Management Project workshop in Darwin in February 2005. NAILSMA partners and the Technical Reference Group (TRG) agreed that the *Handbook* should comprise plain English summaries of the following information:

- Indigenous values and knowledge of dugongs and marine turtles;
- Knowledge and opinions derived from scientific research; and
- Management initiatives to protect and sustainably use dugong and marine turtle populations.

Part 1 is an introduction to the scope of Indigenous knowledge and values relating to dugong and marine turtles in Australia and provides examples from selected Indigenous groups across northern Australia. Information presented is limited to Indigenous knowledge and values that are already in the public domain, e.g. in publications and on web sites.

Parts 2 contains an introduction to the methods used by scientists to study dugongs and marine turtles. Part 2a and Part 2b include summaries of information derived from scientific research on dugongs and the six species of marine turtles living in Australian waters. Much of this information is derived from recently published technical literature reviews on dugongs and marine turtles.

Part 3 contains an overview of legislation, policy, conservation status and management initiatives relating to dugongs and marine turtles in Australia.

References to information sources

Key references are referred to in footnotes throughout the text and listed in full at the end of each chapter; the combined references from all chapters are provided at the end of the document.

+PART 2

SCIENTIFIC UNDERSTANDING OF DUGONGS AND MARINE TURTLES

Scientific names and classification systems

Scientists use a system of naming and classifying animals and plants that provides a name for each species that is recognised worldwide. The classification system is based on scientists' knowledge of each species, and on how similar or different they are to other species. This system was started about 270 years ago in Sweden by a scientist called Carl Linnaeus who collected plants in northern Sweden (where he worked with the Indigenous Sami people) and later studied collections of plants brought back from many parts of the world. This scientific naming system is called the Linnaean system, or the "bi-nomial" system because the name of each species is made up of two parts. For example, the scientific name for Dugong is *Dugong dugon* and the scientific name for Green Turtle is *Chelonia mydas*. The first part of the name refers to the "genus" or closely related group to which the animal belongs; the second part of the name identifies the particular species within that group.

The scientific classification system places all living things into the following hierarchy of groups:

Phylum
Class
Order
Family
Genus
Species

Research and Monitoring

Researchers use a variety of methods to learn about how many dugongs and marine turtles are living in northern Australian waters, where they breed, where and on what they feed, and what are the threats to their long term survival. These methods include aerial surveys, satellite tracking, tagging turtles and counting turtle tracks on beaches. Information on each of these methods is provided below[36].

[36] A more detailed description of turtle monitoring methods can be found in Eckert et al (1999)

Aerial surveys

Aerial surveys have been used to estimate the population of dugongs in several regions of Australia since the 1970s[37]. The same procedure is used for each survey so that the population estimates can be compared over time. Dugongs are counted by two observers who each watch a 200 metre-wide strip of sea on either side of the aircraft (Figure 6). The plane flies at a constant height (137 metres above sea level) and speed (185 km/h) along pre-arranged paths which are perpendicular to the coast.

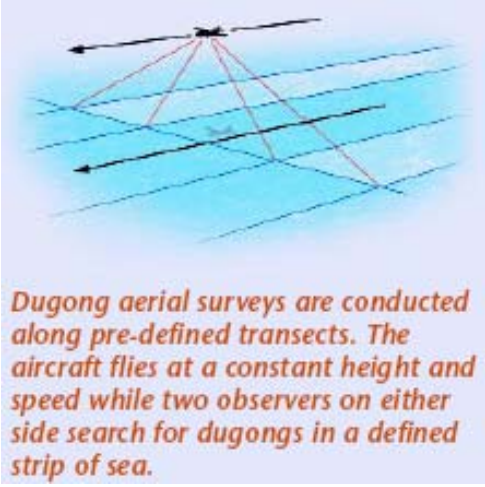

Figure 5: Dugong aerial surveys[38]

The dugong counts are then used to estimate population sizes, taking into account various factors that can influence the number of dugongs seen by the observers. For example, when the water is turbid (not clear), dugongs are difficult to see unless they are near the surface. Fibreglass models of dugongs have been used to measure the depths at which dugongs can be seen from the air in waters of different turbidity and sea condition. Miniature computers have been attached to the tails of 15 dugongs to measure the depths and times of 40,000 dives. This allows researchers to estimate how much time dugongs are likely to be available to observers during aerial surveys in waters of different turbidities, depths and sea conditions.

