



MARINE MAMMAL PROTECTED AREAS TASK FORCE



**Working to Implement Conservation Actions in  
Important Marine Mammal Areas (IMMAs)  
in the Republic of Palau  
30<sup>th</sup> October – 6<sup>th</sup> November 2017**



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Environment and Tourism

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*Cover photo:* Bowriding spinner dolphins, *Stenella longirostris*, in the southern portion of the Palau Archipelago, November 2017 (photo by Moses Hoyt).

## Executive Summary

A team of five international experts assembled by the IUCN Marine Mammal Protected Areas Task Force ([www.marinemammalhabitat.org](http://www.marinemammalhabitat.org)) visited the Republic of Palau in October/November 2017 (Fig. 1). The goal of the visit was to support the implementation of conservation and management considerations for an Important Marine Mammal Area (IMMA) for dugongs and an Area of Interest (AoI) for spinner dolphins, sperm whales and other cetaceans in Palau waters. Both areas were proposed in Palau through the Pacific Islands IMMA expert workshop held in Apia, Samoa in April 2017 and went through the peer review process.

The Apia Workshop was the first of five workshops organised to identify IMMAs in Pacific and Indian Ocean regions of the Southern Hemisphere. The project includes an implementation component, following three of the regional workshops. For the Pacific Islands, Palau was considered to have a favourable marine conservation climate by virtue of specific national policies, including the designation of the Palau National Marine Sanctuary (PNMS), Palau Marine Mammal Sanctuary (PMMS), Palau Shark Sanctuary (PSS) and Palau's Protected Area Network (PAN).

This report describes the efforts conducted in Palau, leading to a set of management recommendations developed during the team's visit to the area. The work included an analysis of threats to marine mammals in the selected pilot area, engagement with stakeholders at local, national and international levels to discuss conservation tools and management plans, and the selection of conservation tools and support to the development of management plans for the selected area.

It was determined that the two marine mammal taxa inhabiting Palauan waters (i.e., cetaceans and the dugong, a sirenian) have different conservation challenges and will require different management approaches. This dual approach was discussed and agreed with the various stakeholders encountered during the visit.

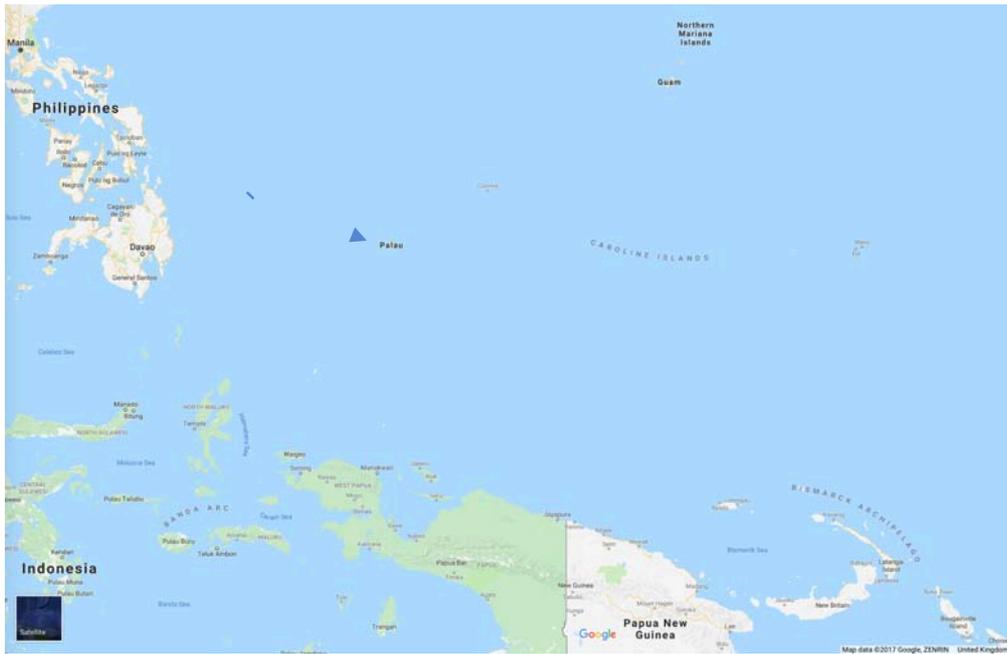
This report includes a narrative of the visit, with details of the places visited and the people providing input and discussion during the visit, followed by a set of management recommendations that could be a starting point to inform the shaping of future marine mammal conservation policies in Palau.

The team determined that implementing conservation action within IMMAs could never be achieved from outside Palau or from the top down within Palau, whether by members of the Task Force or by international conservation groups or other outside entities. Instead, the success of IMMAs depends upon full engagement by all stakeholders at the local community level, as well as researchers, government and NGOs. The recommendations reported here provide the baseline for the development of targeted scientific, management and policy measures to be coordinated by a local entity.

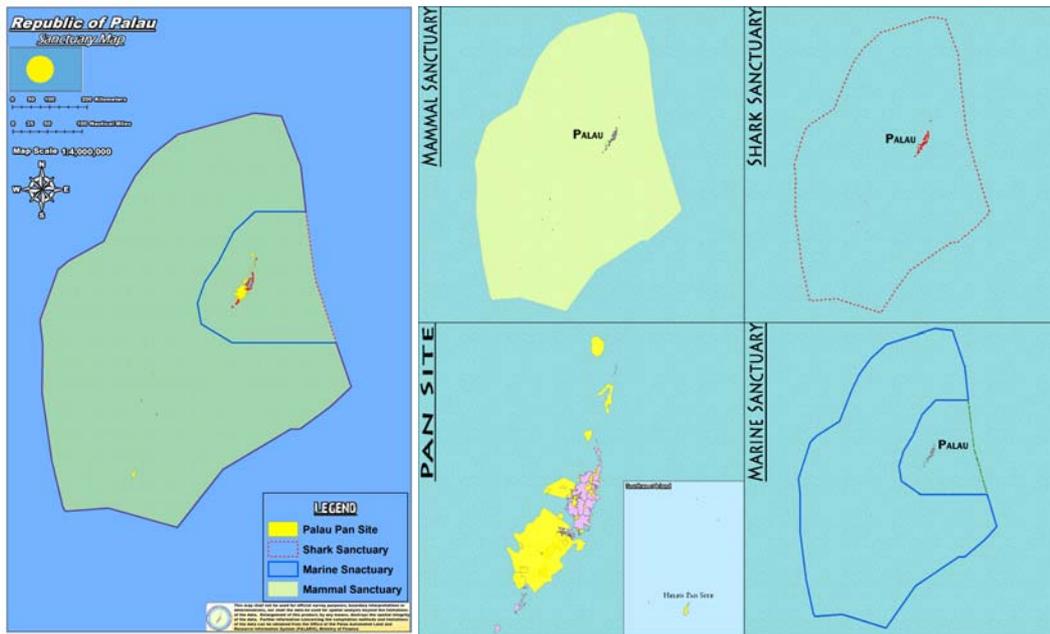
Urgent actions include (1) addressing the critically endangered dugong's situation by stopping poaching and ensuring their habitat is protected, and (2) preparing a comprehensive tourism plan including marine mammal watching.

The medium- to long-term objectives were envisaged as the core of the strategic plan to be developed locally. This would allow Palau to capture the benefits from the Task Force assessment and to utilize monitoring and adopt subsequent approaches to move forward. The longer-term objectives start with the need to compile good baseline studies, followed by the establishment of long-term monitoring and research capabilities, and building capacity for all aspects of conservation including preparing financing plans, making periodic vulnerability assessments, and instituting information sharing, education and effective enforcement.

