MARINE MANAGEMENT SUPPORT
SHARK BAY

DISTRIBUTION AND MOVEMENT PATTERNS OF SHARK BAY DUGONGS:

Data Report: MMS/SBY/SBA – 62/2002

A collaborative project between CALM Marine Conservation Branch, CALM Shark Bay District, Yadgalah Aboriginal Corporation, Edith Cowan University and James Cook University.

A project funded through

Coasts & Clean Seas

Lotteries Western Australia
Millions Won. Thousands Helped.

Prepared by
D.K. Holley
Marine Conservation Branch

January 2003

Marine Conservation Branch
Department of Conservation and Land Management
47 Henry Street, Fremantle
Western Australia 6160

ACKNOWLEDGEMENTS

The Marine Conservation Branch (MCB) of the Department of Conservation and Land Management would like to thank the following people for their contribution to the project.

- Dr. Nick Gales - Australian Antarctic Division.
- Benny, Brendan and Dianne Bellottie, Kim and Jimboy Poland, Daniel Cocks, Darren Capewell and the Committee – Yadgalah Aboriginal Corporation (Inc.).
- Dave Rose, Kevin Crane, Richard Hall and Brad Barton – Shark Bay District, Department of Conservation and Land Management
- Dr. Ivan Lawler, James Sheppard and Prof. Helene Marsh. - James Cook University
- Dr. Paul Lavery, Nick Wood and Mark Westera – Edith Cowan University
- Craig and Jessie Shankland - James Scheerer Research Charters.

Other CALM contribution

- Gordon Wyre – A/Director Nature Conservation
- Dr. Chris Simpson – Manager Marine Conservation Branch.
- Nick D'Adamo - Section Leader, Marine Management Support, Marine Conservation Branch
- Phil Kindleysides – GIS presentation, Marine Conservation Branch

---

This report may be cited as:

Holley, D.K. (2003). Distribution and movements patterns of Shark Bay dugongs: Data Report MMS/SBY/SBA-62/2002. (Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St., Fremantle, Western Australia, 6160). Unpublished report.

Copies of this report may be obtained from:

Marine Conservation Branch
Department of Conservation and Land Management
47 Henry St.
Fremantle, Western Australia, 6160

Ph: (08) 9336 0100
Fx: (08) 9430 5408

SUMMARY

Shark Bay, Western Australia, was listed on the World Heritage register with a number of significant conservation values. These values as listed in the Shark Bay Marine Reserves Management Plan (CALM, 1996- 2006) include a large and secure population of dugongs (*Dugong dugon*) and the largest seagrass meadows in the world with an unusually high species diversity. Within the Management Plan a number of strategies are outlined in order of priority to maintain these values. Of these strategies there is need in the short term for further research into dugong distribution, biology and behaviour in the reserves as well as a medium term need to encourage the wise management of important dugong habitats outside the reserves

This data report presents results obtained from the deployment of location recording and transmitting tags on dugongs within the Shark Bay World Heritage Property during the period March 2000 through to September 2002. The project was a collaboration between the Marine Conservation Branch, Wildlife Branch and Shark Bay District of the Department of Conservation and Land Management, Shark Bay Yadgalah Aboriginal Corporation Inc., Edith Cowan University and James Cook University.

Funding for this project has been provided through the Western Australian Lotteries Commission, UNESCO World Heritage, and the Natural Heritage Trust, Coast and Clean Seas program.

CONTENTS

1. INTRODUCTION 1
1.1 Background 1
1.2 General 1
1.3 Project Objectives and Purpose 2
2. METHODS 3
2.1 Study Area 3
2.2 Mapping 3
2.3 Capture and Deployment 5
2.4 Tag Descriptions 7
2.5 Data Retreival and Projection 9
2.6 Spatial Analysis 9
3. RESULTS 10
4. METADATA 11
5. DATA MANAGEMENT 11
5.1 Report 11
5.2 GIS Layers 11
6. REFERENCES 12
APPENDIX – METADATA FOR DISTRIBUTION OF TAGGED DUGONGS IN SHARK BAY 2000-2002 18

* * *

FIGURES

Figure 1. Location map of the Shark Bay World Heritage Property. 4
Figure 2. Distribution of all PTT tagged dugongs in Shark Bay 2000-2002. 14
Figure 3. Distribution of all GPS tagged dugongs 2000-2002. 15
Figure 4. Combined distribution of dugongs 2000-2002. 16

* * *

TABLES

Table 1. Location classes for fixes determined by Service Argos. 9
Table 2. Details of dugongs tagged during the period March 2000 – August 2002 10

1. INTRODUCTION

1.1 BACKGROUND

The dugong (*Dugong dugon*), which is the only herbivorous marine mammal that is strictly marine, is listed as vulnerable to extinction at a global scale on the World Conservation Union (IUCN) Red List of Threatened Species (IUCN, 2002). A recent dugong status report and action plan for countries and territories, produced for the United Nations Environment Program (UNEP) details that throughout much of its range, the dugong is represented by relict populations separated by large areas where its numbers have been greatly reduced or it is already extirpated (Marsh *et al*, 2002).

Whilst Australian waters contain possibly the largest remaining dugong populations in the world, there is strong evidence of significant population decline in some parts of the dugong's Australian range (Marsh, 2000). Threats to dugongs include, but are not restricted to, fishing practices, hunting, habitat degradation, and disturbance from activities such as aquaculture and tourism. Effective conservation of these populations is a major requirement for the survival of the species globally.

