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Iongh, H.H. de; Hutomo, M.; Moraal, M.; Kiswara, W.

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Part I

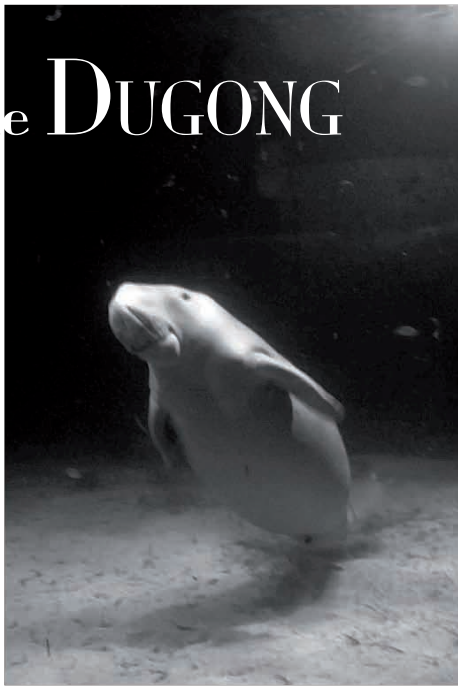
Scientific report
April 2009

Prepared by the Dugong Strategy Steering Committee

Edited by:

Dr. Hans de Iongh - Dr. Malikusworo Hutomo
Marloes Moraal MSc - Wawan Kiswara MSc

National Conservation Strategy and Action Plan for the Dugong in Indonesia



Part I

Scientific report

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Part I Scientific Report

April 2009

National Conservation Strategy and Action Plan for the Dugong in Indonesia

Prepared by the Dugong Strategy Steering Committee

Edited by:

Dr. Hans de Iongh - Dr. Malikusworo Hutomo
Marloes Moraal MSc - Wawan Kiswara MSc

Contents

Preface

It is a pleasure to present to you the publication of Part I (Scientific document) and Part II (Strategy document) of the National Conservation Strategy and Action Plan for the Dugong in Indonesia (NCSAPDI). This first publication is in English, a Bahasa Indonesia version is in preparation. The process which has resulted in the completion of these two publications has taken two full years. During those two years three meetings of the Steering Committee took place and two NGO consultations (in Bali and Manado). During the process a large number of stakeholders, including government staff, scientists and NGO staff have participated in the preparation of both documents.

The present document gives a follow up to the Global Status Report and Action Plans for Countries and Territories prepared by Marsh *et al.* (2002), which resulted from a resolution of the IUCN World Conservation Congress in Buenos Aires (1995). The present report also builds on the Policy, Strategy and Action Plan for Management of Seagrass Ecosystems in Indonesia (UNEP-GEF, 2003).

The completion of the National Conservation Strategy and Action Plan for the Dugong in Indonesia (NCSAPDI) would not have been possible without the active support of the main sponsors, the United Nations Environmental Programme (UNEP) and the Convention of Migratory Species (CMS) in Bonn, the Ecosystem Grant programme (EGP) of the Netherlands Committee for IUCN and the Hong Kong Ocean Park Conservation Fund.

The present publications include recommendations for dugong research, conservation and management, the selection of pilot projects, a communication and awareness programme and other actions. It is wished that these recommendations will result in improved management and conservation of the remaining dugong populations in Indonesia.

M. Syamsul Maarif
Director General of Marine, Coastal and Small Island Affairs
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Acknowledgements

The development of the NCSAPDI for Indonesia has been financially supported by the UNEP Regional Seas Programme, the Convention on Migratory Species (CMS), the Ocean Park Conservation Foundation, Hong Kong (OPCF), the IUCN Netherlands Committee Ecosystem Grants Programme (EGP) and the Regional Network for Indigenous Peoples in South East Asia (RNIP), as an Indonesian-Dutch collaboration. The Research Centre for Oceanography in Jakarta is the national focal point in Indonesia and the Institute of Environmental Sciences Leiden, the Netherlands, is the Dutch coordinator. These institutes have also contributed by making available staff time and logistics. Many individuals have contributed to the completion of the NCSAPDI and the editors want to thank all profoundly for their contributions.

Summary

This publication covers Part I (the scientific report) of the National Conservation Strategy and Action Plan for the Dugong in Indonesia (NCSAPDI) and includes the technical and scientific background information regarding the ecology, population size and distribution of the dugong in Indonesia. Part II covers the National Conservation Strategy and Action Plan for the Dugong in Indonesia (NCSAPDI) itself and this document is published separately. Part III is comprised of the National Dugong Database for Indonesia, which will become a web based database including information on dugong population numbers and distribution, regularly to be updated (a summary of the data base is presented in Annex II). The main goal of the NCSAPDI is to develop a conservation strategy and action plan which will be a viable basis for the long term conservation and management of dugong populations in Indonesia.

The present document gives a follow up to the Global Status Report and Action Plans for Countries and Territories prepared by Marsh *et al.* (2002), which resulted from a resolution of the IUCN World Conservation Congress in Buenos Aires (1995). The present report also builds on the Policy, Strategy and Action Plan for Management of Seagrass Ecosystems in Indonesia (UNEP-GEF, 2003). The preparation of this document was based on consultations with a joint Steering Committee (SC) and with a large number of NGOs during 2007 and 2008. The present report includes an analysis of information on the occurrence and distribution of dugongs and their seagrass habitats in Indonesia. The report also covers information on the dugong life history and biology, local myths, indigenous use and the major threats to dugong populations in Indonesia. Important dugong populations and seagrass habitats are believed to occur from Arakan Wawontulap to Lembeh Strait (between Lembeh and the mainland, North Sulawesi), on the east coast of Biak Island, in western Cendrawasih Bay Marine National Park (Papua Barat), around the Lease and Aru Islands (Maluku), and around the Flores-Lembata Islands (East Nusa Tenggara), in Ujung Kulon National Park, Sunda Strait, Banten Bay, Bangka Belitung and Trikora Beach (Bintan).

Dead dugong on the local market of Bangka Island

I

Introduction

This publication covers the scientific report of the National Conservation Strategy and Action Plan for the Dugong in Indonesia (NCSAPDI) and will focus on the technical and scientific background information regarding the ecology, population size, distribution, and legal, socio-cultural and socio economic aspects of the dugong in Indonesia. The main goal of the NCSAPDI is to develop a conservation strategy which will be a viable basis for the long term conservation and management of dugong populations in Indonesia.

This document forms Part I of a series of documents and a database which were prepared based on consultations with a joint Steering Committee (SC) during 2007 and 2008 (see Annex I). Part II forms the National Conservation Strategy and Action Plan for the Dugong in Indonesia (NCSAPDI) itself. Part III covers the National Dugong Database for Indonesia, which will become a web based database including information on dugong population numbers and distribution, to be updated regularly (see Annex II).

The present document gives a follow up to the Global Status Report and Action Plans for Countries and Territories prepared by Marsh *et al.* (2002), which was drafted as a result of a resolution of the IUCN World Conservation Congress in Buenos Aires (1995). The present report also builds on the Policy, Strategy and Action Plan for Management of Seagrass Ecosystems in Indonesia, which provided recommendations for the conservation of seagrass habitats in Indonesia (UNEP-GEF, 2003).

The development of the NCSAPDI for Indonesia has been financially supported by the UNEP Regional Seas Programme, the Convention on Migratory Species (CMS), the Ocean Park Conservation Foundation, Hong Kong (OPCF), the IUCN Netherlands Committee 'Ecosystem Grants Programme' (EGP) and the Regional Network for Indigenous Peoples in South East Asia (RNIP), as an Indonesian-Dutch collaboration. The Research Centre for Oceanography in Jakarta is the national focal point in Indonesia and the Institute of Environmental Sciences of Leiden University, the Netherlands, is the Dutch coordinator. These institutes have also contributed by making available staff time and logistics.

The dugong (*Dugong dugon*), by local Indonesian people also referred to as *sakoko ka kaot* (pig of the sea), *ikan duyung* (dugong fish) or *babi laut* (pig of the sea) has been recorded in Indonesia since colonial times. The first known record of a dugong was reported by the painter Samuel Fallours in 1712. This dugong was kept in a bath tube in Ambon for four days and seven hours, before it died (Pietsch, 1991). Anecdotal evidence suggests that they used to be common in the entire Indonesian archipelago, but that the populations seem to be depleted in more recent times (Salm and Clark, 1984; Salm and Halim, 1984). Dugongs have been reported from Sumatra to Papua and from north Sulawesi to south Bali. There have been observations of individual dugongs or dugongs in small groups, of 2-10 individuals (Salm and Halim, 1984; Marsh *et al.,* 1984; De Iongh and Persoon, 1991; De Iongh *et al.,* 2007). It has been suggested that dugong populations in some areas of Indonesia, like the Aru Islands, have shown dramatic declines because of loss and degradation of dugong habitat (seagrass pastures), fishing pressure, indigenous use and hunting and coastal pollution (De Iongh, 1996b; De Iongh, 1997). There are also indications that dugongs in other parts of Indonesia have declined, but there is no sound basis for this claim, since detailed information on dugong distribution in Indonesia from the past and present is missing. Most of the available information is anecdotal, outdated and/or based on incidental records or claims by local people.