These recommendations for urgent actions needed as well as medium- to long-term objectives are the heart of this report (p22-26).



**Fig. 1** Palau’s location in the Western Tropical Pacific

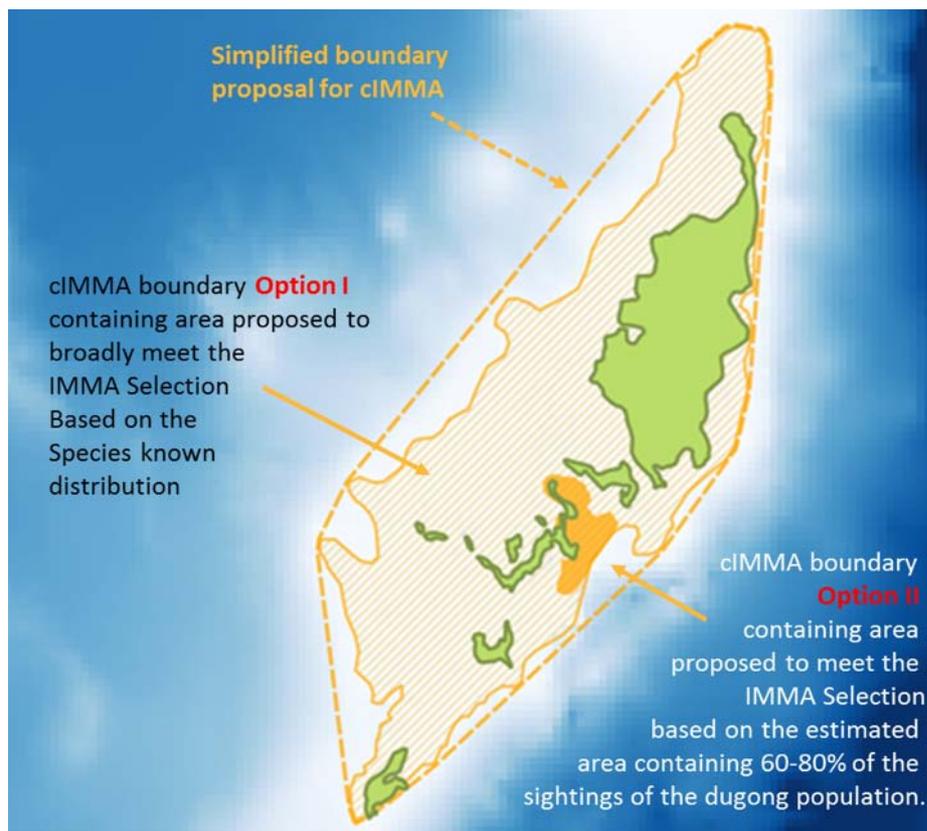


**Fig. 2** Maps delineating various sanctuaries established in Palau

## Background

A visit to the Republic of Palau in October/November 2017 was undertaken by a team of international experts assembled by the IUCN Marine Mammal Protected Areas Task Force ([www.marinemammalhabitat.org](http://www.marinemammalhabitat.org)). The goal of the visit was to support the implementation of conservation and management considerations for an Important Marine Mammal Area (IMMA) and a nearby Area of Interest (AoI) selected for the purpose.

During a regional expert workshop conducted in Apia, Samoa in April 2017 to identify IMMAs in the Pacific Islands region, an IMMA identified in Palau for dugongs (Fig. 3, Fig. 4) and an AoI for spinner dolphins, sperm whales and other cetaceans were selected as candidates for implementation recommendations for management and conservation measures. The reasons for these recommendations included (a) the favourable marine conservation climate existing in Palau by virtue of specific national policies, (b) counteracting the high level of threat which the Palau dugong population is subjected to, (c) the possibility that spinner dolphins, identified as part of the AoI outside the reef might also be returning to some areas inside the reef where the dugong IMMA is located, and (d) the possible future value for biodiversity and tourism of the cetacean AoI in the waters outside the reef. It was envisioned that the work in Palau could serve as a case study to examine how IMMAs could be used to foster marine mammal conservation in a given country at the national level.



**Fig. 3** Dugong cIMMA identified in Palau at the Apia IMMA Workshop (2017) based on existing data and expert input. After panel review, Option I was selected.

The Apia Workshop was the first of five workshops organised to identify IMMAs in the Pacific and Indian Ocean regions of the Southern Hemisphere. These five workshops,

being held between 2017 and 2021, are part of the framework of the GOBI/IKI Project funded by the Government of Germany. The project includes an implementation component, following each of the first three regional workshops — Pacific Islands (2017), North East Indian Ocean and South East Asian Seas (2018), and Western Indian Ocean and Arabian Seas (2019). At each workshop, stakeholders are engaged to discuss the implementation of pilot management activities based on one or more IMMAs and, in some cases, AoIs identified in these regions.

This report describes the efforts conducted in Palau, leading to a set of management recommendations developed during the team’s visit to the area. The work includes an analysis of threats to marine mammals in the selected pilot area (Activity VI.4 of the GOBI-IKI Project), engagement with stakeholders at local, national and international levels to discuss conservation tools and management plans (Activity VI.5), and the selection of conservation tools and support to the development of management plans for the selected area (Activity VI.6).



**Fig. 4** Dugong IMMA approved by independent panel peer-review, as shown in the IMMA e-Atlas on [marinemammalhabitat.org](http://marinemammalhabitat.org)

The visit ascertained that the waters of Palau host an important diversity of marine mammal species, which are not currently the subject of the attention which their ecological, cultural and economic value seem to deserve. Marine mammals in Palau belong to two separate orders – sirenians with one species, the dugong, *Dugong dugon*, and cetaceans with at least 15 species (see Appendix 1). Dugongs are confined to the

shallow waters around the islands within the reef boundaries, whereas cetaceans occupy deep water habitats outside of the reef system, although some, such as spinner dolphins *Stenella longirostris*, are known to periodically enter the reef habitat.

This ecological difference between the two taxa also results in significant differences in their threat levels and in their current and potential importance for the local human communities.

The dugong in Palau has a small, isolated population, only 216 individuals based on a 2011 estimate (Prof. Helene Marsh, pers. comm.), and thought to be declining. They have a high local cultural value in addition to their ecological importance, but are subject to poaching and are considered by global experts to be Critically Endangered.

By contrast, cetaceans are not known to be affected by specific threats, and have never been the subject of special attention in Palauan tradition and culture. However, their predictable presence not far from shore and remarkable species diversity indicate that in Palau there is a promising, untapped whale watching potential that needs to be urgently regulated before an industry develops in an undesirable, uncontrolled manner.

Thus, the two marine mammal taxa inhabiting Palauan waters have different conservation challenges and will require different management approaches. This dual approach was discussed and agreed with the various stakeholders encountered during the visit.

This report includes a narrative of the visit, with details of the places visited and the people providing input and discussion during the visit, followed by a set of management recommendations that could be a starting point to inform the shaping of future marine mammal conservation policies in Palau.