The Shark Bay World Heritage Property on the mid west coast of Western Australia is a location with a large and stable dugong population exposed to limited threatening activity. Within the Shark Bay Marine Reserves Management Plan 1996-2006 (CALM, 1994), a number of strategies are outlined in order of priority to maintain this population's stability. Of these strategies there is need in the short term for further research into dugong distribution, biology and behaviour in the reserves as well as a medium term need to encourage the wise management of important dugong habitats outside the reserves

1.2 GENERAL

The Shark Bay World Heritage Property is located at the southern extremity of dugong distribution on the Australian West Coast and approximates the southward limit of large dugong concentrations on the eastern Australian coast at Moreton Bay (Anderson, 1982). Aerial surveys of dugongs conducted since 1977 (Marsh, 1994; Prince, 1979; Preen, 1997) have shown that

Shark Bay is a location with a significant dugong population. Results from these surveys indicate that Shark Bay has supported a stable population of ~ 10,000 individuals over the last decade with the latest estimate at approximately 12,000 individuals (Holley, unpublished data). It is the most important known dugong area in the Indian Ocean (Preen, 1997).

Variations between winter and summer aggregations in Shark Bay have been identified (Prince, 1979; Anderson, 1982a; Anderson, 1982b) with distribution appearing to be predominately temperature and seagrass dependent (Anderson, 1986; Marsh, 1994). These aggregations have been confirmed from three major winter aerial surveys in July 1989, June 1994 and July 1999 (Marsh, 1994; Preen, 1997, Gales, unpublished data), as well from surface vessels and other aerial surveys (Prince, 1979; Anderson, 1998; Anderson, 1986; Anderson, 1982b; Anderson, 1982a). Anderson (1986) suggested that water temperature determined the movements of dugongs in the bay throughout the year and that dugongs are forced to migrate from summer feeding grounds to a winter refuge to minimise low temperature stress. This movement pattern has clear implications for population management and was the driving force in the establishment of this program using remote recording devices to further understand dugong movement patterns within the Shark Bay World Heritage Property.

Satellite transmitter terminals have been used to analyse the movements and home ranges of individual dugongs along the tropical and subtropical north and east coasts of Australia (Marsh and Rathbun 1990; Preen, 2001) and in a tropical island system in East Indonesia (DeIongh 1996). The only other studies on movements of individual dugongs within Shark Bay were conducted on the basis of sketches, photographs and paint marked animals (Anderson, 1982a).

1.3 PROJECT OBJECTIVES AND PURPOSE

The objectives of this project were to determine the feasibility of tracking individual dugongs using a combination of satellite Platform Transmitter Terminals (PTT) tags and Geographical Positioning Systems (GPS) tags as tools for determining movements of individual dugongs in Shark Bay. Results obtained show the spatial and temporal distribution of tagged dugongs during the project period.

The purpose of this report is to outline the methods used in the catching and tagging of dugongs, describe tag capabilities and spatial accuracy, and to present maps showing the distribution of tagged dugongs in relation to current Marine Park boundaries.

2. METHODS

2.1 STUDY AREA

Shark Bay is located on the western most point of the Australian coast between latitudes 24^0 35'00" and 27^0 00'00" (Figure 1). It is a large (13 000km^2), shallow (mainly <15m) basin with restricted oceanic exchange and high rates of evaporation (Logan *et al,* 1970). The bay is located near the northern limit of a transition region between temperate and tropical marine flora and fauna (CALM, 1994).

2.2 MAPPING

Information layers were constructed using ArcView GIS 3.2 (ESRI) software.

Detailed descriptions of methods used in mapping are provided in the metadata statement (see Appendix).