[37] CRC Reef Research Centre (2002)
[38] http://www.reef.crc.org.au/publications/brochures/dugong_2002.pdf

Marine turtles can also be counted during aerial surveys. However, as it difficult to identify particular turtle species from the air this method is of limited use for turtle research and management.

Satellite tracking[39]

Satellite tracking is a technique for following the movements of individual dugongs or turtles over long distances over several months. A specially designed instrument, which plots the animal's location and depth beneath the water transmits this information to the researcher's computer via a satellite. On a dugong, the satellite transmitter is attached to the tail by a long rope. The rope is padded so that it does not damage the tail and a weak link is installed in the rope so that it will break free if it gets tangled. A timing device is also installed to automatically release the instrument after a set period of time. Satellite tracking devices can also be attached to marine turtles, but they are either glued directly onto their shells, or attached to their shells by a short towing line[40].

Tagging turtles

A reliable way to get information about the movement of turtles over long periods of time is to attach a numbered metal or plastic tag to one of the front flippers, or to insert a tiny microchip tag under turtle's skin (like vets do with dogs). Female turtles can be tagged during or immediately after laying their eggs; turtles can be tagged by capturing them "rodeo-style" while they are swimming. Hatchling turtles are too small to carry a metal tag so researchers have instead marked them by snipping pieces from the edge of the turtle's shell. When turtles are tagged, information such as the date, location and carapace length is recorded; this information can then be compared when the turtle is captured again, perhaps years later. Indigenous hunters and members of the public are encouraged to contact researchers if a tagged turtle is found. In Queensland some nesting populations of marine turtles have been tagged and monitored each year for over 30 years. For example, some female loggerhead turtles that were tagged as hatchlings in 1975 returned to lay their eggs on Mon Repos beach 29 years later[41]. Some researchers also use turtle tags to tag dugongs caught at several places on the Queensland coast.

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[39] http://www.abc.net.au/science/scribblygum/august2004/default.htm
[40] http://www.epa.qld.gov.au/nature_conservation/wildlife/watching_wildlife/turtles/turtle_tracking/
[41] http://www.epa.qld.gov.au/nature_conservation/wildlife/watching_wildlife/turtles/turtle_tracking/

Counting turtle tracks[42]

The tracks of turtles on beaches can be counted to estimate the number of nesting turtles. However, this method is only reliable when there are small numbers of turtles using a beach. If there are large numbers of turtles, the tracks of individual turtles become too hard to count. If more than one turtle species is using the same beach for nesting, the tracks of one species can cover the track of other species.

Turtle tracks are also useful for indicating which beaches are most important as turtle nesting beaches, which is important information to help protect nests from the impact of tourism or other developments.

Aerial surveys of beaches[43]

Aerial surveys are sometimes used to monitor turtle nesting beaches, particularly in remote mainland or island beaches that are difficult or impossible to reach on foot or by vehicle. Photographs taken from the air can be studied later to enable the number of turtle tracks to be counted, and sometimes the turtle species can also be identified from the tracks. Aerial surveys are also used to help decide which areas should be monitored in more detail on the ground.

Egg and hatchling counts[44]

Researchers gather information about turtle populations by counting the number of eggs in each nest, and the number of clutches laid by each female in a breeding season. In addition to the total number of eggs laid, researchers may count the number of eggs without yolks and number of eggs with more than one yolk. Eggs can also be weighed and measured to determine the average egg size for each clutch.

The number of hatchlings that emerge from each nest can also be counted. The "emergence success" of a clutch is calculated as the number of hatchlings that successfully reach the beach surface divided by the total number of yolked eggs laid

[42] Carter (2003)
[43] Carter (2003)
[44] http://www.earthwatch.org/expeditions/bell/bell_04.pdf

in the clutch. This value does not include live and dead hatchlings found in the egg chamber when the nest is excavated.