## Personnel involved in the visit

### **Task Force international group:**

Tundi Agardy - Sound Seas, USA and IUCN Marine Mammal Protected Areas Task Force

Amalia Alberini - Duke University, USA; project manager for International Conference on Marine Mammal Protected Areas (ICMMPA) 5, for WWF Greece

Jon Day - James Cook University, Townsville, Australia; formerly a director of the Great Barrier Reef Marine Park Authority

Erich Hoyt - Co-Chair, IUCN Marine Mammal Protected Areas Task Force; research fellow, Whale and Dolphin Conservation

Giuseppe Notarbartolo di Sciara - Co-Chair, IUCN Marine Mammal Protected Areas Task Force; founder and honorary president, Tethys Research Institute

### **IMMA local coordinating group:**

Tiare Holm - Founder and Principal, Sustainable Decisions, Palau

David Orrukem - Bureau of Tourism; formerly Director, Bureau of Marine Resources, Palau

Ron Leidich - Professional tour guide and local cetacean researcher, Palau

Percy Bitoh Recheluul - Fisheries officer, Bureau of Marine Resources; national focal point to dugongs, Palau

Yimnang Golbuu – CEO, Palau International Coral Reef Center

Keobel Sakuma – Executive Director, Palau National Marine Sanctuary; formerly senior adviser to Palau’s president

Charlene Mersai - Secretariat, National Environmental Protection Council, Palau

Michelle Dochez - Researcher, Research & Aquarium Dept., Palau International Coral Reef Center

Vanessa Jaiteh - Ministry of Natural Resources, Environment and Tourism; formerly Coral Reef Research Foundation, Palau

# Narrative of the visit and meetings

**29<sup>th</sup> – 30<sup>th</sup> October 2017**

*Arrival in Palau of IMMA international group, lodging at Palau Pacific Resort (PPR)*

**30<sup>th</sup> October 2017**

*Location: Bureau of Marine Resources and Tourism*

*Attendees: IMMA international group, Tiare H., Michelle D., Vanessa J., Ron L.*

## PRESENTATION ON PALAU CETACEAN RESEARCH PROJECT BY TIARE H.

- First dedicated cetacean research study in Palau with two seasons of transect surveys (March 2012 and May 2013) covering more than 500 miles of transects, using volunteer research vessels. Eleven cetacean species identified.
- Objectives: inform management planning, building local and national capacity, and used to propose candidate Important Marine Mammal Area (cIMMA) which, after peer review, was later made an Aol, subject to further research.
- Cetacean research has been supported by: Palau Bureau of Marine Resources, Australian government, South Pacific Whales Research Consortium, SPREP, Whales Alive, Whaleology, Sustainable Decisions, and the Palau Coral Reef Research Foundation.

## PRESENTATION ON "CITIZEN SCIENCE"/OPERATOR RESEARCH ON CETACEANS IN PALAU BY RON L.

- At least 15 marine mammal species were identified through hotspot monitoring and confirmation by photo documentation (Appendix 1 provides a list of marine mammals found in waters around Palau presented by Ron L.)
- Sightings were made using acoustic technology, underwater cameras, and drones.
- Two confounding factors bias the sightings:
  1. Sightings were weather dependent, only made in good weather
  2. Seasonality: sightings were not possible during high tourism periods when there was much less whale watching.

Thus, cetacean survey results in Palau are opportunistic counts, not weighted by effort (sightings in hotspots do not use a random grid approach).

## THREATS TO MARINE MAMMALS (SEE APPENDIX 3)

- Illegal poaching of dugong. Also, sometimes a dugong is consumed by highly ranked chiefs on special occasions, e.g., funerals, or celebrating the appointment of highly ranked chiefs.
- US Navy Sonar Testing in Guam was linked to stranding of beaked whales (850 miles off Palau); may be danger of spread to Palau.
- Bycatch: there are no observers for longline fisheries, only for purse seine vessels, but this certainly is a threat for marine mammals.
- Mass tourism: The President is proposing a new airport to accommodate 1 million capacity (As of 2017, there are 200,000 visitors/year with only 20,000 residents, already a high ratio of visitors to residents).
- Whale watching is not yet developed; the tourism industry has the potential to grow faster than the regulatory structure can accommodate. All in all, the tourism industry is as yet unprepared to start

marine mammal tourism without the guarantee of sensible practice and that further development will not seriously risk the resource.

- There are cumulative impacts on marine mammals from all of the above, and everything is exacerbated by climate change.

#### PRESENTATION ON DUGONGS (*DUGONG DUGON*) IN PALAU BY TIARE H. (SEE ALSO APPENDIX 2)

- Palau population of dugongs is isolated and considered to be Critically Endangered (Prof. Helene Marsh, pers. comm.) Last estimate in 2011 was no more than 216 individuals.
- Separate breeding population (geographically and genetically): dugongs breed very slowly (long-lived 70 years or longer); Palau has most isolated dugong population in the world. The nearest other population is 800km away.
- Heart-felt story for locals compared to cetaceans. Cetaceans are guides and friends to fishermen, but they are far less significant for Palauan culture compared to dugong. There is no tradition of using cetaceans for food.
- Community identity is linked to dugongs. It is a legendary species consumed on rare occasions by highly ranked chiefs.
- Increased penalties and legislation are now in place for poaching.
- Greatest challenge is to use the proper legislative regime to enforce penalties for poaching.
- Recognition of IMMA for dugongs could add value to the conservation measures both culturally and biologically.

#### EXISTING LEGISLATION AND MOUS

- Palau Dugong Protection Act
- Convention on Migratory Species (CMS) Memorandum of Understanding (MoU) for Cetaceans and their Habitats in the Pacific Islands Region.
- Convention on Migratory Species (CMS) Memorandum of Understanding (MoU) for dugongs.
- SPREP Whale & Dolphin Action Plan.

#### IMMA PRESENTATION BY GIUSEPPE NDS, ERICH H.

##### Key points

- IMMAs are not MPAs since they are a science tool (does not include any socio-economic data or political considerations) designed to conserve marine mammals using various management strategies.
- Palauan IMMA and AoI are two separate discussions: currently there is only one IMMA for dugongs; the Area of Interest (AoI) is for cetacean diversity (pelagic species in surrounding waters) but with more supporting data it could become an IMMA.

#### PRESENTATION ON ECOTOURISM INDUSTRY BY DAVID O.

- Ecotourism is globally a fast-growing sector of tourism.
- Vision for Palau: increase ecotourism quality versus quantity.
- Need to develop measures in which tour operators are enrolled in a system to discuss guidelines.

#### PRESENTATION ON PALAU NATIONAL MARINE SANCTUARY BY KEOBEL S.

- Palau National Marine Sanctuary is not yet enforced: foreign fishing fleets still have access to Palauan waters.
- The PNMS will be enforced in 2020 with funding provided by other countries: US, Japan, Australia.
- Not enough data on fisheries, marine mammals and marine ecosystems, especially outside the reef.
- See Fig. 2.

PRESENTATION ON PALAU MINISTRY OF NATURAL RESOURCES, ENVIRONMENT AND TOURISM (BUREAU OF MARINE RESOURCES, BUREAU OF TOURISM) BY DAVID O.

- Bureau of Tourism was established in 2014.
- No tourism regulation, no developed standards in place validated by the government but draft standards are now being reviewed by the Palau government legal team within the Attorney General's Office. After the AG Office review on legal grounds, the Bureau of Tourism will put the standards out for APA (Administrative Procedure Act) and they will then need to be signed off by the President before they become enforceable.
- Palau must have 100% locally owned tour operators but some only on paper, not in reality (locally owned but reside overseas).
- Palau's Protected Area Network (PAN): 16 states are involved in this community-based network.
- The Bureau has been trying to deal with voucher-based tourism — foreign-based tourism offering tourists all-inclusive (hotel, meals, tours) holidays: Voucher tourism is run by foreign businessmen who are partners with Palau citizens who function as a front for the business. No revenue remains in Palau, and Palau provides for the use of the infrastructure.