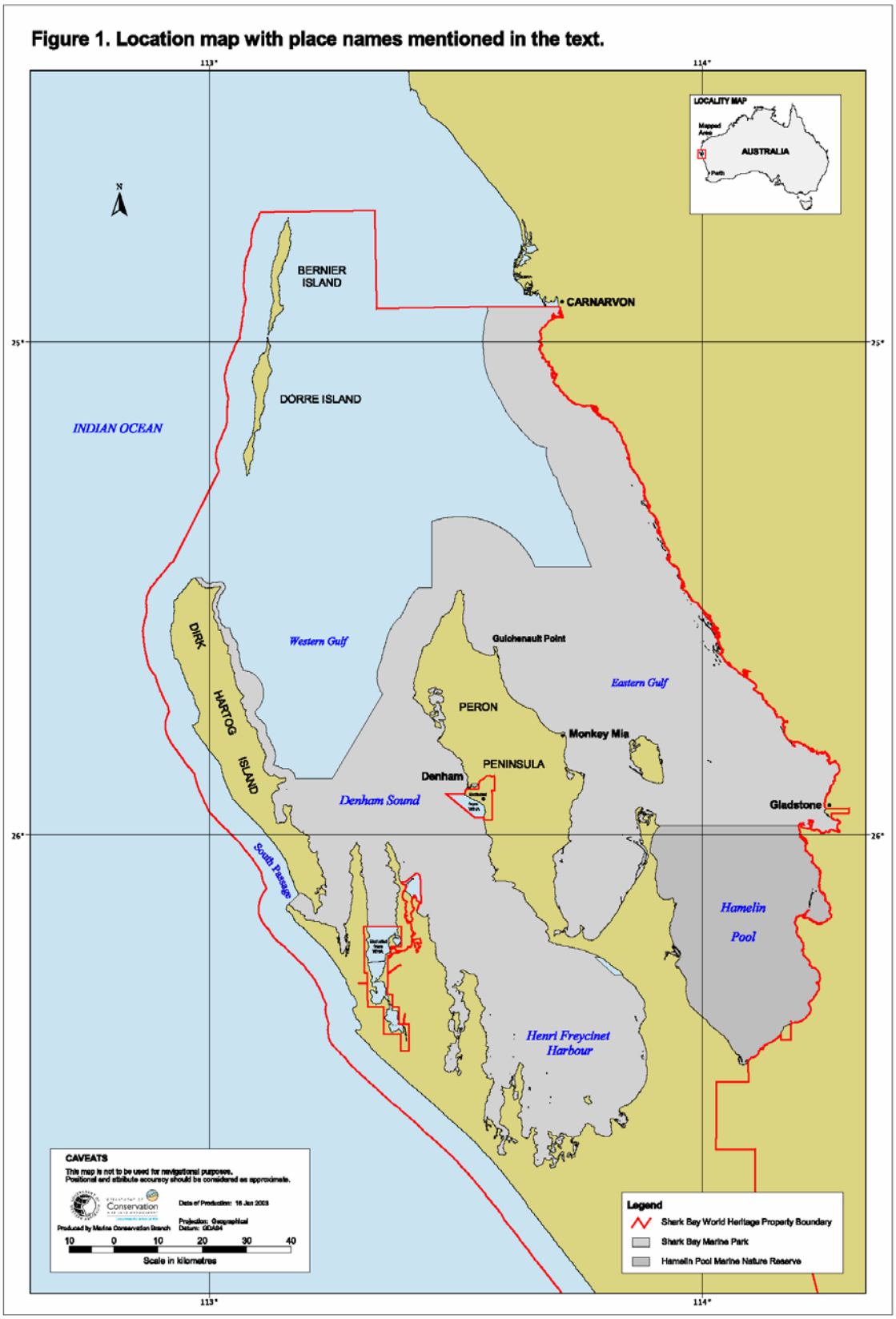

Figure 1. Location map of the Shark Bay World Heritage Property.

2.3 CAPTURE AND DEPLOYMENT

A total of six deployments were undertaken during the project period, March 2000 to September 2002 (Holley, 2002 a, b, c) Dates of each deployment are presented in Table 2.

Dugong capture sites were selected from areas of known seasonal dugong aggregation determined by aerial surveys (Anderson, 1986; Preen *et al,* 1994; Marsh *et al,* 1997; Gales *et al* 2002) and anecdotal references from local fisherman. Dugongs were captured using a 'chase and grab technique', modified from a 'rodeo' system (Limpus 1978) developed for the capture of marine turtles. This technique has been developed as an alternative to the use of a hoop-net capture system (Preen, 1992), and has been successfully applied to dugong captures in shallow water in Queensland over the past few years (J. Lanyon, personal communication)

The capture technique requires candidate dugongs to be in water depths of less than about 1.8m at the point of restraint. Dugongs move up onto shallow sea grass beds to feed with the edges of these banks visually surveyed from two small boats travelling approximately 100m apart.

When dugongs move into shallow waters they commonly do so in groups and cow-calf pairs are often included in such feeding herds. The capture technique requires an intense period of pursuit and herding during which an acute level of disturbance is caused to the target animal and any dugongs in the immediate vicinity. In areas of high dugong density boat-dugong collisions are a real risk. As a result, the following capture selection protocol was developed:

- Dugongs in, or close to, water of 1-1.8m were selected. The catch sequence was not initiated until the animal had moved at least 50m from water >1.8m.

- Only dugongs estimated to be >2.2m were selected. These animals were assumed to be of sufficient age to be nutritionally and socially independent.

- Where possible dugongs >100m from other dugongs were selected.

- When capturing dugongs from a herd, animals on the edge were selected, and the pursuit and herding procedure attempted to direct the dugong away from the group. A maximum of two capture attempts from any one herd (group within about 100m of each other) was made.

- Captures were not made from groups containing cow-calf pairs.

Once a suitable dugong was located the GPS co-ordinates were recorded and the catch boat (5.4m, centre-console, fibreglass hulled, inflatable Zodiac powered by a 50HP four-stroke Yamaha outboard) approached the dugong at less than wake speed (approximately 5km/hr) from between it and the nearest deep water. The approach was maintained until the dugong was startled and swam rapidly away from the capture boat; the time was recorded and the chase commenced.

The three dugong catchers on the bow of the catch boat would maintain visual contact with the dugong and point towards it to direct the boat driver, who would attempt to position the boat into the capture position immediately behind and just to one side of dugong. If the dugong headed for deep water, as was often the case, the catch boat would attempt to move to the side and just ahead of the dugong and herd it back towards shallow water. If necessary, a second smaller boat would assist with the herding operation and might temporarily take over the primary chase position (just behind the dugong) if the dugong turned suddenly and temporarily evaded the chase boat.

The initial chase speed was likely to be the maximum swimming speed of the dugong in shallow waters (approximately 20-30km/hr). Great care was needed to co-ordinate the close manoeuvres of the two boats around the dugong. High-speed chases were aborted if a capture had not been affected within 3 minutes, or the dugong had taken more than three breaths. Chases in excess of either of these limiting parameters only occurred if the dugong slowed down to rest, taking several breaths, at a time when the capture boat had not been able to maintain the catch position. Dugongs are not capable of sustained high-speed swimming and rapidly become exhausted during this type of pursuit.

During a chase the pursued dugong would slow down and come to the surface to breath. The breath cycle takes at least two seconds, during which the animal first presents it head at the surface, inhales, and then raises its back and tail peduncle to the surface prior to diving. If the catch boat is in position during a surfacing, the dugong is allowed to take a full breath, and, when

the back and tail peduncle are presented, the nominated catcher leaps from the boat onto the dugong and wraps his arms rapidly and firmly around the peduncle. It is essential to establish this firm grip prior to the animal being able to establish a powerful tail beat, as this is likely to dislodge and potentially injure the catcher.

Once the grip is established the catcher then stands up with the dugong's fluke held down against his body. Two other catchers immediately follow the primary catcher into the water and attempt to grip one each of the dugong's pectoral fins. During the establishment of the restraint, the capture boat manoeuvres alongside and an additional person enters the water from the second boat with a 120 x 12cm foam flotation device ('noodle') with 1.2m of rope attached to each end. This is placed under the dugong, immediately behind the pectoral fins with the ropes being secured to an inflatable pontoon of the capture boat. The noodle acts as a cradle preventing the animal from rolling and ensures that the animal is able to lift its head out of the water to breathe. The primary catcher continues to hold the dugong by the tail fluke. If during any stage of the restraint and stabilisation procedure the dugong was not able to acquire a breath for a period in excess of 30secs, the animal is released immediately.