II

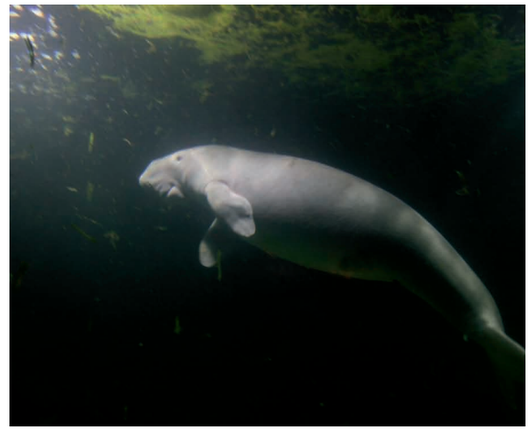
Global and Regional Dugong Conservation Status and Distribution

Dugongs only occur in tropical and sub-tropical waters of the Indo-Pacific region. Their range is extensive, spanning 48 countries and territories from the Arabian Gulf to Vanuatu (Marsh *et al.,* 2002). Approximately 85,000 of the world's dugongs are found in the inshore waters of northern Australia. This is likely to be at least three quarters of the global population, possibly even more (Marsh *et al.,* 2002). The second largest dugong population occurs in the Arabian Gulf where the population was estimated in 1987 at 7,310 dugongs (Preen, 1989; Preen *et al.,* 1989). Elsewhere, populations are small and fragmented and in some areas, such as Mauritius, the Maldives and parts of Cambodia and Laos, dugongs may already have become extinct (Marsh *et al.,* 2002).

In Indonesia no reliable and accurate dugong population estimates are available. In the 1970s the dugong population in Indonesia was estimated around 10,000 and again in 1994 the population was estimated at about 1,000 (Marsh *et al.*, 2002). However, since both estimates are based on educated guesses, this should not be considered as evidence for a population decline.

Dugongs are classified on the global Red List of IUCN as 'Vulnerable to extinction' (IUCN, 2006) and are included (like all Sirenia) in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2007).

Based on resolutions during the World Conservation Congress in Buenos Aires (1995) a Global Dugong Status Report and Action Plan was developed and published in 2002 (Marsh *et al.*, 2002). Several countries and territories have already started working on national or regional dugong conservation strategies. A Dugong Conservation Strategy was developed for the Philippines in 1995 (Kataoka *et al.,* 1995). A western Indian Ocean Dugong Conservation Strategy covering the countries Kenya, Tanzania, Mozambique, Madagascar, Seychelles, Union of the Comoros, Mayotte and Réunion was published in 2004 (WWF, 2004). In Queensland a Nature Conservation (Dugong Conservation) Plan was developed in 1999 [Nature Conservation Dugong Conservation Plan, 1999]. Also local management plans were developed. A Dugong Management and Conservation Project for the Moluccas was implemented with EU support during 1989 until 1993, resulting in recommendations for local dugong sanctuaries and community based conservation (De Iongh and Persoon, 1991).



Dugong in the Sea World Oceanarium, Jakarta, in 2008

III

Background Context

III.1 Indonesian waters

Indonesia is one of the largest and most varied archipelagic countries in the world. The country extends from 5,120 kilometres from east to west and 1,760 kilometres from north to south. It encompasses 17,508 islands, of which only 6,000 are inhabited (CIA, 2007).

There are five main islands (Sumatra, Java, Kalimantan, Sulawesi, and Papua), two major archipelagos (Nusa Tenggara and the Maluku Islands), and sixty smaller archipelagos. Indonesia's generally recognized territory (land and sea) is about 2 million square kilometres, with a land area of 1,826,440 square kilometres and another 93,000 square kilometres of inland seas (straits, bays, and other bodies of water) (CIA, 2007).

The warm waters support a rich and diverse variety of marine flora and fauna. Indonesian waters are considered as one of the most biodiverse waters worldwide (Bleakley and Wells, 1995).

Characteristic marine habitats include beaches and coastal mud flats, extensive mangrove forests, coral reefs, seagrass fields and open waters. These habitats provide important nesting and foraging grounds for many different species, such as dugongs and turtles.

Important dugong habitats are believed to occur from Arakan Wawontulap to Lembeh Strait between Lembeh and the mainland (North Sulawesi); on the east coast of Biak Island and in western Cendrawasih Bay Marine National Park (Papua Barat), around the Lease and Aru Islands (Maluku), and around the Flores–Lembata Islands (East Nusa Tenggara) (Marsh *et al.,* 2002).

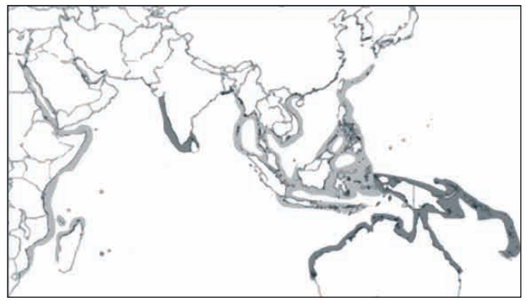


Figure 1. Distribution of the dugong (Marsh et al, 2001) Dark grey: certain dugong distribution. Light grey: probable dugong distribution

III.2 Existing conservation programmes in the Indonesian waters

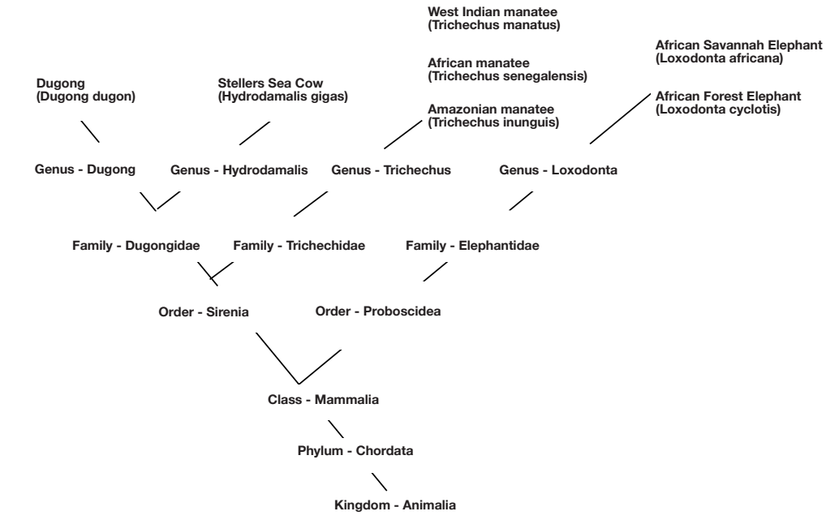
Several conservation programmes in Indonesia are involved in marine protection, recently under the umbrella of the Coral Triangle Initiative according to the Coral Reef Rehabilitation and Management Project (COREMAP). Some of these programmes are supported and coordinated by the national or regional and local government, some by local and international NGOs or in partnerships. International NGOs like WWF, TNC, Wetlands International, WCS and IUCN are actively involved in coastal and marine conservation programmes, in partnerships with local stakeholders. Several of these programmes cover dugong habitat.

Other marine conservation programmes involve national conservation strategies for marine ecosystems. At the moment conservation strategies for seagrasses, mangroves and corals are being developed in Indonesia. During 1989 until 1993 a Dugong Management and Conservation Project for the Moluccas was implemented with support of the EU, resulting in recommendations for dugong management and conservation (De Iongh and Persoon, 1991).

IV

Dugong Life History and Biology

IV.1 Taxonomy



The dugong is part of the order *Sirenia*. All sirenians are herbivore marine mammals and quite well adapted to their marine environment. The *Sirenia* order consists of two families *Trichechidae* and *Dugongidae*. The dugong is one of the two members of the family of the *Dugongidae*. The other member 'Stellers sea cow' was hunted to extinction in the 18th century, only 30 years after its discovery. The *Trichechidae* family consists of the three manatee species (Florida manatee, Amazon manatee and W. African manatee). Both the dugong and the manatee are often referred to as sea cow but the dugong feeds primarily on seagrasses and the manatee is more gregarious. The dugong's closest non-sirenian relative is the elephant (Bertram and Bertram, 1973).

IV.2 Physical characteristics

Like all sirenians the dugong is a herbivore marine mammal and well equipped to life in the water. The dugong has close resemblance with the manatee. They both appear quite fat and have a greyish wrinkled and tough skin, but are highly muscular and hydrodynamically shaped. They use their tail for movement. The manatee has a paddle-shaped tail, while the dugong's tail is more similar to that of a whale or dolphin.

The head is heavy and blunt and well equipped for taking breaths of air on the water surface. Both the dugong and the manatee are herbivore mammals. The dugong is more specialized and almost exclusively feeds on seagrass while the manatee also feeds on other aquatic vegetation. The dugong has coarse hairs around its rostrum (mouth), which serve

as sensors when it searches for edible sea grasses (Nishiwaki and Marsh, 1985). Most male dugongs and usually older female dugongs have large upper incisor tusks, which are often thought to play a role in feeding on seagrass rhizomes.
They have two limbs (flipper like) in the front of their body which are used for balance and moving along the ocean floor during grazing. Manatees and dugongs have very small eyes and they can still produce tears which are often harvested by fishermen and sold as "aphrodisiac".
Adult dugongs can grow up to 3 meters and weigh around 400 kg. Their lifespan is estimated to be 70 years (Nishiwaki and Marsh, 1985).