REGULATIONS AND PRACTICES IN PALAU

- Every state has its governor and state legislature body.
- Strong traditional community groups (elected/appointed by matriarchs).
- Patrilineal society but really run by matriarchs (men bearing a traditional chief title are picked by women).
- Three branches of government modelled on the US system: Executive, Judicial and Legislative (Congress: Senate and House of Representatives).
- Palauans are said to be the most over-governed people in the world with high percentage of the 20,000 plus population in government. As a democratic state, Palau has various levels of governance, the chiefs manage the community behaviours (they can impose moratoria for taking species and exploiting habitats). Chiefs are key but they follow what the matriarchs say.
- Challenges relevant to marine mammals are: lack of up-to-date knowledge, lack of statistically robust data with density and covering different seasons; the need to integrate observations with survey efforts and to carry out well-designed surveys.

**31<sup>st</sup> October 2017**

*Location: Bureau of Marine Resources and Tourism*

*Attendees: IMMA international group, Tiare H., David O.*

THE ATTENDEES DISCUSSED THE NEED TO:

- Identify existing bodies that should be empowered to increase knowledge and management of dugongs and marine ecosystem: BMR, BOT, PICRC
- Increase efforts to regulate marine mammal tourism, which is one of the fastest growing industries in the world — before it comes to Palau.
- Use political momentum from IMMAs: The 12th Meeting of the Conference of Parties to the Convention of Migratory Species has adopted a new Resolution on IMMAs in which it sets out a number of recommendations for international organizations to support and use IMMAs for “stimulating protected area network design and connectivity, or addressing threats to aquatic mammals more comprehensively” (UNEP/CMS/COP12/Doc.24.2.1).

## MEETING WITH HON. UMIICH SENGEBAU, MINISTER OF NATURAL RESOURCES, ENVIRONMENT AND TOURISM

1. Introductions
2. IMMA presentation by Erich H., Giuseppe NdS.
3. Discussion:

The attendees discussed the following items:

- Dugongs and cetaceans are different cases. Dugongs are local, iconic species whereas cetaceans need further consideration. Need to first assess the facts and then incorporate social and political issues.
- Need for a threat-based approach: assess the threats, including from the tourism industry and explore if the existing legislation addresses those threats.
- Comprehensive marine spatial planning should be done for Palau (both in national and state waters).
- Need to focus separately on the 13 states that have dugongs in order to provide individual recommendations.
- Erich H. offered benefit of his background in socioeconomics of marine mammal tourism as perspective to Palau to learn from problems and disasters that have occurred in other countries.
- Challenge: There is no marine mammal officer currently hired at the Bureau of Marine Resources. A marine mammal officer, all agreed, would give marine mammals a voice and a much needed profile in communities and in national government.

## KEY POINTS DISCUSSED BY THE IMMA INTERNATIONAL GROUP IN AN INTERNAL MEETING AT THE END OF THE DAY

The group discussed the need to:

- Set the management expectations for conducting nature-based tourism at the appropriate level. The current system does not support the expectations. For whale watching and marine nature tourism, there is a need to refine guidelines, starting with IWC guidelines and updating from input of the research;
- Develop responsible marine mammal-based tourism benefiting the local economy;
- Connect with marine tourism managers and foreign ecotourism operators of other countries with small terrestrial areas and large ocean areas. Good examples of a permit approach with a precautionary carrying capacity include South Africa, New Zealand and Great Barrier Reef Marine Park;
- Use citizen science: such as is used by the NASA global observer programme and 'Eye on the Reef' for the Great Barrier Reef Marine Park;
- Incorporate non-scientific traditional knowledge;
- Include historical dugong data on aerial imagery to compare habitats;
- Use the IMMA AoI in Palau to draw attention to the need for more studies, provide the basis for future research and to be used as a fundraising tool. Sperm whales could help make a cultural connection to help highlight the rich biodiversity of the Palau Trench;
- Integrate dugong and cetacean research in the science plan developed by Michelle D. for the Palau National Marine Sanctuary.

**1<sup>st</sup> November 2017**

*Location: Bureau of Marine Resources and Tourism*

*Attendees: IMMA international group, Tiare H., David O., Keobel S.,*

*Four Governors from the states of Kayangel, Ngarchelong, Ngardmau and Sonsorol*

#### PRESENTATION ON PALAU CONTEXT BY TIARE H.

- Palau is home to high levels of biodiversity including marine mammals.
- Its geographic location, its isolation, is responsible for species drift which leads to high rate of endemism.
- Positioned at the edge of Philippines tectonic plate, Palau has the Palau Trench on one coastline and the Philippine Sea and basin on the other coastline. Palau has four geological island types: volcanic, uplifted limestone, low lying coral platform, and atolls. This contributes to diversity in marine mammals as well as many other species.
- Other than dugongs, Palauans rarely address the issues of marine mammals.

#### Ongoing challenges include:

- Limited information on dugong and cetaceans despite the knowledgeable conservation community;
- The need for regular effective dugong surveys and monitoring;
- No targeted cetacean research organisation or programme exists in Palau;
- To date, only one targeted cetacean research project has been conducted in Palau, and only seasonally over two years;
- No organization can effectively prioritize marine mammal conservation.

#### IMMA PRESENTATION BY GIUSEPPE NDS., ERICH H.

#### THE ATTENDEES DISCUSSED THE POTENTIAL FOR MARINE MAMMAL TOURISM IN PALAU SINCE:

- Marine mammal based tourism is one of the fastest growing sectors of nature tourism worldwide with strong potential for Palau;
- Marine mammal tourism provides a new niche for locally regulated and benefited tourism.

#### Opportunities

- Develop guidelines for marine nature watching tourism that feature marine mammals including setting proper expectations, regulating inshore interactions, if appropriate, considering potential of non-visual encounters, educating tour guides and managing the typical tourism fatigue after 3-4 years (when operators become burned out or blasé).
- Invest in and help develop management, research and monitoring through the Protected Areas Network (PAN), Palau International Coral Reef Center (PICRC), and Palau National Marine Sanctuary (PNMS).
- With respect to dugong conservation, the approach must be state-by-state, before going nationally. Approach the matriarchs and traditional leaders first, then the governors' association, and other state leaders.

## **2<sup>nd</sup> November 2017**

*Location: Bureau of Marine Resources and Tourism*

*Attendees: IMMA international group, Tiare H., Patrick and Lori Collin (Palau National Coral Reef Foundation), Vanessa J., Mandy Thijssen Etpison (Managing Director and Curator of the Etpison Museum, and Honorary Consul of France to the Republic of Palau), Michelle D., Keobel S., Percy B.R., Olive Andrews (former cetacean researcher in Palau, currently marine officer at Conservation International, Pacific Islands region), Abolade Majekobaje from Palau Conservation Society*

### PRESENTATION ON EXISTING POLICY TOOLS FOR DUGONG CONSERVATION BY TIARE H.

- Palau Dugong Protection Act (2013)
- Palau Protected Areas Network
- Micronesia Challenge
- Palau Marine Mammal Sanctuary: 2010 at CBD COP 10 in Nagoya through a Presidential Declaration 100% Palauan waters
- Palau Dugong Protection Act (2013)
- Palau National Marine Sanctuary (2011) through Palau National Marine Sanctuary Act

### Challenges

- PICRC was focused on coral reefs not marine mammals, but now PICRC is much more interested in marine mammals and other species which represent an opportunity for further research.
- There is no interest in dugong from the Micronesia Conservation Trust.
- The Nature Conservancy and Conservation International are both minimally involved with marine mammals.
- The Bureau of Tourism is understaffed. In all of Palau, there are 23 officially registered tour operators, 180 non-registered.