Once secured alongside the boat the following procedures are undertaken:

- Measurements of standard length (straight lie from tip of face to mid-fluke) and of axillary girth.
- Dorsal skin biopsy taken with a 5mm biopsy punch.
- Application of temporary paint mark using a non-toxic livestock marker.
- Determination of sex from inspection of anal-genital openings.
- Collection of facial vibrissae for stable isotope analysis.
- Application of the archival GPS or PTT tag.

2.4 TAG DESCRIPTIONS

Three types of floating positioning tags were used during the study period. These were, Telonics Platform Transmitter Terminal (PTT) satellite tags and combination PTT/GPS- Gen-II GPS tags (Telonics, Inc. Mesa, AZ, USA.) and Lotek MGS_3 Geographical Positioning System (GPS) tags

(Lotek Fish and Wildlife Monitoring Systems, Newfoundland, Canada.). The tags are attached to the dugong by a flexible tether to a padded harness around the base of the tail as described in Marsh and Rathbun (1990). All tag types incorporate a very high frequency (VHF) radio beacon for field tracking from either boat or plane. The Lotek and Telonics Gen-II tags are user programmable, with fix acquisition rates that can be set at between five minutes and six hours. With a frequent acquisition rate, e.g. every five minutes, there is an associated power cost that reduces the length of deployment. It is necessary to retrieve these tags via by intensive radio telemetry in order to access location information, as the tag's position cannot be accessed remotely.

To enable retrieval of the Lotek tags a remote release mechanism was designed and built into the units. This eliminates the need to recapture the dugong to retrieve the tag, and allows the tag to be retrieved at will. To operate the system, visual contact needs to be made with the tag floating behind the dugong. A unique VHF signal is fired at the unit from a distance no greater than 500m. This triggers a nine-volt charge along the tether to the harness, where a section of the harness wire is exposed. This activates an electrolytic reaction, resulting in the wire breaking and the harness and tag breaking away in free-floating mode from the animal.

The tags, up to 63cm in length and 2.7kg in weight, are neutrally buoyant and torpedo shaped to minimise drag. As dugongs are slow moving grazing herbivores, energy expenditure as a result of towing the tag is considered to be minimal and of little consequence to the animals normal behaviour.

The PTT units are smaller than the GPS units at 50cm long and 2.4kg in weight and are attached in the same manner as the GPS tags. Although these units transmit data, it is ideal to recover the units enabling them to be reprogrammed and reused. To enable this a corrodible link is built into this system. This link holding the harness around the dugongs tail corrodes after a six-week period, releasing the harness and the unit in free-floating mode. PTT's operate by transmitting a signal at regular intervals that is received by the Argos system of satellites. Positions are then relayed back to a base station and are accessible through the Internet. Effective for the determination of large scale movement patterns, PTT's are erroneous in the range of 150 – 4000m. This has implications in determining habitat usage as misclassification can occur because the true location of a radio marked animal can only be estimated.

2.5 DATA RETRIEVAL AND PROJECTION

At each successful GPS fix attempt the Lotek MGS_3 GPS tags and the Telonics Gen-II GPS tags record latitude and longitude in milliseconds in the World Geodetic System 1984 (WGS 84) datum. The units also record: time, date, temperature, receiver status, activity sensor values and satellite information including satellite identification and signal strength.

For retrieval of data from the Lotek and Telonics Gen II tags a Download Link Unit is required. This unit connects to the tag via a specialised serial cable and connects to the computer through a port interface. Running software specific to each tag type, data are retrieved and formatted into a comma-delimited file (.csv).

Location data from the PTT units are accessed through Service Argos. In addition to the fields listed above these units record the location class of each fix. Location classes and estimated accuracy determined by service Argos during the deployment periods are listed in Table 2.

Table 1. Location classes for fixes determined by Service Argos.

CLASS	ESTIMATED ACCURACY IN LATITUDE AND LONGITUDE.
3	< 150m
2	150m ≤ accuracy <350m
1	350m ≤ accuracy <1000m
0	>1000m

2.6 SPATIAL ANALYSIS

Once location and sensor data are retrieved from each unit, they are saved into text-delimited files (.txt) and imported into ArcView 3.2, Geographic Information System package (ESRI, Redland, CA, USA). Each recorded position is viewed as a point in relation to an enhanced map of the Western Australian coastline showing Shark Bay. Existing GIS datasets of existing Marine Park, Nature Reserve and World Heritage boundaries were imported and presented relative to dugong distribution.

3. RESULTS

Results showing the distribution of all tagged animals are presented as a series of maps (Figures2-4). Figure 2 shows the distribution of dugongs tagged with satellite PTT's while Figure 3 presents the distributions of all animals tagged with GPS tags. Figure 4 shows the combined distribution of all tags. All maps show current Marine Park, Nature Reserve and World Heritage Boundaries. Details of tags deployed and the sex of each animal along with deployment duration of each tag are presented in table 2.

Table 2. Details of dugongs tagged during the period March 2000 – August 2002

UNIT ID	TAG TYPE	SEX	DEPLOYMENT DATE	RETREIVAL DATE
5534	PTT	M	23/03/2000	25/10/2000
5519	PTT	M	22/03/2000	11/12/2000
5536(1)	PTT	M	23/03/2000	04/04/2000
5536(2)	PTT	M	06/04/2000	28/05/2000
5065	PTT	M	22/03/2000	05/04/2000
5535	PTT	F	23/03/2000	23/10/2000
5537	PTT	M	22/03/2000	16/08/2000
1311	PTT	M	16/05/2001	01/07/2001
8001	GPS	M	15/08/2000	05/10/2000
8002	GPS	M	16/08/2000	04/10/2000
8003	GPS	F	16/08/2000	03/10/2000
8004	GPS	F	17/08/2000	21/09/2000
8005	GPS	M	17/08/2000	01/10/2000
7301	GPS	F	18/09/2001	28/09/2001
7001	GPS	M	20/09/2001	28/09/2001
0803	GPS	M	21/03/2002	11/05/2002
0702	GPS	F	17/06/2002	25/07/2002
0606	GPS	M	18/06/2002	09/08/2002
0602	GPS	M	19/06/2002	04/07/2002
0603	GPS	M	20/06/2002	02/07/2002

4. METADATA

The metadata associated with the distribution of tagged dugongs within the Shark Bay World Heritage Property presented in the map series are included in the Appendix.