IV.3 Reproduction

Dugongs become mature around the age of 10. The females have a gestation period of about 14 months and give birth to a single calf every 2.5 to 5 years. The calf will stay with its mother for about 18 months during which it relies primarily on its mother's milk. Because of this slow reproductive cycle it has been calculated that a dugong population can only sustain a very low mortality rate of about 1 - 2% every year (Marsh *et al.,* 1984).

IV.4 Feeding behaviour

Dugongs are known to eat a wide variety of seagrasses. In the wild the dugong often feeds on seagrass species which are sparse and delicate, usually species of the genus *Halodule* or *Halophila*. The dugong is well equipped to eat fibrous foods. The dugong is a hindgut fermenter, which means that the anaerobic digestion of food by microbes occurs in the *caecum* (hind part of the large intestine). The gut passage time is quite long. Lanyon and Marsh (1995) found a mouth-to-anus retention time of 146-166 hours, which is much longer than those of most other herbivorous mammals. They also found the dugong is an atypical hindgut fermenter, since it has quite a low food intake of low-fiber material, which is almost completely digested during the extensive period in the hindgut.
The dugong normally consumes about 28 to 40 kg wet weight of seagrass each day. Although the dugong feeds primarily on seagrasses, some researchers have suggested that they can incidentally consume invertebrates (Preen, 1995c). Both leafs and rhizomes and also parts of the roots of the seagrasses are eaten, producing distinctive feeding trails.
It is thought that although dugongs eat all seagrass species, they prefer seagrass species which are high in nitrogen content (Lanyon, 1991), low on fibre and high on energy (De Iongh, 1996a). When the stomach content of a female dugong from the Spermonde Archipelago (S. Sulawesi) was investigated, over 99% of the digesta consisted of seagrass. Mainly species of the genera *Halophila*, *Halodule* and *Cymodocea* were found (Erftemeijer *et al.*, 1993).
The species high on nitrogen and low on fibre are usually the fast growing pioneer species, which grow intertidally or subtidally on sand or mud, like *Halophila* sp. and *Halodule* sp. These areas are often found in sheltered bays and lagoons less than 5 m. deep. The dugong has been observed in these areas feeding during the day as well as during the night. With the increasing population density and water traffic in coastal areas it is thought that the dugongs have shifted their feeding pattern from diurnal (day-time) to nocturnal (night-time) to avoid the heavy boat traffic (Anderson, 1981). However it is also possible that dugongs feed during the night because of the tidal fluctuation. Dugongs can only access the intertidal seagrass fields when the tide is high.
Preen (1995b) suggested that dugongs create their own favourable food by manipulating seagrass beds to encourage regeneration of the fast growing pioneer seagrass species by so called "cultivation grazing". Large groups of dugongs would regularly return to the same seagrass beds and feed in the same areas to maintain the regrowth of the fast growing

Grazing tracks in Balikpapan Bay

pioneer species which are high in energy and low in fibre. In Australia large herds of dugongs have been observed regularly recropping the seagrass beds. In Indonesia only small numbers of dugongs have been observed. But they have been observed returning to the same areas regularly (De Iongh *et al.*, 2007).

IV.5 Movements

Dugongs have been observed from east Africa to north Australia. It is not known if they can cross the Indian Ocean. However movements of up to 600 km have been recorded (Marsh and Rathburn, 1990). Also dugongs travelling from north Australia to Papua and Nusa Tenggara have been mentioned. A single dugong arrived in June 2002 in the Cocos (Keeling) Islands after travelling more than 1000 km across deep open ocean, originating most probably from the west coast of Java (Hobbs *et al.*, 2007).
In Australia movements are usually dictated by the seasonal changes. When the temperature gets colder the dugongs move to warmer waters (Anderson, 1986). Since in Indonesia temperatures are moderate throughout the year no such movements have been recorded.
During 1990 to 1996 dugong movements have been tracked in a number of studies using VHF or satellite transmitters (Marsh and Rathburn, 1990; De Iongh *et al.*, 1998). These studies provided a first insight in dugong movements and home ranges. Generally, dugongs tend to be fairly resident and most movements are within areas of seagrass beds and are dictated by the tides. In the Maluku four dugongs were caught and satellite tracked for up to 9.5 months. The animals moved quite individualistic and over large areas as far as 65 km in two days. They regularly returned to the same areas where they stayed for a maximum of 42 days (De Iongh *et al.*, 1998). These localized movements highlight the importance of protected area networks in dugong conservation.

IV.6 Indigenous use and myths of the dugong

IV.6.1 Indigenous use

Traditionally the bones of the dugong are believed to give protection and good luck. They can be kept in the houses or elsewhere in the village. In Indonesia (but also in Malaysia and the Philippines) several parts of the dugong (hair, bones, teeth, tusks, liver, gall bladder and penis) are believed to have medicinal power. The teeth are also used to make cigarette holders.
The tears of the dugong are believed to have aphrodisiac qualities. They are collected when the dugong is caught alive. When the eyes are exposed to air, the lacrimal gland excretes tears. This is locally called '*air mata duyung*', 'tear of the dugong' and is sold in bottles and can be mixed with perfume. Nowadays *air mata duyung* can still be found in the market, but it often doesn't contain the real tear of the dugong any more.
In some areas the dugong is considered a sacred animal and is therefore not actively hunted by local people (e.g. Lease Islands), while in other areas there is evidence of dugongs being caught regularly (at least in the past). In Aru for instance there is evidence that when a dugong is caught, the meat is shared by the whole community. The meat is said to be delicious and can be consumed fresh or dried to

Dugong teeth used as a cigarette holder

Dugong products sold in a local shop in Dobo

keep for future consumption. (De Iongh and Persoon, 1991; Hendrokusumo *et al.*, 1976).

IV.6.2 Myths

The word dugong originates from the Malay word *duyung*, which means 'lady of the sea'. The mermaid legend is believed to originate from early dugong sightings. Sailors, from a distance, could have mistaken a dugong for a half-human/half-fish creature. In Indonesia still some mythological stories exist about the origin of the dugongs. They usually consist of a woman transforming into a dugong. On the island of Sumba the story is told of a mother transforming into a dugong after she has disobeyed her husband (Forth, 1988). Similar stories are known from Sulawesi and the Moluccas.

IV.7 Threats

Apart from the Aru Islands no data is available on a decrease of dugong populations in Indonesia. It is however safe to assume that such a decrease has taken place. There is no clear indication on what the main cause is of this decreasing population. Several threat factors have been identified to have a negative impact on the present dugong populations in Indonesia (Marsh *et al.*, 2002; De Iongh, 1997):

- Habitat destruction and degradation of seagrass meadows caused by local industries, boat traffic, agricultural pollution.
- Coastal pollution by land based sources, but also by sea based sources (oil spills), which may both have an impact on the dugongs and on their seagrass habitat.
- Destructive fishing; impact of destructive fishing methods such as sodium cyanide fishing and coral blasting.
- Accidental catches in shark nets, gillnets or tidal traps (belat or sero).
- Indigenous hunting. The deliberate harpooning of dugongs is reported from the Aru Islands, but since the eighties this practice has been abandoned in some areas.
- Boat related impacts. Mortality of dugongs by the impact of outboard engines has been reported both in Balikpapan Bay and in Ambon (De Iongh, 1996a; De Iongh *et al.*, 2007).

The shallow, near-shore habitat requirements of dugongs and the slow rate of reproduction make the dugong very vulnerable to extinction. Processes that threaten the dugong vary to some degree across its range. Direct threats and indirect threats may cause a serious risk to the remaining dugong populations.
Direct threats to the dugong populations are mainly formed by human activities such as the unintentional and intentional catch of dugongs. But also the oil spills or other forms of pollution can have a direct effect on the health of the dugong (Preen, 1989; Preen *et al.,* 1989).