### IMMA PRESENTATION BY GIUSEPPE NDS, ERICH H.

### INPUT FROM PARTICIPANTS ON RESEARCH EFFORTS FOR DUGONGS

- Vanessa J. will be studying dugong behaviour and habitat use (project will start end of 2017; this will be the continuation of Mandy Thijssen Etpison's studies).
- Mandy Thijssen Etpison has been doing aerial surveys, the most recent in 2013. Mandy highlighted the need to collect marine mammal data from the private sector — tour operators and other photographers will help enrich the database. Mandy also discussed the need for a central agency to take care of all marine mammal issues, not only dugongs. It was noted again that there is no legal framework to regulate the marine mammal tourism industry.
- Attendees agreed that it is important to manage expectations with respect to marine mammal tourism.

### PRESENTATION ON GREAT BARRIER REEF MARINE PARK (GBRMP) BY JON D.

The presentation focused on the multiple layers of management used in the GBRMP including the spectrum of zones, statutory plans of management for high-use areas, site planning, permits and public education. A politically acceptable network of highly protected no-take zones has been developed but all the zones help facilitate the conservation of the habitats of the GBRMP. A risk matrix was shown to prioritize the range of pressures and management measures (based on their likelihood and consequence). Four major threats have been identified but the cumulative impacts of up

to 40 threats is a serious concern. Climate change is the biggest emerging concern with impacts being observed on the coral reefs (mainly bleaching).

THE TASK FORCE INTERNATIONAL GROUP, WITH TIARE H. AND DAVID O., STARTED DRAFTING RECOMMENDATIONS FOR THE IMPLEMENTATION OF MANAGEMENT MEASURES WITH RESPECT TO THE IMMA AND AOI (SEE RECOMMENDATIONS, P22-26).

VISIT TO THE CORAL REEF RESEARCH FOUNDATION BY THE IMMA INTERNATIONAL GROUP WITH TIARE H AND VANESSA J.

The attendees met with Patrick L. Colin, Director, and Steve Lindfield, Research Biologist, who gave presentations about their long-term aerial surveys and mapping of Palau. They also talked about the projects currently being developed at the CRRF.

### **3<sup>rd</sup> November 2017**

*Location: Bureau of Marine Resources and Tourism*

*Attendees: IMMA international group, Tiare H., David O.*

THE ATTENDEES DISCUSSED THE NEED TO:

- Design various management strategies for dugongs and cetaceans;
- Enhance the role of state conservation rangers (remuneration through PAN) to implement national law;
- Learn from the results of the Palau Shark Sanctuary — Shark enforcement is less complicated since the threat is fishing by foreign vessels but dugongs are a different case;
- Develop state-based legislation and engage community discussion: State legislation should mirror federal legislation to assist public understanding and ease of enforcement;
- Invest in public awareness;
- Build an effective framework with the support of traditional leaders, matriarchs, community;
- Use a “neutral” messenger: IMMA local coordinating group;
- Build a sense of pride and ownership within the traditional community;
- Establish a new marine mammal NGO — possibilities to provide fiscal sponsorship include PICRC, Coral Reef Research Foundation and the Palau Community Action Agency;
- Discuss further the potential fiscal sponsorship list.

VISIT TO PALAU AQUARIUM - IMMA INTERNATIONAL GROUP, TIARE H., DAVID O. — VISIT WAS LED BY PICRC STAFF ASAP BUKURROU

VISIT TO PALAU VICE-PRESIDENT’S OFFICE - IMMA INTERNATIONAL GROUP, TIARE H., DAVID O.

*Location: Palau Vice President’s office*

*Attendees: IMMA international group, Tiare H., David O., Hon. Raynold B. Oilouch, Palau Vice President and Minister of Justice (see Fig. 5)*

1. Introductions
2. IMMA introduction
3. Discussion:

The Vice President highlighted the importance of dugongs as a precious element to Palauan culture which he considers “a sacred animal that we all feared when we were children”. In reply to the IMMA International group’s concerns about the decline of the dugong, he said that he is committed to providing statistics on dugong poaching. He also said he would consider offering Brenda Santos (national ranger) as a focal person for marine mammals within the Ministry for Justice, and he agreed that improving national legislation in addition to the existing national legislation (e.g., by increasing penalties in some states) should be prioritized. He highlighted the need to put in place speed and route regulation in critical dugong habitats, and offered to provide any assistance he could to the IMMA international group.



**Fig. 5** Meeting in the Vice-President’s office: (L-R) Tiare H., Amalia A., Erich H., Giuseppe NdS., Tundi A., Vice President Raynold Oilouch, Jon D., David O.

*Location: High Chief’s house*

*Attendees: IMMA international group, Tiare H., David O., High Chief Reklai Bao Ngirmang Basilius, Chairman of the traditional North-east Alliance [see Fig. 6]*

1. Introductions
2. Discussion:
  - Palauans welcome international scientist input with regard to dugong and cetaceans.
  - The chief highlighted the need to advance dugong conservation to the new generation. The new generation can educate their families — he gave evidence of this in Palau’s successful anti-littering campaign. The kids drove this campaign and made it work.
  - The chief promised that he would mention the IMMA visit to the President of the Republic, and to the 16 state governors.



**Fig. 6** Visiting High Chief Reklai's house: (Back) David O., Tiare H., Amalia A., Jon D., (Reklai's grandson); (Front) Tundi A., Giuseppe NdS., High Chief Reklai Bao Ngirmang Bacilius, Erich H.

High Chief Reklai, who had celebrated his 85<sup>th</sup> birthday the week before, showed us a newspaper clipping and asked us to read it out. It was his horoscope from that morning's local paper "Island Times" (3 Nov. 2017, Vol. 12, No 107): "Scorpio (Oct. 23 – Nov. 21) A number of young visitors could come to your home with news to pass on and information to share....[The] conversation feeds your intellect and gets your curiosity going". We all laughed. He just smiled.

#### **4<sup>th</sup> November 2017**

*Location: Visit to Rock Islands, Milky Way Lagoon, coral reefs, a drop off area with frequent shark and diverse species sightings, spinner dolphins and potential dugong habitat. The Rock Islands Southern Lagoon is a UNESCO World Heritage Site (mixed natural/cultural site).*

*Attendees: IMMA international group, Tiare H., Olive Andrews (Conservation International)*

Rock Islands Southern Lagoon covers 100,200 ha and includes 445 uninhabited limestone islands of volcanic origin. Many display unique mushroom-like shapes in

turquoise lagoons surrounded by coral reefs. The aesthetic beauty of the site is heightened by a complex reef system featuring more than 385 coral species and different types of habitat. The Rock Islands sustain diverse plants, birds and marine life including dugong and at least thirteen shark species. The site harbours the highest concentration of marine lakes anywhere — isolated bodies of seawater separated from the ocean by land barriers. They are among the islands' distinctive features and sustain high endemism of populations which continue to yield new species discoveries. The remains of stonework villages, as well as burial sites and rock art, bear testimony to the organization of small island communities over some three millennia. The abandonment of the villages in the 17th and 18th centuries illustrates the consequences of climate change, population growth and subsistence behaviour on a society living in a marginal marine environment (<http://whc.unesco.org/en/list/1386>).