5. DATA MANAGEMENT

5.1 REPORT

Hard copies of this report will be held at the following locations:

1. Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry Street, Fremantle Western Australia, 6160. Ph: (08) 9336 0100 Fax: (08) 9430 5408.

2. Woodvale Library, Science and Information Division, Ocean Reef Road, Woodvale, Western Australia, 6026. Ph: (08) 9405 5100 Fax: (08) 9306 1641.

3. Archives, Woodvale Library, Science and Information Division, Ocean Reef Road, Woodvale, Western Australia, 6026. Ph: (08) 9405 5100 Fax: (08) 9306 1641.

4. Shark Bay District, Department of Conservation and Land Management, 67 Knight Terrace, Denham, Western Australia, 6537. Ph: (08) 9948 1208 Fax: (08) 9948 1024.

5. Midwest Region, Department of Conservation and Land Management, 193 Marine Terrace, Geraldton, Western Australia, 6530. Ph: (08) 9921 5955 Fax: (08) 9921 5713.

Digital copies of this report will be held at the following:

1. The Marine Conservation Branch server:
   Shareddata on 'Calm-frem-1'
   [T:\144-Marine Conservation Branch\Shared Data\Current_MCB_reports\MMS\mms_6202]

2. The Marine Conservation Branch server full backup DAT tape:
   Shareddata on 'Calm-frem-1'
   [T:\144-Marine Conservation Branch\Shared Data\Current_MCB_reports\MMS\mms_6202]

3. CD ROM held at Marine Conservation Branch and Archives (Woodvale Library, Science and Information Division):
   CD-ROM [mms_6202]

5.2 GIS LAYERS

The data presented in the form of GIS information layers will be stored digitally in the Marine Information System (MIS) on the MCB Server and the MCB Server full backup DAT tape.

6. REFERENCES

Anderson, P. K. (1982a). "Studies of dugongs at Shark Bay, Western Australia. II. Surface and subsurface observations." Australian Wildlife Research **9**: 85-99.

Anderson, P.K. (1982b) "Studies of dugongs at Shark Bay, Western Australia I. Analysis of Population size, composition and habitat use on the basis of aerial survey." Australian Wildlife Research **9**: 69-84.

Anderson, P. K. (1986). "Dugongs of Shark Bay, Australia- seasonal migration, water temperature and forage." National Geographic Research **2**: 473-90.

Anderson, P.K. (1998) "Shark Bay dugongs (*Dugong dugon*) in summer II: Foragers in a *Halodule*-dominated community". Mammalia **62**: 409-425.

De Iongh, H.H. (1996) "Plant-Herbivore interactions between seagrasses and dugongs in a tropical small island ecosystem". PhD thesis, Centre for Environmental Science. Leiden University, Netherlands, 205p.

Holley, D.K. (2002a,b,c) "Movements and community based conservation of dugongs - Deployment and retrieval of location recording devices on dugongs". Field Program Reports. Unpublished reports.

Limpus, C.J. (1978) "The reef: uncertain land of plenty". Richmond Hill Press, Richmond, Victoria.

Department of Conservation and Land Management (1996). "Shark Bay Marine Reserves - Management Plan 1996-2006". Perth, National Parks and Nature Conservation Authority**:** 100.

Marsh, H. and G. B. Rathbun (1990). "Development and application of conventional and satellite radio tracking techniques for studying dugong movements and habitat use." Australian Wildlife Research **17**: 83-100.

Marsh, H., R. I. T. Prince, et al. (1994). "The distribution and abundance of the dugong in Shark Bay, Western Australia." Wildlife Research **21**: 149-161.

Preen, A.R., Marsh, H., Lawler, I.R., Prince, R.I.T., and Shepherd, R. (1997). "Distribution and abundance of dugongs, turtles, dolphins and other megafauna in Shark Bay, Ningaloo Reef and Exmouth Gulf, Western Australia". Wildlife Research **24**: 185-208.

Preen, A. (2001). "Dugongs, boats, dolphins and turtles in the Townsville-Cardwell region and recommendations for a boat traffic management plan for the Hinchinbrook Dugong Protection Area". Great Barrier Reef Marine Park Authority**:** 92.