Dugong caught by fishermen in Tulehu Bay, Ambon

'Air mata duyung' sold in small bottles as an aphrodisiac

V

Seagrass

V.1 Seagrass ecology

The ecological importance of seagrasses has already been highlighted in the Global Seagrass Atlas (Green and Short, 2003) and in the Policy, Strategy and Action Plan for Management of Seagrass Ecosystems in Indonesia (ISC, 2003). Seagrasses are angiosperms which grow in marine environments. They usually form monospecific (one species) or multispecific (more species) beds or meadows. In Indonesia monospecific seagrass beds of *Thalassia hemprichii* are most widespread throughout the archipelago (Kuriandewa *et al.,* 2003). There are around 60 species of seagrass recognized in the world. In Indonesia 12 species of seagrass can be found (Kuriandewa *et al.,* 2003).
All seagrass species are rhizomatous, clonal plants. They spread through rhizome extension. Species like *Cymodocea serrulata* and *Posidonia oceanica* only reproduce through rhizome extension. However some seagrass species such as *Zostera marina* and *Enhalus acoroides* also reproduce sexually (Duarte, 2002).
Most seagrass species grow subtidally on sand or mud, although species within some genera such as *Zostera, Phyllospadix* and *Halophila* can also grow intertidally.
Seagrasses, like most plants, use photosynthesis for their growth and metabolic processes. They need sunlight as an energy source. The depth range depends on the available sunlight.
Tropical seagrasses are usually more dynamic than seagrasses in other parts of the world. They tend to grow faster and are better adapted to disturbances. The distribution and abundance of tropical seagrass meadows can vary with seasons.
It has been shown that this seasonal variation of intertidal seagrass beds depends on tidal variation. The seagrass leaves will burn or die off when they are exposed to direct daylight, resulting in a decrease in above ground biomass. In some areas this annual cycle will occur when the low water spring tide shifts from the night to the daytime (Erftemeijer and Herman, 1994; De Iongh *et al.*, 1995b; Stapel *et al.*, 1996).
When the low water spring tides shift back to the night-time, biomass will be restored by creating new shoots and leaves by mobilizing carbohydrates from the rhizomes. It is thought that dugongs come

Halodule uninervis pioneer seagrass with a large below ground fraction (left) and a low above ground fraction (right)

Dugong skull hanging from the roof of a house in Siberut, West Sumatra

to feed on the intertidal seagrass fields when the seagrass biomass is restored and the carbohydrates are high and the fibre is low (De Iongh *et al.*, 1995b).

V.2 Threats

Seagrass ecosystems are important but fragile ecosystems, which are mainly found in the coastal zone (Green and Short, 2003; ISC, 2003). There is evidence that seagrass beds worldwide are declining, due to human disturbances. Humans create damage by construction, eutrophication, siltation, aquaculture, etc. (Marsh *et al.,* 2002).

One of the most direct threats to seagrass beds is physical human disturbance. About 40% of the human population inhabits the coastal zone. Activities such as dredging and landfill activities for land reclamation, result in a reduction of water clarity and are very damaging to the seagrass ecosystem. Also widespread eutrophication of coastal waters is resulting in the global deterioration of the coastal water quality (Duarte, 2002).

V.3 Seagrass distribution in Indonesia

In Indonesia seagrass beds have been found all over the archipelago, from Sumatra to Papua and from north Sulawesi to south of the Nusa Tenggara. Green and Short (2003) and Tomascik *et al.* (1997) estimated that the total seagrass area in Indonesia is about 30,000 km². Kuriandewa *et al.,* (2003) published 'The Seagrasses of Indonesia', a chapter in 'World Atlas of seagrasses' edited by Green and Short. But the seagrass coverage for Indonesia is not comprehensive and there are still many gaps in information, in particular for the distribution of deep water seagrass beds and intertidal *Halodule* meadows.

VI

Regional Synthesis

This chapter presents a preliminary dugong assessment for Sumatra, Java, Kalimantan, Sulawesi, Bali, Nusa Tenggara, Maluku and Papua. A literature review and field studies carried out in the past in East Aru, Maluku Tenggara and East Kalimantan by staff and students from the Pattimura University in Indonesia and Leiden University in The Netherlands were used to obtain the information. Since very little information is available and often outdated this assessment may not give a complete overview of the present status and distribution of the dugong in Indonesia. It represents a first attempt.

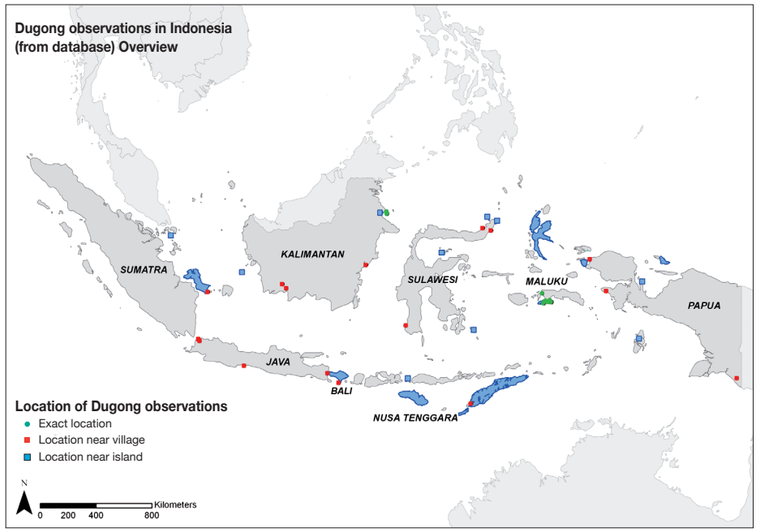
VI.1 Sumatra

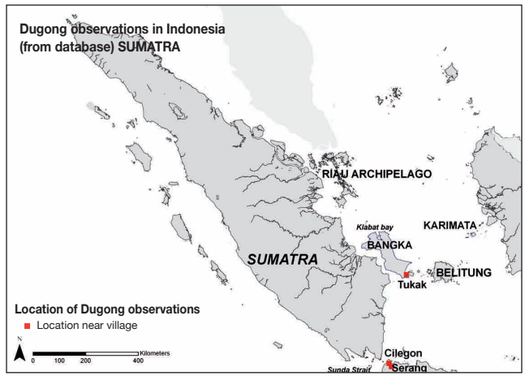
VI.1.1 Dugong distribution

Sumatra is the second largest island of Indonesia. In 1976 a survey team from the Jaya Ancol Oceanarium in Jakarta surveyed the islands Bangka and Belitung (northeast of south Sumatra) during which two dugongs were caught in Tukak Bay, south on Bangka Island (personal communication, Ibu Mega). In a small town on the shore of Klabat Bay (Blinyu) the survey team found that dugong meat was being sold in the market (Hendrokusumo *et al.*, 1976). In 2006 a dead dugong was again found on a local market on Bangka Island (Kiswara, Personal communication). Anecdotal evidence also suggests that dugongs can be found in the Riau Archipelago (Hendrokusumo *et al.*, 1976) and West of Sumatra on the Island of Siberut.

VI.1.2 Seagrass status and distribution

Seagrass fields around Sumatra range as far north





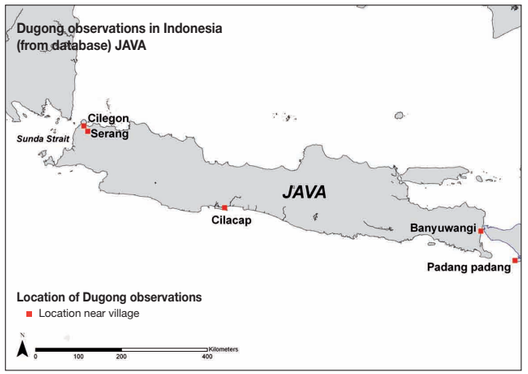
as the Riau Archipelago. Seagrass species of *Thalassia hemprichii* and *Enhalus acoroides* are widespread around Sumatra. North of Bangka Island, species of *Halophila ovalis*, *Halophila ovata*, *Enhalus acoroides* and *Thalassia hemprichii* can be found. The Sunda Strait between South Sumatra and Java contains the largest diversity of seagrass species around Sumatra. Among the species present there are *Halophila ovalis*, *Halophila ovata*, *Enhalus acoroides*, *Thalassia hemprichii*, *Syringodium isoetifolium* and *Halophila spinulosa* (Kuriandewa *et al.*, 2003).

VI.2 Java

VI.2.1 Dugong distribution

Java is the fifth largest Island of Indonesia and the most populated of Indonesia. Dugongs have been observed in: Ujung Kulon National Park, Cilegon Coast, Labuhan Coast, south of Cilacap, Segara Anakan, southeast of Blambangan, see Marsh *et al.*, (2002) and De Iongh (1997). In October 1999 a dugong was accidentally caught by fishers in Cilegon and transferred to the Jaya Ancol Oceanarium. Dugongs have also been reported to occur at Banten Bay in the Banten Province (Jakarta Kompas Daily 26/05/2000, in Marsh *et al.,* 2002).

During a survey study of the Jaya Ancol Oceanarium in 1975, local people in the area of north Serang claimed they caught several dugongs during 1974. As evidence they were able to show dugong tusks (Hendrokusumo *et al.*, 1976). The research team from the Jaya Ancol Oceanarium also found anecdotal evidence of dugong presence in West Java, Cilacap, Macassar Strait, Banyuwangi/Blambangan.



VI.2.2. Seagrass status and distribution

Seagrass fields can be found all around Java (Kuriandewa *et al.,* 2003). Especially the fields on the east and west (see Sumatra) side are diverse (Kuriandewa *et al.,* 2003). In Banten Bay a lot of seagrass research has been conducted. Species like *Thalassia hemprichii, Enhalus acoroides, Halodule uninervis* and *Halophila ovalis* can be found there. The dugong kept in the Ancol Oceanarium is fed fresh seagrass leaves, which are collected regularly in Banten Bay (Tas'an and Hendrokusumo, 1979).

The Seagrass Watch Organization monitored four locations in Kepulauan Karimun Jawa Marine National Park and reported that the marine park contains vast areas of seagrass meadows dominated by *Cymodocea rotundata*, *Thalassia hemprichii* and *Enhalus acoroides* and also present but in smaller amounts *Cymodocea serrulata, Halodule uninervis* and *Halophila ovalis* (McKenzie *et al.*, 2006).