The highlight of the day was spending 20 minutes with a group of 30-40 spinner dolphins, the core group of 10 or so came over to bow-ride. Olive A. was able to recognize the dorsal fin of one dolphin that she had photographed in previous years. This inner reef sighting was encouraging as there had been some discussion about the spinner dolphins moving outside of the reef in recent years.

Note: There were no signs or other indication that this was a UNESCO World Heritage Site, and for that matter virtually no indication from Palau tourism literature, although one tour company's brochure (IMPAC Tours) did show a logo inside their brochure. The UNESCO World Heritage listing is a matter for celebration as well as education and can help to foster community and tourism respect for extraordinary natural and cultural sites.

### **5<sup>th</sup> November 2017**

*Location: Restaurant Longshoremen*

*Attendees: Task Force international group, Tiare H., David O.*

#### CONTINUING WORK ON RECOMMENDATIONS OF THE IMMA INTERNATIONAL GROUP

Discussion centred on: developing recognized guidelines for whale watching activities (explore different regulations for different species); the need to have a discussion on licensing/certification and where the income would go. A proposed marine mammal NGO could train tour operations to be certified by the Bureau of Tourism, and could help develop template legislation for each state which can be uniformly applied in each state.

Ideas to develop include:

- Promoting dugong and cetacean value to the Assembly of Matriarchs;
- Focusing on four key threats for dugongs: Fishing entanglement, poaching, boat strikes (all direct impacts) and habitat degradation (indirect impact);
- Developing a project to support the Palauan criminal investigation division to tackle dugong illegal hunting;
- Pushing for a dedicated local marine mammal expert within government.

*Location: Palau's Highest Ranking Matriarch's house*

*Attendees: IMMA international group, Tiare H., David O.,  
Highest Ranking Matriarch, Bilung Gloria Salii [see Fig. 7]*

## Discussion

The attendees highlighted the importance of preserving the critically endangered dugong and ensuring cetacean diversity in Palau. Bilung described the importance of dugongs in Palauan culture, especially their symbolic decorative use during the ceremonies of the highly ranked appointed chief. Bilung mentioned the role and importance of women in the protection of key species such as the Hawksbill sea turtle *Eretmochelys imbricata*, and the Napoleon Wrasse *Cheilinus undulatus*. She offered to advance dugong conservation at the annual Palau women's conference that will be held in September 2018. It will be the 25<sup>th</sup> annual edition of this conference strand that she founded and continues to take a leading role in conservation, environment and promotion of Palauan heritage values, as well as other matters of concern by Palauan people. For this conference, she spontaneously invited representatives of the IMMA international group to attend the event and call for the adoption of a Resolution to further advance dugong conservation. She also encouraged the group work towards strengthening existing regulations on dugongs by taking a state-by-state approach while honouring national laws already in place. She intimated that she could have a polite word with Palau's president about this. Lastly, she committed to offer and provide any possible assistance to the IMMA endeavours in Palau.



**Fig. 7** Meeting at Bilung Gloria Salii's house: (L-R) David O., Tiare H., Giuseppe NdS., Tundi A., Amalia A., Erich H., Bilung Gloria Salii, Jon D.

## Recommendations

From the start of this work, there was the strong suspicion that implementing IMMAs could never be achieved from outside whether by members of the Task Force or by international conservation groups or other outside entities. This was confirmed during our visit. Further, as we spent more time and talked to more people in Palau, and saw the results or lack of results from other conservation projects, we began to see that successful implementation of an IMMA and associated conservation actions would be a matter of working with (1) local communities through the matriarchs and chiefs, (2) state governors, (3) federal government officials up to the president, as well as with (4) NGOs based in Palau including the foreigners with interests in the islands. Consideration would need to be given to the different types of engagement required with each to reach these diverse sectors of society. The recommendations below should provide the baseline for the development of targeted scientific, management and policy measures to be coordinated by a local entity.

### URGENT ACTIONS NEEDED

1. Considering that the dugong in Palau is critically endangered<sup>1</sup>, and likely to disappear soon, it is essential to stop unsustainable mortality (a) with the greatest emphasis on the poaching of dugong, and (b) by listing the threats to dugong state-by-state. This includes bringing the latest scientific information into communities on a state-by-state basis (mapping mortalities and risk assessments) and building ownership through community engagement and sharing tools starting with matriarchs, high chiefs and governors, delegates, traditional groups, possibly creating mirror state and national legislation but relying on traditional *bul*<sup>2</sup> for each state.
2. Assist the Bureau of Tourism in developing a tourism management plan. Regulations should initially prohibit commercial marine mammal watching using motorized vessels and aircraft until regulations are in place with the idea of proactively allowing control of whale watching and relying on adapting the best guidelines from other areas.<sup>3</sup> This should include strengthened enforcement and allocation of permits only to local operators with a cap on the number of permitted operators (based on carrying capacity with a generous precautionary approach), a system of certification (including a training course and licensing for tour guides at state levels) and licensing of companies at national levels, the requirement for scientific and educational components, and model operator behaviour around the whales, all tied to the privilege of holding a permit and with the knowledge that the permit can be revoked.

*In order to support 1 and 2, the following need to be undertaken as prerequisites:*

3. Develop template legislation (along the lines suggested in 2) that can then be uniformly applied across all states. There should be allowance for an increase in fines,

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<sup>1</sup> CR = is considered to be facing an extremely high risk of extinction in the wild (C2a(ii)).

<sup>2</sup> A temporary closure for a specified area established by the chief if resources are threatened.

<sup>3</sup> See list of documents for guidelines [add refs for ACCOBAMS, IWC, Caribbean UNEP-SPAW, Pacific Islands Guidelines for Whale Watching, from SPREP].

and a placeholder for a marine mammal-specific tourism plan, including specification of areas off-limits to tourism and consideration of land-based areas and other strategies to spread impact from the tourism on marine wildlife and the environment (to be determined from surveys). While marine mammal watching is being restricted, maybe consider one or two temporary pilot permits to experimentally develop and study the issues surrounding the industry. Then regulations can be prepared and finalised.

4. Assess and improve effectiveness of surveillance and enforcement (all aspects, emphasizing, if needed, the prosecution of infractions). Ensure consistency of approaches by PNMS and PAN.
5. Develop a project to support the Palauan criminal investigation division for uncovering the mechanisms of dugong exploitation and trade (including articulation of the supply chain from poacher to end-user).
6. Discuss among tourism departments, operators and tourism businesses and agree a public relations strategy on a state-by-state basis regarding how much information to divulge about the presence and distribution of marine mammals. Control the flow of information carefully while enhancing education. It is important to emphasize that a dugong is more valuable alive than dead, including cross-generational values and other values that can be captured through contingency valuation and other techniques through economic studies that reveal both direct and indirect values.
7. Push for a dedicated marine mammal scientific officer who could represent the interests of marine mammals across multiple agencies (tourism, fisheries, justice) and coordinate with Percy Bitoh, the political point of contact, Dave O. with tourism, and others. It is also necessary to encourage the establishment of a domestic Palauan marine mammal targeted NGO/ coordinating or working group or committee who see the big picture but are independent of government.

## **MEDIUM TO LONG-TERM OBJECTIVES**

The medium- to long-term objectives are envisaged as the core of the strategic plan to be developed by the local informal IMMA coordinating group and in future by the proposed NGO or working group. This would allow Palau to capture the benefits from the existing assessment and to utilize monitoring and develop subsequent approaches to move forward.