FIGURES

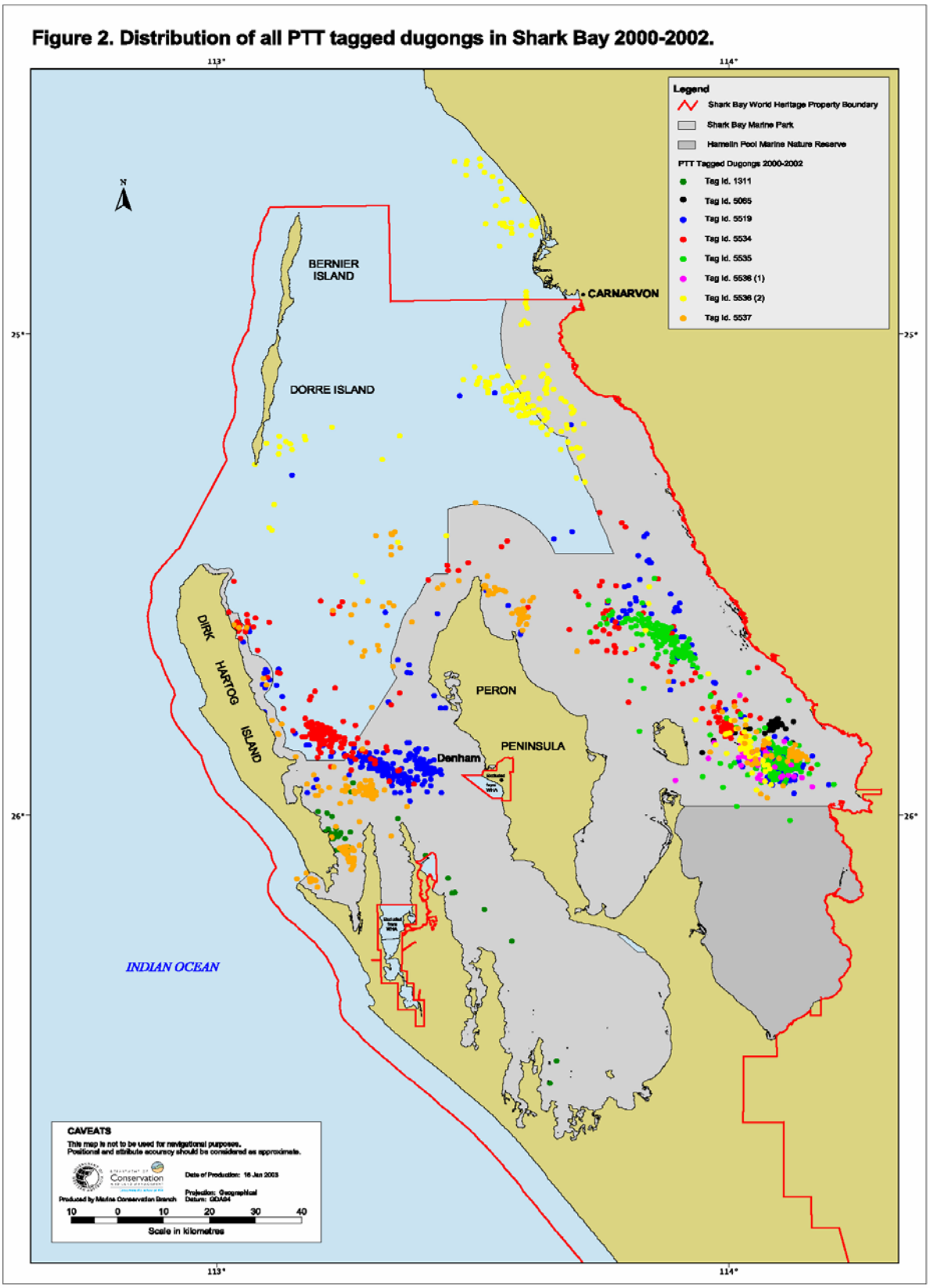

Figure 2. Distribution of all PTT tagged dugongs in Shark Bay 2000-2002.