VI.3 Kalimantan

VI.3.1. Dugong distribution

Kalimantan is together with Malaysia located on Borneo, the second largest island in the world. Anecdotal evidence exists of dugong presence in east, west and south Kalimantan (Hendrokusumo *et al.*, 1976).

Dugongs have been observed around the east coast in the Berau delta and in Balikpapan Bay. In 2000 a dugong was sighted during a field survey in Balikpapan Bay (Kreb and Budiono, 2005). During 2001 till 2007 several students from Leiden University in the Netherlands surveyed Balikpapan Bay and recorded a number of dugong sightings and a vast number of dugong grazing tracks in the bay (De Iongh *et al.*, 2006a). During this study they also found anecdotal evidence for dugong presence in Derawan Island.

Anecdotal evidence also exists of dugong presence in Kotawaringin, Karimata Island Marine Reserve and Kumai Bay (Marsh *et al.*, 2002).

Balikpapan Bay

Balikpapan Bay is located on the east coast of Kalimantan, below Samarinda. During 2001 till 2007 studies on the distribution and ecology of dugong and seagrass have been conducted in the area. In 2002 during a period of 4 months dugongs were observed 15 times during field surveys. The sightings were mainly around an intertidal seagrass field dominated by *Halodule uninervis* close to the village of Kariangau. In 2005 dugongs were sighted only three times during similar field surveys.

During the period August – December 2005 a total of 1414 dugong feeding tracks were found on *Halodule uninervis* seagrass beds (on average 63 grazing tracks per day). The dugong population was estimated at 12 dugongs at most (De Iongh *et al.,* 2007).

Questionnaire survey

In 2005 a small scale interview survey was carried out by students from Leiden University in three villages (Jenebora, Kariangau and Pantai Lango) around Balikpapan Bay. A total of 23 people, mostly fishermen, were interviewed.

When asked if they had ever seen a dugong, 20 of the 23 people replied they had ever seen a dugong, 17 people saw a dead dugong and 3 people saw a living dugong.

When the cause of death was asked, 10 people mentioned a tidal trap as a cause, 2 people said by collision with a boat, 1 person claimed he killed a dugong by his own hands and 4 people didn't know how the dugong died. From the interviews, it became clear that 8 of the interviewed people had ever caught a dugong, 6 by accident in a tidal trap and 2 on purpose. It also became clear that in 2005 at least two dugongs were accidentally caught in a tidal trap. One in April and one in June. In both cases it seemed to be a juvenile dugong of about 100 kg.

When the interviewers informed about the decline in dugong numbers in the Bay, 10 people noticed a decline in dugong numbers, 2 people said the dugong numbers stayed stable and 8 people didn't know.

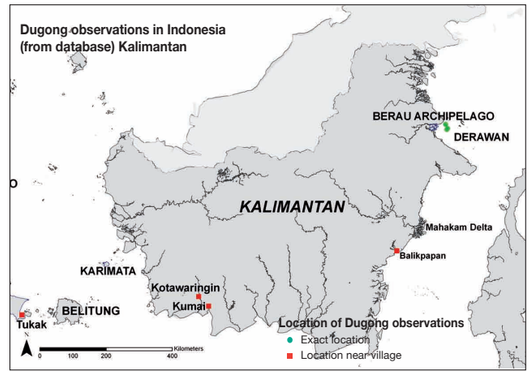
Dugong sightings from Balikpapan Bay interview survey

Where was dugong seen	Number of people
Caught in tidal trap	17
Swimming in sea	5
After collision with boat	2
Dead on beach	0
Never seen	3

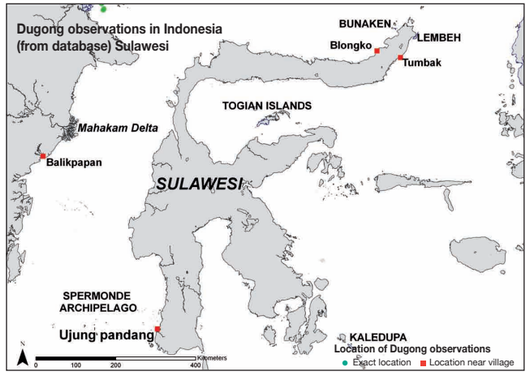
VI.3.2 Seagrass status and distribution

According to the World Atlas of seagrasses, most seagrasses around Kalimantan can be found in the Berau Area and on the south coast of Kalimantan, close to Banjarmasin (Green and Short, 2003). Possibly also in the Mahakam Delta seagrass is present (Kreb and Budiono, 2005).

In 2002, 22 seagrass beds were discovered along the



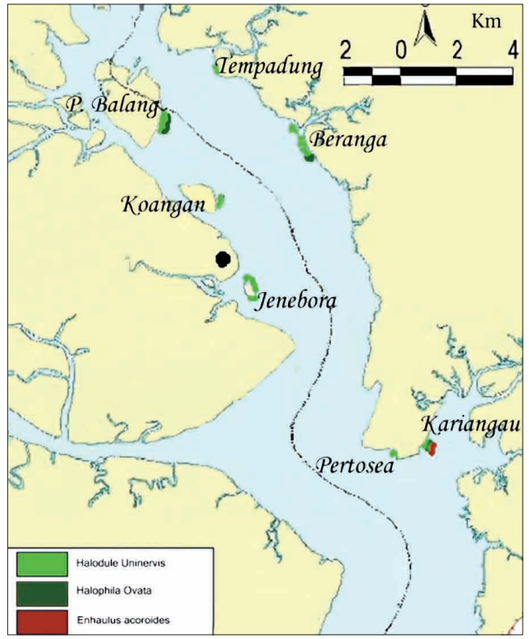
coastal line of Balikpapan Bay by students from Leiden University. A lot of these fields were intertidal and dominated by *Halodule uninervis*, but also *Halophila ovata*, *Halophila ovalis* and *Enhalus acoroides* were found (see map below).
The carrying capacity of the seagrass beds in the bay was calculated at 16 dugongs (De Iongh *et al.*, 2007).



VI.4 Sulawesi

VI.4.1 Dugong distribution

Sulawesi is the most central island of Indonesia. Dugongs can be found in North Sulawesi, around the seagrass bed of Arakan Wawontulap (southern portion of Bunaken Marine National Park). The population in this region was estimated at approximately 1,000 dugongs (Marsh *et al.*, 2002).
Marsh *et al.*, (2002) mentions that in 1997 a Taiwanese fishing company caught and disposed of nine dugongs in the Lembeh Strait, and that in Tumbak Village locals often catch dugongs for their meat. In Central Sulawesi around the Togian Islands Marine Park individual dugongs can often be seen. In 1975 a survey team from the Jaya Ancol Oceanarium caught five dugongs near Ujung Pandang (Allen *et al.*, 1976; Hendrokusumo *et al.*, 1976). At that time, the area was thought to support about 15 dugongs. In more recent times, local fishers in the area have said that dugong sightings in this area are now very rare, whereas previously there had been many animals. Dugongs have also been caught around Barang Lompo Island in the Spermonde Archipelago (Erftemeijer *et al.*, 1993).



Map of seagrass fields in Balikpapan Bay with the specific seagrass species (De Bruijn, 2002)

Bunaken Marine National Park

Bunaken Marine National Park is located north of Sulawesi, above Manado. In 1994 dugongs have been observed in groups of between one and four during a snorkelling survey in Arakan Wawontulap at the Bunaken Marine National Park. One hundred dugongs were supposed to be sighted at this seagrass bed over a period of one month. A local NGO, "KELOLA", which has been studying dugongs in northern Sulawesi, estimated approximately 1,000 dugongs in the region (Kelola, 1994 in Marsh *et al.*, 2002).
The Seagrass Watch Organization (McKenzie *et al.*, 2006) also mentions that dugongs have been reported in northern Sulawesi, in Blongko Marine Sanctuary. At full moon dugongs have been reported to come over from a nearby bay to feed on seagrass meadows, which are only accessible for them during spring tide. Dugongs are also reported to be present at other locations within and outside Bunaken Marine National Park and near Mantehage Island (personal communication, Angelique Batuna).

VI.4.2 Seagrass status and distribution

Seagrass research on *Thalassia hemprichii* has been carried out in South Sulawesi (Stapel *et al.,* 1996). Off Mantehage and Nain Islands, seagrass beds are present and in northern Sulawesi the seagrass species *Thalassia hemprichii, Halophila ovalis* and *Cymodocea sp.* have been recorded (Marsh *et al.*, 2002). The Seagrass Watch Organization monitored Blongko Marine Sanctuary, a small sanctuary within Bunaken Manado Tua Marine National Park and found that the Blongko site consists of a mix of seagrass species including *Cymodocea rotundata, Thalassia hemprichii* and *Enhalus acoroides*. They also monitored a site called Airbanua (Terremel), also within Bunaken Manado Tua Marine National Park and found seagrass species of *Enhalus acoroides* and *Thalassia hemprichii* (McKenzie *et al.*, 2006). According to the World Atlas of Seagrasses (Kuriandewa *et al.,* 2003), seagrass fields exist in North Sulawesi around Arakan Wawontulap Marine Reserve and Bunaken Marine Park, around the Togian Islands Marine Park, along the coast of southeast Sulawesi, in Wakatobi Marine Park, Take Bone Rate Marine Park and around the south tip of west Sulawesi.