8. DEVELOP THE NEEDED BASELINE		relevant to	
		dugongs	cetaceans
a	Conduct updated surveys with the support of the best available expertise using robust methodology to provide evidence of population trend and estimates of active breeding population. This should include mapping of key dugong habitats and map occurrence data for cetaceans and possibly pelagic habitat — though this appears highly dynamic and modelling the habitat may be difficult (see below).	both	
b	Synthesize existing marine mammal information, utilizing all sources (canvassing communities / elders,	mostly dugongs	

	publications, reports, tour operator information, interested individuals)		
c	Perform governance assessment – where are the opportunities and gaps? Where are potential synergies? (not just government, but all the main actors. Perhaps “actor mapping” is needed.)	dugongs	
d	Demonstrate the role of dugongs in maintaining the ecosystem (trophic cascades).	dugongs	
e	Undertake a more detailed threats assessment for dugongs and cetaceans, risk and vulnerability analysis, including assessment of poaching, and threats to habitat (including traffic, noise, fishing gear entanglement and derelict nets, loss of sea grass, dredging/runoff, etc.); assess uncertainties regarding climate change and cumulative impacts (see Table 1 in Appendix 3 as possible template).	mostly dugongs	
f	Conduct a valuation exercise (current and potential) for both dugongs and cetaceans, incorporating both economic and cultural values including ecosystem services and other indirect non-use values (heritage, spiritual, existence, etc.); map the values (carefully – see item 3 above) to provide a basis for a spatial plan / zoning for marine mammal conservation. The valuation exercise should answer how to get the most dollars into the local economy with the least impact on marine mammals.	mostly dugongs	
g	Review existing marine spatial planning to ensure state and national arrangements appropriately consider marine mammal requirements; propose and refine zoning layer or other management layers as needed.	mostly dugongs	

9. DEVELOP LONG-TERM MONITORING AND RESEARCH		relevant to	
		dugongs	cetaceans
a	In conjunction with global experts to plan the surveys, arrange for periodic surveys of dugongs, perhaps utilizing Palau’s Protected Area Network (PAN) and Coral Reef Research Foundation. Incorporate local knowledge when assessing scientific outputs (density estimations, behavioural aspects, threats, etc.)	dugongs	
b	Undertake training of PAN team at the state level to monitor dugongs and cetaceans.	both	
c	Plan for periodic surveys of marine mammals – this can help ground-truth habitat modelling, but will have to include plans for managing and analysing data.	both	
d	Set up mechanism for ongoing data collection on how tourism industry is utilizing the marine mammal component (this derived from patrolling, canvassing, or perusing web sites and FaceBook pages).	both	

e	Assess how dugong habitats have changed in the past, and develop habitat models to predict where they are likely to be in future.	dugongs	
f	Develop scenarios assessing future possible outcomes for dugong, e.g., full protection to full exploitation, and the implications of these outcomes. Assessing trade-offs could also be done for other marine mammal tourism.	dugongs	
g	Build community engagement through a training exercise such as disentanglement training (contact: David Mattila, IWC). This could spread the message about dugong and marine mammals and get people working together on this subject.	both	

10. BUILD CAPACITY		relevant to	
		dugongs	cetaceans
a	Develop a financing plan for ongoing surveys and research through foundation grants, innovative financing schemes (PES) and/or user fees.	both	
b	Identify ways a marine mammal officer can be supported long-term.	both	
c	Feed marine mammal information into existing planning efforts (science plan for PNMS, MSP, etc.)	both	
d	Develop and launch outreach/communications strategy, especially with communities (perhaps through PAN but beyond it as well). Consider how 'citizen science' might value-add to research knowledge. Investigate application of an app for coordinated reporting of all Palauan marine wildlife.	both	
e	Establish simple, useful method for periodic vulnerability assessments (see Box 1 for the GBRMP example).	mostly dugongs	
f	Hold multi-stakeholder workshops (PICRC, CRF, private sector) to establish information-sharing and do training on marine mammal research, monitoring and response. This would include workshops on addressing strandings and entanglements.	both	
g	Set up informal mechanism to allow Palau to utilize IMMA international group and IMMA local group, for advice and review, as needed.	both	
h	Build capacity to perfect and continue to adapt and amend marine mammal regulatory control and enforcement mechanisms at all the relevant governance levels.	mostly dugongs	
i	Work with the Ministry of Education to develop and strengthen supplementary materials for marine mammals that can be used by teachers.	both	

Box 1. Conduct a formal vulnerability assessment, integrating science and management, with the aim to:

- identify and document the range of pressures acting on all marine mammals using a standardised and transparent process,
- document levels of exposure and sensitivity to key threats within each State and assess the capacity of different marine mammals to adapt naturally or through management actions to determine their overall vulnerability to each pressure,
- engage with relevant agencies (e.g., Bureau of Marine Resources, Bureau of Tourism), relevant States, key stakeholders (e.g., matriarchs) and the wider community to manage identified at-risk habitats, species and groups of species, and
- identify gaps in management effectiveness, including deficiencies in legislation and policy, and where additional research is needed for making informed decisions.

See also Appendix 3. Hazard Risk Assessment Process (p30-32)

## Acknowledgments

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# Appendices

## **Appendix 1 - List of main marine mammals found in waters around Palau** (identified by the Palau Cetacean Research Project and the hotspot monitoring activities by Ron Leidich, Palau)

### **Cetacea**

- Bryde's whales, *Balaenoptera edeni*;
- sperm whales, *Physeter macrocephalus*;
- dwarf/pygmy sperm whales, *Kogia* spp.;
- beaked whale species (possibly Blainville's beaked whales, *Mesoplodon densirostris*; Ginkgo-toothed beaked whales, *Mesoplodon ginkgodens*; Deraniyagala beaked whales, *Mesoplodon hotaula*; Cuvier's beaked whales, *Ziphius cavirostris*; Longman's beaked whales, *Indopacetus pacificus*);
- killer whales, *Orcinus orca*;
- false killer whales, *Pseudorca crassidens*;
- pygmy killer whales, *Feresa attenuata*;
- melon-headed whales, *Peponocephala electra*;
- short-finned pilot whales, *Globicephala macrorhynchus*;
- Risso's dolphins, *Grampus griseus*;
- rough-toothed dolphins, *Steno bredanensis*;
- spinner dolphins, *Stenella longirostris*;
- pantropical spotted dolphins, *Stenella attenuata*;
- striped dolphins, *Stenella coeruleoalba*;
- Indo-Pacific bottlenose dolphins, *Tursiops aduncus*.

### **Sirenia**

- Dugongs, *Dugong dugon*.

## **Appendix 2 – Important facts about dugongs (*Dugong dugon*)**

### **Life-history traits**

- maximum longevity (~70 years or longer)
- low reproductive potential
  - delayed sexual maturity
  - age before breeding (females 6-17 years; males 4-16 years)
  - maximum possible rate of increase (e.g., low natural mortality and no human-induced mortality) is 5% per year
  - only a single calf per birth
  - time between breeding – 3-7 years; not in continuous breeding condition all year-round
- calves rely heavily on mother, both for sustenance and for protection
- migratory (may stay in localised areas or range widely) but mainly use inshore habitats
- primarily graze on seagrass but can also eat marine algae

### **Worldwide, the dugong is listed in the IUCN Red List as being vulnerable to extinction:**

- Palau's dugongs are geographically and genetically the most isolated dugong population in the world
- Estimates range from only 100 to approximately 200 individuals (very small population)
- Considered to be Critically Endangered (Prof. Helene Marsh, JCU, pers. comm.)