Examinations of reproductive organs[45]

Researchers sometimes examine the reproductive organs of turtles to determine the sex of hatchlings, the sexual maturity and breeding condition of adults. This is done using an instrument called a laparoscope, which is inserted through a small cut in the skin and which enables the male or female reproductive organs to be visually inspected. Laparoscopic examinations enable researchers to determine whether adults are mature enough to breed, and whether females have previously produced eggs. Studies in Queensland over many years have shown that turtles that have undergone laparoscopic examination breed just as successfully as those that have not been subjected to this procedure.

Population genetics[46]

Population genetics refers to studies undertaken to find out how animals of one species are related, and can be grouped into separate breeding populations (also called stocks). The most common way researchers determine breeding populations is by examining small tissue samples (e.g. a very small piece of skin) for particular genetic material (molecules) that are passed on through the female line (usually mitochondrial DNA). Individuals that belong to a particular breeding population have the same molecules; and these molecules are different to equivalent molecules from the same species but which belong to a different breeding population. So when members of different breeding populations come together to feed it is still possible to identify which individuals belong to which breeding population, and for turtles which area they will breed. This can be very important information for making management decisions to support the survival of particular species – for example to ensure that nesting beaches used by each breeding stock of a turtle species are protected.

[45] http://www.earthwatch.org/expeditions/bell/bell_04.pdf
[46] Marsh et al (2002); Moritz et al. (2002)

Part 2a: Dugongs

Knowledge and concerns about dugongs based on scientific research

English name: Dugong, Sea Cow
English classification: Marine mammal

Scientific name: *Dugong dugon*
Scientific classification: Class Mammalia; Order Sirenia; Family Dugongidae

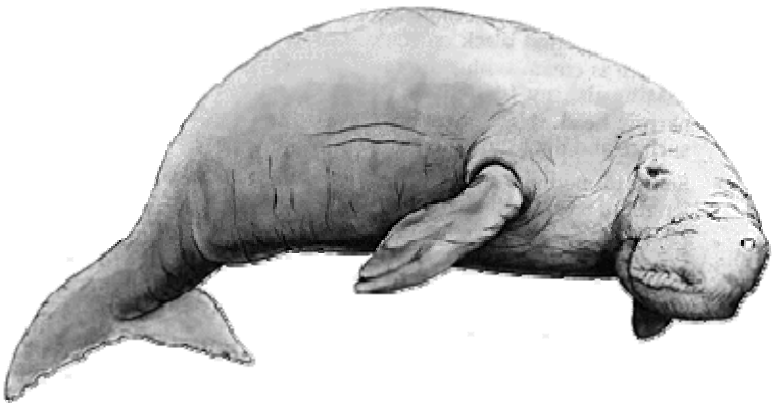

Figure 6: Dugong[47]

The following information on dugong biology and management is derived from recently published technical literature reviews on dugongs[48] and other sources identified with footnotes throughout the text.

Dugongs are classified as mammals because they:

- Maintain a warm body temperature;
- Feed their young with milk;
- Have sparse hair on their bodies.

[47] Photo source: http://www.gbrmpa.gov.au/corp_site/info_services/publications/dugong/

[48] Saafield and Marsh (2004) and Marsh et al. (2002)

Dugongs are classified in the Order Sirenia. They share the following characteristics with other species in this Order:

- Spend all their lives in water;
- Eat aquatic plants almost exclusively;
- Heavy, fish-like bodies with a horizontally flattened tail fin;
- No hind limbs;
- Forelegs are modified into flippers;
- Female has a pair of mammary glands, one near the base of each flipper.

Dugongs are the only living species in the Family Dugongidae. Another member of this family, Steller's Sea Cow (*Hydrodamalis gigas*), is now extinct (see Box 1)

Box 1: *What happened to the Steller's Sea Cow?*[49]

The Steller's Sea Cow, which grew up to 10 metres in length and weighed up to 6,000 kg, used to live in the cold waters of the Bering Sea between Alaska and Russia. The species became extinct due to over-hunting by European sealers in 1768, less than 30 years after being discovered by Russian sealers. Previous populations had occurred along the Pacific Rim from Mexico to Japan but had gradually become more restricted. Steller's Sea Cow fed on kelp and became so well adapted to shallow waters that it could no longer dive, making it easy prey for hunters. It was the first marine mammal recorded as becoming extinct in recent times.