VI.5 Bali

VI.5.1 Dugong distribution

Bali is a popular tourist destination. Several scuba diving sites make notice of incidental dugong sightings around Bali. According to Marsh *et al.* (2002) individual dugongs have been sighted by surfers at Uluwatu- and Padang-padang beach on the southwest extremity of the Bukit Peninsular and locals reported that an individual dugong visits the beach almost every day.
The survey team from the Jaya Ancol Oceanarium (Hendrokusumo *et al.*, 1976) mentions that two dugongs were caught around the south coast of Bali during 1977-1978.

VI.5.2 Seagrass status and distribution

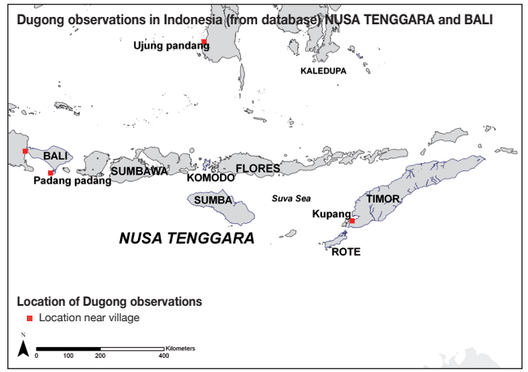
Segrasses around Bali are very diverse. Species like *Enhalus acoroides, Thalassia hemprichii, Halophila ovalis, Halodule uninervis, Halophila spinulosa* and *Cymodocea rotundata* can be found (Kuriandewa *et al.,* 2003). The Seagrass Watch Organization (McKenzie *et al.*, 2006) monitored the fringing reef flat at Sanur, Bali and found that the reef was covered by extensive intertidal and subtidal *Enhalus acoroides* dominated seagrass meadows. The meadows extend from near shore to reef crest. Large meadows of *Thalassodendron ciliatum* cover the reef crest on the edge of the surf zone and adjacent to channels.
According to the Ecology of the Indonesian Seas (Tomascik *et al.,* 1997) around the south coast of Bali, around the south coast of Bukit Badung Peninsula, often monospecific meadows of *Thalassia hemprichii* are found on the intertidal reef flats. Since the seagrasses there are subjected to harsh waves and high velocity tidal currents, the above ground biomass is often low (blades 5-7 cm, but the rhizomes are extensive 15-20 cm deep).

VI.6 Nusa Tenggara

VI.6.1 Dugong distribution

The Nusa Tenggara, or Lesser Sunda Islands, is a group of islands east of Java. The two largest islands of West Nusa Tenggara are Lombok and Sumbawa. East Nusa Tenggara consists of about 550

Coastal fisheries depend on seagrass ecosystems; repair of traditional boat on an intertidal seagrass bed, in East Aru



islands, but is dominated by the three main islands of Flores, Sumba, and West Timor. Other islands include Adonara, Alor, Ende, Komodo, Lembata, Menipo, Rinca, Rote Island (the southernmost Island in Indonesia), Savu, Semau and Solor.

According to Marsh *et al.,* (2002) dugongs are present in Komodo National Park within Selat Lintah separating Flores and Sumbawa. Singleton and Sulaiman (2002), the Seagrass Watch Organization (McKenzie *et al.,* 2006) and De Iongh (1997) also mention dugong presence in Komodo National Park.

During a dugong catch operation of the Jaya Ancol Oceanarium team in 1978, two dugongs were caught in Kupang Bay on West Timor (personal communication, Ibu Mega). Dugongs were also sighted around Rote Island.

Rote Island

Rote Island is located southwest of Timor and is the most southernmost island of Indonesia. In 1997 in front of the Island of Rote, during a diving trip and during a boat expedition near the Island of Sumba, an individual dugong was sighted in 2007 (Suharsono, personal communication).

In 2004 a series of interviews were conducted in the Savu Sea (Mustika, 2005). From the interviews it could be concluded that dugongs in the area are incidentally caught by small scale fisheries. Again during a visit to Rote Island in July 2004 the villagers revealed that the dugong populations there have decreased to insignificant numbers, compared to the dugong numbers observed two or three decades ago. Dugongs did not seem to be deliberately hunted; however accidental catches by artisanal fisheries (in addition to coastal ecosystem degradation) were mentioned as a possible cause of the regional dugong population decline.

Dugongs are difficult to spot, only the nostrils reach the sea surface

VI.6.2 Seagrass status and distribution

Seagrasses can be found all along the coast of the Nusa Tenggara. The Seagrass Watch Organization (McKenzie *et al.*, 2006) monitored four sites around Komodo National Park.

Two sites on Seraya Kecil Island, just outside the Komodo National Park boundary and two other sites on the Papagaran Island, inside the park boundaries were surveyed. The Seagrass Watch Organization found that the Seraya Kecil sites are dominated by *Enhalus acoroides* and *Thalassia hemprichii* with varying amounts of *Halophila ovalis, Syringodium* sp., *Halodule* sp. and *Cymodocea* sp. The sites at Papagaran were dominated by *Enhalus acoroides* with some *Thalassia hemprichii*. On the central north coast near Riung on Flores, the Seagrass Watch Organization found that Bakau Island is also dominated by *Enhalus acoroides* and *Thalassia hemprichii* with small amounts of *Halophila ovalis* and *Halodule uninervis* and that Ontoloe Island is dominated by *Thalassia hemprichii* and *Cymodocea rotundata,* also with a small amount of *Halophila ovalis* and *Enhalus acoroides.*

VI.7 Moluccas

VI.7.1 Dugong distribution

The Moluccas archipelago consists of around 1000 islands; the largest being Halmahera, Seram, Buru and Ambon. The island group is located between Sulawesi, The Philippines, Papua Barat and East Timur.

In 1990 and 1992 research on the distribution, migration and feeding ecology of the dugong was carried out in East Aru and the Lease Islands by staff and students from the Pattimura University in Indonesia and Leiden University in The Netherlands. Aerial surveys were conducted in 1990 and 1992 around the coastal waters of the Lease Islands (Ambon and the Islands of Haruku, Saparua, and Nusa Laut) in Maluku Province. The minimum population of dugongs within the study area was estimated at between 22 and 37 animals (De Iongh *et al.,* 1995a). During an interview survey in 14 villages of East Aru, the villagers mentioned a decline in dugong numbers between 1989 and 1990.

In 1994 four dugongs were caught and tagged with Telonics satellite platform transmitters (De Iongh *et al.,* 1998). The animals showed individualistic movement patterns and moved over large areas. One animal even travelled 65 km in two days.

Furthermore dugongs have been reported in the Aru Tengara Marine Reserve, around Seram and south of Halmahera (Marsh *et al.*, 2002; De Iongh, 1996b; De Iongh, 1997).

Ambon

During December 1990 and December 1992 seagrass distribution and seasonal changes were studied in relation to dugong grazing in Nang Bay on the east coast of Ambon. A considerable number of feeding tracks was found in intertidal seagrass meadows dominated by *Halodule uninervis.* Between August-December 1991 a total of 800 feeding tracks were counted. The tracks were mainly found in seagrass patches dominated by *Halodule uninervis*, but feeding also occurred on patches of *Thalassia hemprichii* and *Cymodocea rotundata.* During August-September 1991 the feeding frequency was the highest. Most feeding occurred when tidal fluctuations were high (De Iongh *et al.,* 1995b).

Aru

During December 1990 and December 1992 a field study on the ecology of the dugong was carried out in the Aru archipelago. Grazing swards were discovered showing signs of intensive rotational grazing by dugongs in intertidal inshore *Halodule univervis* meadows. During interviews, local villagers confirmed this rotational grazing by dugongs and suggested that dugongs show seasonal grazing patterns in these intertidal meadows, synchronising with the monsoon periods. During a field survey several observations were made of dugongs making typical grazing dives, or resting adjacent to the intertidal monospecific *H. uninervis* meadows. All intertidal meadows with high densities of dugong grazing tracks were located close to the mangrove edge, in riverine estuaries (De Iongh *et al.,* 1995a).

Interview survey

During a field survey a total number of 14 coastal villages between Pulau Karawai and Pulau Workai were visited. The village head, and a number of selected fishermen were interviewed with reference

Dugong skull with tusks from east Aru

to their knowledge on the numbers of dugongs that had been caught in the village over the past years. Based on these interviews it was estimated that in 1989 around 59-90 dugongs were caught and in 1990 around 29-36 dugongs were caught. Before 1989 the villagers remembered the number of catches to be even higher. These results indicate a decline in dugong numbers (De Iongh, 1996b).

Aerial survey

During December 1990 and August 1992 two aerial surveys were performed along the coastline of the Lease Islands. Dugongs were found in small (1-3 animals) grazing assemblages. 5-11 dugongs per

hour were observed. A minimum population of 22-37 dugongs was estimated in the area of the Lease Islands (De Iongh *et al.,* 1995a).