Maps of dugong surveys in Palau are shown in Fig. 8 (Davis, 2004) and Fig. 9 (Etpison, 2012).

### Appendix 3 – Hazard Risk Assessment Process: Mortality threats to dugongs and marine mammals

To be assessed and completed by community representatives, state-by-state.

Major pressure types	Pressures	Likelihood # (considering both current and likely future situation)	Consequence #	Overall Risk (considering both likelihood and consequence)	Possible management response(s)
Land-sourced impacts	Clearing or modifying coastal habitats increasing sediment runoff				
	Habitat loss (e.g., coastal reclamation)				
	Nutrient and pesticides from run-off				
	Industrial/urban pollution				
Marine – sourced impacts	Boat strike (especially near ports, vessel access channels)				
	Noise concerns (e.g., vessels, pile-driving)				
	Changed dugong behaviour because of vessels (e.g., high speed vessels, jet-skis)				
	Poaching/illegal hunting				
	Disease				
	Dredging and/or dumping of dredge material				
	Incidental capture in fishing gear (nets)				
	Marine debris (e.g., ghost nets)				
Climate change	Marine habitat degradation from typhoons				
	Bleaching impacting seagrass				

# Use guidance below in Tables 1-4 to assess Consequence, Likelihood and Risk Level.

**Assessing consequence.** Note that separate tables should be used to define the consequences applicable to environment (ecosystem) and environmental perception, as described in Tables 2 and 3 below:

DESCRIPTION	DEFINITION
CATASTROPHIC	Impact is clearly affecting the nature of the ecosystem over a wide area OR impact is catastrophic and possibly irreversible over a small area or to a sensitive population or community Recovery periods of greater than 20 years likely OR condition of an affected part of the ecosystem irretrievably compromised.
MAJOR	Impact is significant at either a local or wider level or to a sensitive population or community. Recovery periods of 10 - 20 years are likely.
MODERATE	Impact is present at either a local or wider level. Recovery periods of 5 - 10 years anticipated.
MINOR	Impact is present but not to the extent that it would impair the overall condition of the ecosystem, sensitive population or community in the long term.
INSIGNIFICANT	No impact or, if impact is present, then not to an extent that would draw concern from a reasonable person. No impact on the overall condition of the ecosystem.

*Table 1: Consequence (Environment –Ecosystem level)*

DESCRIPTION	DEFINITION
CATASTROPHIC	Negative and extensive national media attention and national campaigns
MAJOR	Negative national media attention and national campaign
MODERATE	Negative regional media attention and regional group campaign
MINOR	Individual complaints
INSIGNIFICANT	No media attention

*Table 2: Consequence (Environmental Perception)*

**Assessing likelihood.** The second step in the hazard risk assessment process is to individually assess the likelihood of the consequences of an event occurring. There are five levels used in this step, as described in Table 3.

DESCRIPTION	FREQUENCY	PROBABILITY
Almost certain	Expected to occur more or less continuously throughout a year (e.g. more than 250 days per year)	95-100% chance of occurring
Likely	Expected to occur once or many times in a year (e.g. 1 to 250 days per year)	71-95% chance of occurring
Possible	Expected to occur once or more in the period of 1 to 10 years	31-70% chance of occurring
Unlikely	Expected to occur once or more in the period of 10 to 100 years	5-30% chance of occurring
Rare	Expected to occur once or more over a timeframe greater than 100 years	0-5% chance of occurring

*Table 3: Likelihood*

**Assessing risk level.** Risk = likelihood x consequence. Having determined the likelihood and consequence, Table 4 is used to determine the hazard risk grade (ie., Low, Moderate, High or Extreme).

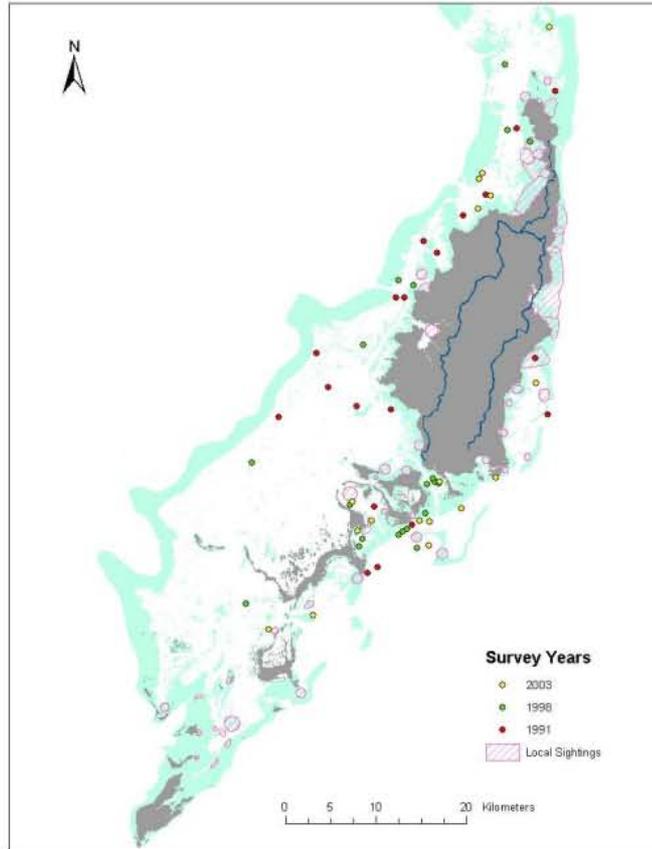
This provides a uniform, single method of grading hazards against each other in order to determine a priority order for dealing with the risks identified and deciding what resources will be allocated to each hazard. It is important to note that these risk grades have no absolute value and so care may need to be applied for ranking purposes across different States.

LIKELIHOOD	CONSEQUENCE RATING				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	M	M	H	E	E
LIKELY	M	M	H	H	E
POSSIBLE	L	M	H	H	E
UNLIKELY	L	L	M	M	H
RARE	L	L	M	M	M

*Table 4: Hazard Risk Grade*

# Acronyms

AoI	Area(s) of Interest
BMR	Bureau of Marine Resources
BOT	Bureau of Tourism
CBD	Convention on Biological Diversity
cIMMA	Candidate Important Marine Mammal Area
CMS	Convention on Migratory Species
EBSA	Ecologically or Biologically Significant Area
GOBI-IKI	Global Ocean Biodiversity Initiative's project supported by the International Climate Initiative
IBA	important bird and biodiversity area
ICMMPA	International Conference on Marine Mammal Protected Areas
ICoMMPA	International Committee on Marine Mammal Protected Areas
IMMA	Important Marine Mammal Area
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
MMPA	marine mammal protected area
MMPATF	Marine Mammal Protected Area Task Force
PAN	Palau's Protected Area Network
PICRC	Palau International Coral Reef Center
PMMS	Palau Marine Mammal Sanctuary
PNMS	Palau National Marine Sanctuary
PSS	Palau Shark Sanctuary



**Fig. 8.** Davis, P. Z. (2004) Current status of knowledge of dugongs in Palau: A review and project summary report. Koror: The Nature Conservancy (Etpison, 2012).



**Fig. 9.** Results of 2009-2011 dugong surveys in Palau (Left) One kilometre square cells (including buffer zone) located along the flight lines most commonly flown, with the number of dugongs per group indicated by coloured circles. (Right) Enlargement of the Malakal Harbour area showing 1 km squares with the 1 km sighting distance (buffer zone) indicated either side of the flight track. The occurrence of dugong sightings is indicated by coloured circles, showing numbers of individuals per sighting (Etpison, 2012).