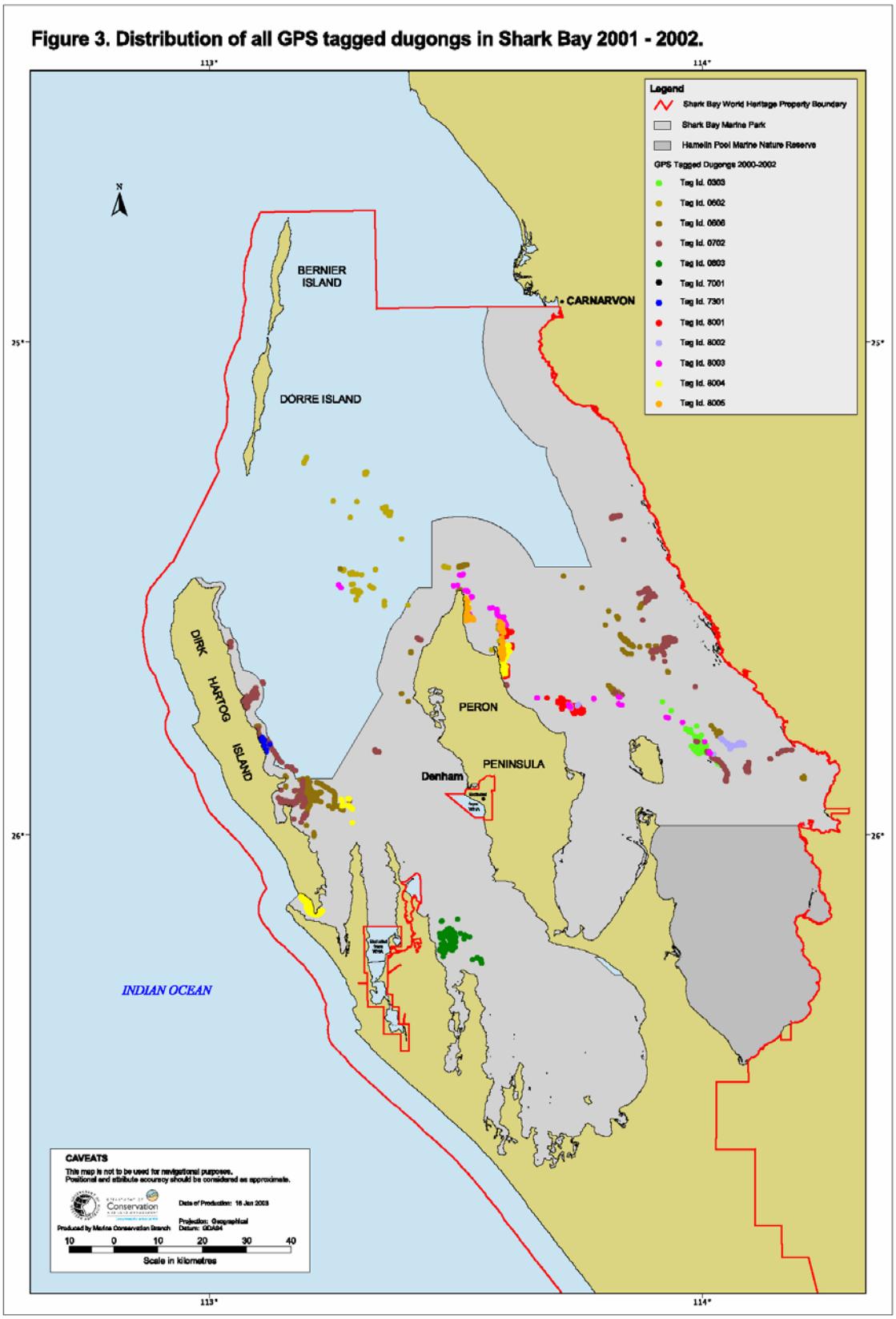

Figure 3. Distribution of all GPS tagged dugongs 2000-2002.

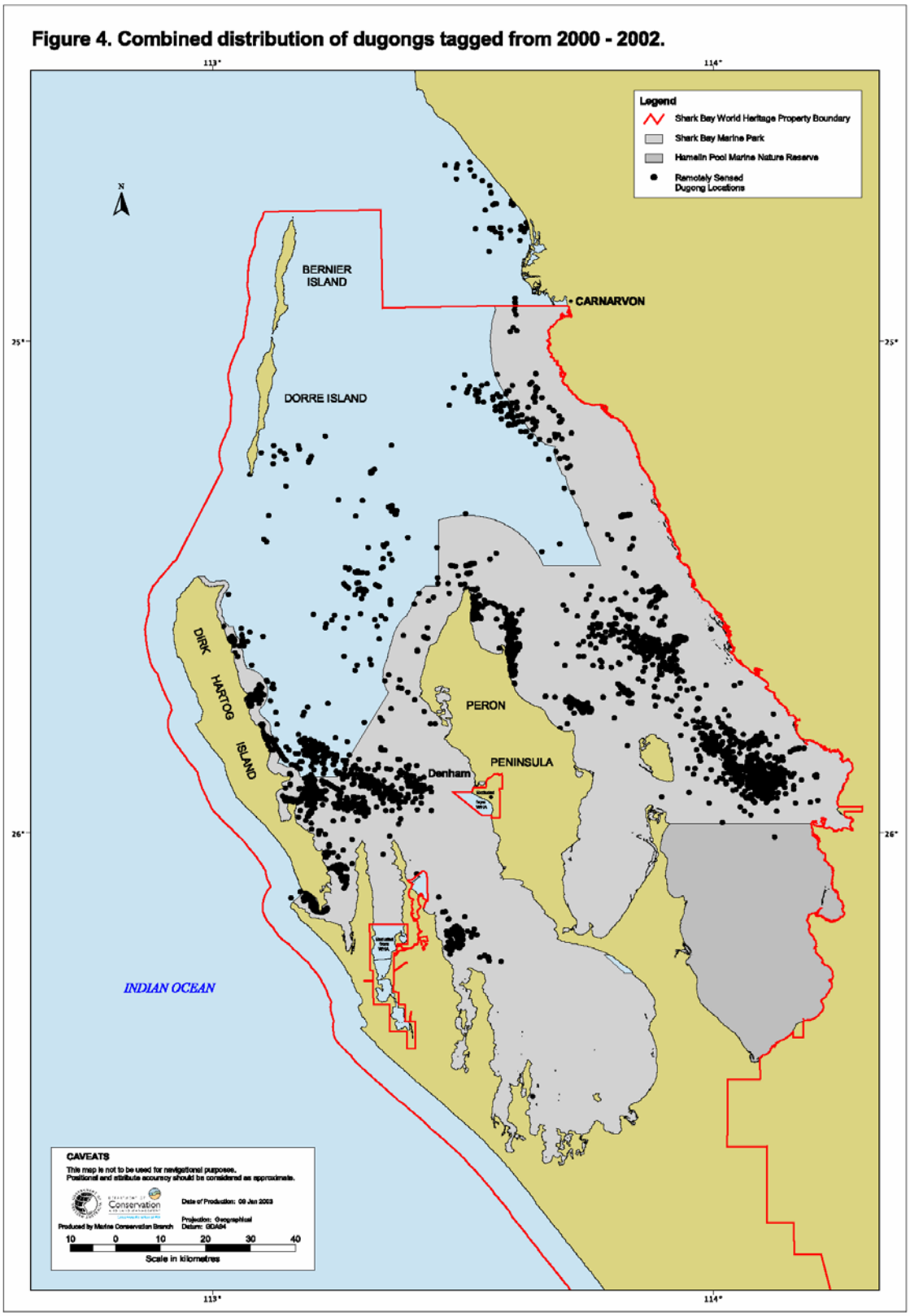

Figure 4. Combined distribution of dugongs 2000-2002.

APPENDICES

APPENDIX – Metadata for distribution of tagged dugongs in Shark Bay 2000-2002.