Satellite tagging

During 1994 four dugongs were caught and tagged with satellite platform transmitters (De Iongh, 1996a). Three adult females and one immature male were caught near Haruku Island and tracked for several months (De Iongh, 1996a). The animals moved over large distances (maximum of 65 km) and showed very individualistic pattern of movement: they never moved together (De Iongh *et al.,* 1998).

VI.7.2 Seagrass status and distribution

Seagrass meadows can be found on the coastal shelf around the Lease Islands. Many of the seagrass meadows are dominated by *Halodule uninervis* but also mixed meadows with *Halophila ovalis, Thalassia hemprichii, Cymodocea rotundata* and *Cymodocea serrulata* can be found (De Iongh *et al.,* 1995a).
During the study in Nang Bay seagrass meadows of *Cymodocea rotundata, Halodule uninervis, Enhalus acoroides, Thalassia hemprichii,* and *Halophila ovalis* were found. *Halodule uninervis* was most commonly found on sandy sediments or sandy sediments with stones. *Cymodocea rotundata* and *Thalassia hemprichii* were rare on sandy sediment, but occurred more on the other categories of sediments (De Iongh *et al.,* 1995a).
According to Marsh *et al.* (2002) also in Kayeli Bay (East Buru), Piru Bay (Buru), Seram and Fakfak seagrass beds are present.

Catch of a satellite tagged dugong in Haruku, Moluccas

VI.8 Papua

VI.8.1 Dugong distribution

Papua is the western half of the island New Guinea. Papua represents the eastern border of Indonesia. It has two provinces Papua and West Irian Jaya.
Dugongs have been recorded in Biak Island-Padaido Islands, Sorong, Fakfak coasts, Cendrawasih Bay Marine National Park and Wasur National Park (Marsh *et al.*, 2002; De Iongh, 1997). Also dugongs are sometimes found in seagrass beds in Mioswaar Island (small island group near Biak), Anggrameos Island and some mainland beaches in the southern part of the park. A small dugong population has been observed around northern Papua Barat during scientific research cruises (Petocz, 1989).
In 1981 a total of 14 dugongs were counted from the air along a stretch of the mainland and the nearby large islands of Roon and Mioswaar. Around the Auri reefs in Cendrawasih Bay two dugongs were seen (WWF, 1981).
A more recent areal survey by the Wildlife Conservation Society in 2008 revealed a total number of 24 dugongs in the Raja Ampat Islands (personal communication Wawan Kiswara).

VI.8.2 Seagrass status and distribution

Seagrass beds are found around the north coast of West Papua, around Cendrawasih Marine National Park, south of Biak Island. Among the species present are *Halodule uninervis, Enhalus acoroides, Thalassia hemprichii* and *Halophila ovalis* (Kuriandewa *et al.,* 2003).

VII
Conclusion

It is clear that dugongs show wide spread and scattered distribution in Indonesian coastal waters. Scientific data on dugong observations is available from Papua, Kalimantan, Moluccas, Sulawesi and Java. Anecdotal data is available from almost throughout the entire Indonesian Archipelago. Dugong population estimates have been made locally. In North Sulawesi dugong population estimates have been made of around 1,000 dugongs in Bunaken Marine National Park. In the Lease Islands, Maluku, the presence of a small population of at most 37 dugongs was confirmed and in Balikpapan Bay a population of at most 12 dugongs was calculated. In the Raja Ampat Islands 24 dugongs were counted.

This information is valuable although difficult to extrapolate to the total dugong population and distribution in Indonesia. In order to be able to protect and conserve the species more data, understanding and knowledge need to be available on the dugongs in Indonesia.

A first priority is population census by interviews, snorkelling surveys and aerial surveys. Further scientific research is vital for the development of a sustainable dugong conservation program.

The main threats of the dugong in Indonesia are habitat (seagrass) destruction, destructive fishing methods (cyanide fishing and blasting), accidental catches in shark nets and tidal traps, collisions with outboard engines of speed boats and deliberate hunting with harpoons and fishing nets.

Dugong tusks for sale in Siberut

VIII

Suggestions for Future Research and Monitoring in Indonesia

Marsh *et al.* (2002) defined the following research needs:

- The distribution and abundance of dugongs and their habitats need to be determined at an appropriate-sized but affordable spatial scale by interviews with local communities;
- The results of these interviews should then be used to plan aerial and/or vessel surveys.

In addition to the recommendations prepared by Marsh *et al.* (2002), it is recommended to include the following research and monitoring projects as priorities for dugong research and surveys in Indonesia during the forthcoming decade:

Project 1) Study the impact of community based conservation of dugong core areas, during a mid term study of five years.

The available scientific information suggests that the protection of certain core areas as dugong sanctuary is an important conservation measure. The declaration of dugong sanctuaries should coincide with the enforcement and enhancement of traditional community based conservation systems, like the local 'sasi laut' with inshore-protected areas and restricted fishing practice. Marsh *et al.* (2002) have emphasized the importance of traditional management systems (called *Sasi* in Indonesia) for the conservation of dugongs in Indonesia, defined as the practice built around the principle of "prohibition of" or "abstaining from" catching specific resources for a certain period of time. Local elders or custom leaders may determine the timing of such temporal closures or they may be "spirited from heaven" through seasonal changes or dictated by calendar years. According to Novaczek and Harkes (1998) the institute of Sasi has survived over about 400 years in various parts of the Maluku Province. New research on the impact of community based conservation on dugong populations in Indonesia is important, because it seems to be the most effective way to conserve dugong populations for future generations in Indonesia.

Project 2) Implement areal surveys and ground surveys (based on interviews and snorkelling surveys) nationwide in areas where dugongs are known to occur, and later in areas where dugongs are suspected to occur.

Evidence gathered through aerial surveys in the study area of the Maluku, a small tropical island ecosystem with a narrow coastal shelf, indicate a dispersed pattern of distribution of low numbers of dugongs (De Iongh *et al.*, 1995a). The number of dugongs per survey hour in the study area was 5-11 dugongs/hour (De Iongh *et al.*, 1995a), which compares with the results of aerial surveys in other tropical island ecosystems, resp. 5.4 and 7.5 dugongs/hour in Palau (Rathburn *et al.*, 1988), 9.2 dugongs/hour in the Torres Strait (Marsh *et al.*, 1984), and 1.9 dugongs/hour in the Philippines (Trono, 1995). New initiatives for dugong surveys are important, because to date, apart from the Maluku province and Raja Ampat (West Irian), no extensive aerial and ground surveys of dugong populations have been reported in Indonesia. Aerial surveys should be complemented with ground surveys, including interviews with villagers, snorkelling surveys and longer term education and awareness programmes supported by local government and (international) NGOs.

Project 3) A mid term study of five years using satellite telemetry on dugongs in the following areas a) Bintan Island; b) Ujung Kulon and Miskam Bay; c) East Kalimantan; d) North Sulawesi and e) Papua.

To date, the only observations in Indonesia on movements and home range of dugongs, using conventional and satellite telemetry, are reported in the Lease Islands, Maluku Province (De Iongh *et al.*, 1998). Three adult females and one immature male were tracked for several months. Similar to the findings of Preen (1995a), the animals showed a surprisingly individualistic pattern of movement, moving over large areas. The subadult male moved 65 km in as little as two days and stayed in a core area in S. Seram for 42 days, until the PTT was released. The three adult females used 2-3 preferred areas 17-55 km apart, where they stayed a maximum of 42 days, each returning at least once to a preferred core area. One adult female dugong made five roundtrips between two core areas were she stayed a maximum of 8 days. The recorded mean home range (50% isopleth) covering sea area in this study was 4.1 km², in the same range as mean home ranges (50% isopleth) of 9.7 km recorded by Preen (1993) in sub-tropical Moreton Bay and 4.1 km² recorded by Marsh (1990) in tropical North Queensland. In all reported studies dugongs move along restricted core areas where feeding takes place in larger (Preen, 1993) or smaller (De Iongh *et al.*, 1998) feeding assemblages. This confirms the observed pattern of grazing by small (facultative) herds of dugongs in restricted feeding swards. New research on dugong movements and home ranges is important for their conservation and management, because it may reveal core areas that need to be protected and interactions between different dugong populations.

Project 4) Initiate a mid term study of five years to investigate the mechanism behind the creation of grazing swards by dugongs in Indonesian coastal waters.

Dugongs seem to have developed three adaptations to cope with their low quality diet. First, they have developed a high capacity of cellulose digestion by combining physiological adaptations in their intestinal track with a slow GPR (Lomolino and Ewel, 1984). Secondly, they select more digestible forage by dietary preference for highly digestible pioneer species like *Halodule uninervis* and *Halophila ovalis* (Preen, 1993; De Iongh *et al.*, 1995b; Marsh *et al.,* 2002). Thirdly, they regularly recrop swards of young seagrass shoots (Preen, 1995b; De Iongh *et al.*, 1995b). Fourth, some studies are known, where dugongs fed specifically on seagrass roots and rhizomes, thus optimising on energy uptake (De Iongh *et al.*, 1995b; Anderson, 1998).
In a study on dugongs in the Maluku Province, East Indonesia mention was made of concentrated grazing swards inside coastal seagrass meadows, with a high density of dugong feeding tracks surrounded by relatively undisturbed meadows in an intertidal *Halodule* dominated meadow and in sub-tidal mono-specific *Halodule uninervis* and *Halophila ovalis* meadows (De Iongh *et al.*, 1995b, 1996). Dugongs in this study do not show cultivation grazing similar as demonstrated by Preen (1995b), but they create grazing swards inside existing mono specific *Halodule* seagrass beds. Although the importance of intertidal meadows is understood, there is very few research on the role of deep water seagrass beds in Indonesia. New research should therefore preferably focus on the balance between dugong grazing on deeper water seagrass beds and seasonal grazing on intertidal seagrass beds, to better understand the dynamics of dugong survival in coastal habitats.