The only other living species of the order Sirenia belong to the Family Trichechidae, which includes three species of Manatees (also known as Sea Cows). Instead of a forked tail like the dugong, manatees have a paddle-shaped tail.

The **West Indian Manatee** (*Trichechus manatus*) (Figure 7) grows to about 3.3 metres long and lives in coastal areas of the southeastern United States, eastern Mexico, Central America, the Greater Antilles (West Indies), and along the northern

[49] http://www.gbrmpa.gov.au/corp_site/info_services/publications/turtle_conservation/ip_biological_notes.html

and eastern coasts of South America. These animals live in salt, fresh or brackish waters and feed on marine, estuarine and freshwater plants.

Figure 7: West Indian Manatee[50]

The **Amazonian Manatee** (*Trichechus inunguis*) (Figure 8) lives in the freshwater of the Amazon River and its tributaries in South America. This is the smallest member of the family Trichechidae (up to 2.8 metres in length), has smooth skin, no nails on its flippers and feeds on freshwater vegetation. It feeds on aquatic plants floating on the water surface (e.g. water lilies) and aquatic grasses near the water's edge[51].

Figure 8: Amazonian Manatee[52]

West African Manatee (*Trichechus senegalensis*) (Figure 9) lives in coastal marine waters, estuaries and rivers of West Africa and grows to between three and four metres long. They eat overhanging vegetations such as mangroves rather than aquatic plants[53].

[50] http://www.savethemanatee.org/manfcts.htm
[51] http://www.animalinfo.org/species/tricinun.htm#data
[52] http://www.brazilianfauna.com/amazonianmanatee.php
[53] http://www.animalinfo.org/species/tricsene.htm

Figure 9: West African Manatee[54]

Figure 10 shows the approximate distribution of five species of Sirenians described above.

Figure 10: Where Sirenians are found around the world[55]

Origins of Dugongs and other Sirenids

Scientists believe dugongs and other the Sirenian species evolved from early plant-eating mammals living in coastal swamps in the African region about 45 million years ago, during what is known as the Eocene Period. Elephants are the closest land

[54] http://www.scienceinafrica.co.za/2005/january/manatee.htm
[55] http://www.sirenian.org/images/distribution.jpg

relative of dugongs today. Fossil Sirenians are found in many parts of the world that no longer support living species, indicating that Sirenians used to have a much greater distribution than they do today. In addition, there used to be many more species of Sirenia than there are today.

Characteristics of Dugongs[56]

Size and weight

Dugongs are about 112 cm long and weigh about 30 kg when they are born. They grow to about 3 metres long and can weigh up to about 450kg.

Distribution and populations

Dugongs live in tropical and sub-tropical, shallow coastal waters in the western Pacific, Australia, south-east Asia, India and the east coast of Africa in the Red Sea, which includes the coastal waters of 48 countries (see Figure 11). Published information about populations of dugongs over much of this range is limited to reports of dugongs that have drowned accidentally in fishing nets, observations from fishers and other incidental sightings. More detailed information for limited coastal areas of some countries is available, but systematic aerial surveys have only been carried out in the Arabian Gulf region, New Caledonia and northern Australia. It is therefore not possible to give an accurate estimate of the total world dugong population or the status of dugong populations in particular regions. Estimates of regional dugong populations are complicated by the large scale movements of dugongs that occur from time to, for example as a result of changes in availability of food.

From the information that is available, however, researchers have concluded that over much of the known international range of dugongs only small, isolated populations of dugongs remain, separated by large areas where they are close to extinction or are already extinct. Because dugongs are slow to reproduce and are dependent for food on seagrass that grows mostly in shallow coastal water, these animals are particularly vulnerable to human impacts, which include:

- Damage to seagrass beds from trawling or build-up of silt caused by mining, poor catchment management or coastal development;

[56] Information in this section is based largely on reviews of dugongs by Saalfeld and Marsh (2004) and Marsh et al. (2002); additional information indicated by footnotes.