DATASET	
Title	***Remotely Sensed Dugong Locations Within The Shark Bay World Heritage Property.***
Custodian	*Department of Conservation and Land Management (CALM)*
Jurisdiction	*Western Australia*
DESCRIPTION	
Abstract	*This dataset consists of location points obtained from GPS data loggers and Satellite Platform Transmitter Terminals (PTT) attached to dugongs to determine large and fine scale movement patterns within the Shark Bay World Heritage Property (SBWHP).* *The length of deployment for each animal ranges from 10days to 11months with all locations falling within the boundaries of the SBWHP.*
Search Word(s)	*Dugong (Dugong dugon), remote tracking, movement patterns, Platform Transmitter Terminals (PTT), Geographical Positioning Systems (GPS).*
Geographic Extent Name(s)	*Shark Bay (SBY) and Zuytdorp (ZUY) IMCRA Regions*
DATA CURRENCY	
Begin Date	*22/03/2000*
End Date	*09/08/2002*
DATASET STATUS	
Progress	*Complete*
Maintenance & Update Frequency	*As required*
ACCESS	
Stored Data Format	*DIGITAL ArcView shapefile in the datum WGS 1984* *NONDIGITAL Paper base maps containing raw information*
Available	*DIGITAL ArcView 3.2 shapefile - alldugong_wgs84.shp*

Format Type	
Access Constraint	*Data available for external use subject to transfer fee and license conditions. Data is not to be distributed without authorisation from CALM. Contact CALM's database administrator for further details.*
DATA QUALITY	
Lineage	*Dataset history.* 1. *Determination of dugong movement patterns within the SBWHP from GPS and satellite telemetry represents a first for the use of this technology in Western Australia. Methods for data capture and tag attachment developed by CALM in conjunction with members of the Shark Bay Yadgalah Aboriginal Corporation, James Cook University and Edith Cowan University.* 2. *#Accumulated data has been obtained from three different types of location units attached to the tail flukes of dugongs. Satellite-monitored platform transmitter terminals (PTT) and generation II combination GPS/PTT units. (Telonics, Mesa, Arizona). Geographical Positioning System (GPS) data loggers (Lotek Engineering Inc. Ontario, Canada).* 3. *PTT's are transmitter platforms that transmit signals at regular intervals that are received by Service Argos receivers aboard NOAA polar-orbiting environmental satellites. At least two satellites are simultaneously in service on sun-synchronous, polar, circular orbits at 850 km altitude, providing full global coverage. Locational accuracy is dependant on signal strength and satellite coverage.* 4. *Attributes recorded from the PTT units include: Location class, date, time-Western Standard Time and Lat/Long in milliseconds.* 5. *The GPS units each with an eight-channel receiver log a unit's position from pulses received from the navstar series of satellites. The GPS units can be user programmed to obtain a position at a rate of between 5min-6hours* 6. *Attributes recorded on the Lotek GPS units include: Lat/Long-in milliseconds, Date, Time-Western Standard Time, Temperature- Degrees Celcius. Attributes on the Telonics Gen II units include; Lat/Long-in milliseconds, date, Time-Western Standard Time, Temperature- Degrees Celcius.* 7. *An accuracy attribute is recorded against each location.* 8. *Deployment and retrieval dates for each unit type are listed below:*

	PTT UNIT: DATE DEPLOYED DATE RETREIVED *5519 22/03/2000 11/12/2000* *5065 22/03/2000 05/04/2000* *5534 23/03/2000 25/10/2000* *5536(1) 23/03/2000 04/04/2000* *5536(2) 06/04/2000 28/05/2000* *5535 23/03/2000 23/10/2000* *5537 22/03/2000 16/08/2000* *1311 16/05/2001 01/07/2001* *GPS UNIT: DATE DEPLOYED DATE RETREIVED FIX ACQUISITION RATE* *8001 15/08/2000 05/10/2000 15 MINUTES* *8002 16/08/2000 04/10/2000 15 MINUTES* *8003 16/08/2000 03/10/2000 15 MINUTES* *8004 17/08/2000 21/09/2000 15 MINUTES* *8005 17/08/2000 01/10/2000 15 MINUTES* *7301 18/09/2001 28/09/2000 20 MINUTES* *7001 20/09/2001 28/09/2001 20 MINUTES* *0803 21/03/2002 11/05/2002 15 MINUTES* *0807 17/06/2002 25/07/2002 15 MINUTES* *0606 18/06/2002 09/08/2002 15 MINUTES* *0602 19/06/2002 04/07/2002 15 MINUTES* *0603 20/06/2002 02/07/2002 15 MINUTES* *9. Data are downloaded from the GPS tags in the datum WGS 1984 via a link unit, in a comma delimited file (.csv) Data are then converted into a text delimited file (.txt) and imported in ArcView and converted into shapefiles (.shp). For the PTT units, data are retrieved from service Argos in a spreadsheet format in the datum WGS 1984, then imported into ArcView in the same manner and converted into shapefiles.*
Positional Accuracy	*1. The two unit types used in determining dugong locations have a varying degree of spatial resolution. PTT units have a degree of error dependant upon satellite strength and location. For PTT location accuracy, service Argos has a location class attribute. The resolution associated with each class is listed below.*

	CLASS — *ESTIMATED ACCURACY IN LATITUDE AND LONGITUDE.* *3* — *<150m* *2* — *150m - 350m* *1* — *350m - 1000m* *0* — *>1000m* 2. *With the removal of Selective Availability GPS units' positional accuracy is estimated at <10m.*
Attribute Accuracy	*Attributes for this dataset are consistent with CALMs Marine Information System standards and values are drawn directly from original download files (see additional metadata)*
Logical Consistency	*All points are labelled correctly with values drawn from the original download files (see additional metadata).*
Completeness	*The data set will be upgraded as more units are deployed and retrieved.*
CONTACT INFORMATION	
Contact Organisation	*Department of Conservation and Land Management, Marine Conservation Branch*
Contact Position	*Marine Zoologist.*
Mail Address 1	*47 Henry Street*
Mail Address 2	
Suburb or Place or Locality	*Fremantle*
State or Locality 2	*WA*
Country	*Australia*
Postcode	*6160*
Telephone	*08 9336 0121*

Facsimile	*08 9430 5408*
Electronic Mail Address	*davidho@calm.wa.gov.au*
METADATA DATE	
Metadata Date	*January 2003*
ADDITIONAL METADATA	
Additional Metadata	*Original download files have been burnt to CD and are held in the CALM\MCB\MIS CD library, 47 Henry street Fremantle, Western Australia, 6160.*