Project 5) Trans-boundary research on shared dugong populations between Indonesia and Malaysia, Indonesia and Australia, and Indonesia and the Philippines, to be integrated in project 1, 2, 3 and 4.

Research institutions which can be involved are research centres (Research Centre for Oceanography Jakarta) and Universities (IPB Bogor, Mulawarman Univ., Hasanudin Univ., etc). More detailed research proposals will be prepared to give a follow up to the recommendations.

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Annex I

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Annex II

National Dugong Database and Questionnaire

Introduction

During 2007 and 2008 a draft National Dugong Database was developed within the framework of the NCSAPDI. The aim was to create an adaptable and accessible National Database of dugong sightings. This Database would give more insight into the status, distribution and trends of dugong populations in Indonesia. Based on this, the main gaps in the present information can be identified.

Sub-objectives of the database are:

1) To provide a tool in which information on dugong sightings in Indonesia can be stored and actively used by stakeholders as an information source on dugong status and distribution.

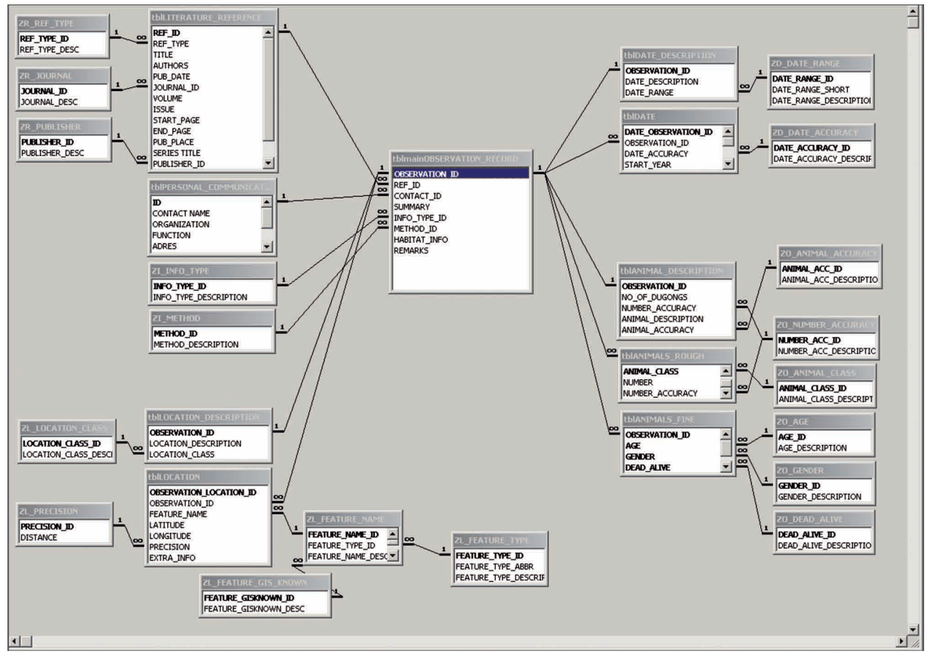
2) To provide a tool which can serve as input for graphic representation of dugong distribution and trends in Indonesia.

User profile

The information which can be gathered from the database will be useful for many people and organizations. The user profile of the National Dugong Database is defined as:

1) National and international NGO's involved in coastal conservation in Indonesia.

2) Other relevant stakeholders who contribute to management and conservation of dugong population.



Overview of the database structure, with tables and relations.

Design of the database

The database stores information on dugong observations in Indonesia.
A dugong observation is defined as: an observation in a specific location in a certain period of time, during at most one month. For instance: 3 dugongs observed in a certain area during one month can be recorded as one observation.
The literature research carried out for the NCSAPDI was used as a basis for the available information on dugong distribution.

Four main types of information are distinguished for each dugong observation:

1) The origin of the information (literature, personal communication).
2) The location of the observation.
3) The date of the observation.
4) Characteristics of the observed dugongs (number of dugongs, age, gender, dead/alive).

Since so little information is available on dugong distribution in Indonesia, the goal is to store as much information as possible in the database. This implies that also ill described dugong characteristics and ill described date and location specifications should be taken into consideration. To keep the data 'clean' (don't leave out valuable information or make information more detailed than it actually is), different data quality classes were created to distinguish between detailed and 'rough' information.

TblmainOBSERVATION_RECORD is the main table to which all the other tables are linked. There are four main groups linked to the main table.

1) **References**
This is where the origin of the data is stored. Data can originate from literature reference (tblLITERATURE_REFERENCE) or from personal communication (tblPERSONAL_COMMUNICATION)

2) **Location**
This is where all the information involving the location of the observation is stored. Rough location description (tblLOCATION_DESCRIPTION) and detailed location description with coordinates (tblLOCATION) and information about the presence in ArcGIS (ZL_FEATURE_GIS_KNOWN) are represented in this area.

3) **Date**
This is where all the information involving the date of the observation is stored. A rough date description (tblDATE_DESCRIPTION) and the detailed date (tblDATE) can be stored here.

4) **Animal description**
This is where all the information on the characteristics of the observed dugongs can be stored. A rough description of the information (tblANIMALS_ROUGH) and a detailed description of the characteristics of the dugongs (tblANIMALS_FINE) can be stored here.

Dugong in the Sea World Oceanarium, Jakarta in 2008

Questionnaire

A questionnaire was developed with the objective to feed the database with additional information on dugong sightings in Indonesia. The questionnaire below presents questions that correspond to the different fields in the database (location, date, dugong description, etc.). The results can therefore be easily transported to the database.
Also other questionnaires, similar to this one but with different objectives (e.g. monitoring dugongs at local level for research purposes) can be developed. However caution is needed when using questions similar to the ones presented in the questionnaire below. These questions may be too difficult to use in the field or could be misinterpreted easily.

Dugong questionnaire

This dugong questionnaire is meant for individuals who have sighted dugong(s) in Indonesia or have other information involving dugong presence in Indonesia. Per questionnaire one dugong observation can be filled in. It is requested to try to fill in the answers as detailed as possible.

Contact Information

Name:
Nationality:
Occupation:
Organization:
Address:
Phone:
Email:

1. General Information

1a. How often have you seen a dugong/dugongs? (Choose from the list below)

- o Regularly, every: o year, o month, o week, o day
- o Several times: fill out a questionnaire for each dugong observation*
- o Only one time
- o Never: go to 4c
- o Other

1b. What were the circumstances during which the dugong(s) were observed (e.g. in the framework of research, vacation, during fishing activities, on the market, etc.)

1c. Which method was used for the observation? (Chose from the list below)

- o Accidental catch
- o Deliberate catch
- o Aerial survey
- o Field survey
- o Satellite tracking
- o Incidental sighting
- o Unknown
- o Other

1d. In what sort of habitat were the dugong(s) seen? (Choose from the list below)

- o Seagrass
- o Coral reef
- o Open water
- o Unknown
- o Other

2. Location

2a. Where were the dugong(s) sighted (Give a detailed location description, exact coordinates or close to a village, bay, island, etc.)

2b. If the dugong(s) were seen in the vicinity of a village, bay or island, etc., what was the estimated distance of the observation in relation to the described location? (Chose from the list below)

- o <1km
- o 1-5km
- o 5-10km
- o 10-15km
- o 15-20km
- o >20km
- o Unknown

2c. Do you have any extra information about the location?

3. Date

3a. When were the dugong(s) sighted (give exact date or period)?

4. Dugong characteristics

4a. How many dugongs were sighted?

4b. Please fill in the table below as detailed as possible for each dugong that was observed.

No.	Age (juvenile / adult / unknown)	Gender (male /female / unknown)	Dead / alive
1			
2			
3			
4			
5			
6			
7			
8			

4c. Do you have any other relevant information?

Thank you for your cooperation
Date: -
Place: -

*What is one dugong observation?

One dugong observation is an observation in a specific location in a certain period of time (no longer than one month). For instance if you have seen a group of dugongs in a certain area during one month, this can be filled in as one observation. But, if you have seen dugongs in a certain area during two months, this are two separate observations. Please fill in the questionnaire again for the second observation.
When a lot of dugongs are observed in a certain area over a long period of time (for instance, 3 observations per day or data from tracking research), then the observations from one month can be regarded as one observation. This in order to prevent every dugong sighting from becoming a separate dugong observation which will give an inaccurate picture of the whole dugong population.

PART I SCIENTIFIC REPORT

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