ASSESSMENT ON THREATENED SPECIES
(Marine Mammals, Sea Turtles, Sharks and Rays)
IN THE CORAL TRIANGLE REGION
INDONESIA

Directorate of Marine Conservation and Biodiversity
Directorate General of Marine Spatial Management
Ministry of Marine Affairs and Fisheries
Republic of Indonesia

ISBN 978-602-53618-2-1

Directorate of Marine Conservation and Biodiversity
Directorate General of Marine Spatial Management
Ministry of Marine Affairs and Fisheries
Republic of Indonesia

ASSESSMENT ON THREATENED SPECIES
(Marine Mammals, Sea Turtles, Sharks and Rays)
IN THE CORAL TRIANGLE REGION
INDONESIA

Directorate of Marine Conservation and Biodiversity
Directorate General of Marine Spatial Management
Ministry of Marine Affairs and Fisheries
Republic of Indonesia

ASSESSMENT ON THREATENED SPECIES IN THE CORAL TRIANGLE REGION - INDONESIA

EDITOR

Director of Marine Conservation and Biodiversity

COORDINATOR:

Ngurah N. Wiadnyana, Center for Fisheries Research, MMAF

CONTRIBUTOR

Firdaus Agung, MMAF (Policy and Management)
Sukendi Darmasyah, MMAF (Policy and Management)
Syamsul Bahri Lubis, MMAF (Policy and Management)
Setiono, MMAF (Policy and Management)
Yudit Tia Lestari, MMAF (Policy and Management)
Prabowo, MMAF (Policy and Management)
Ahmad Sofiullah, MMAF (Policy and Management)
Syifa Annisa, MMAF (Policy and Management)
Rian Puspitasari, MMAF (Policy and Management)
Erina Nelly, MMAF (Policy and Management)
Veda Santiadji, WWF Indonesia (Policy and Management)
Dwi Suprapti, WWF Indonesia (Sea Turtles)
Maulid Dio Suhendro, Universitas Nahdlatul Ulama Kalimantan Barat (Sea Turtles)
Matheus Halim (Sea Turtles)
Sekar Mira, P2O LIPI (Marine Mammals)
Dharmadi, Center for Fisheries Research, MMAF (Sharks and Rays)
Andhika Prasetyo, Center for Fisheries Research, MMAF (Sharks and Rays)
Casandra Tania, WWF Indonesia (Sharks and Rays)
Abraham Sianipar, CI Indonesia (Sharks and Rays)
Benaya, WCS Indonesia Program (Sharks and Rays)
Mahardika Rizqi Himawan, Whale Shark Indonesia (Sharks and Rays)

ISBN: 978-602-53618-2-1

PUBLISHED BY

Directorate of Marine Conservation and Biodiversity
Directorate General of Marine Spatial Management
Ministry of Marine Affairs and Fisheries
Republic of Indonesia
2018

FOREWORD

The Coral Triangle region that covers 5.7 million square kilometers of ocean waters is recognized as the global center of marine biodiversity and a global priority for conservation. The area contains more than 30 percent of the world's coral reefs. Of seven world's known marine, six species inhabit the Coral Triangle, so do the marine mammals like blue whales, sperm whales and dolphins and other endangered species including dugong.

In order to safeguard the region's marine and coastal resources, in 2009, the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) was formally launched through the signing of the Leaders Declaration during the Leader's Summit in 2009 by the leaders from the governments of Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste (the CT6). The CT6 are working together to sustain extraordinary marine and coastal resources through: (1) strengthening the management of seascapes; (2) promoting an ecosystem approach to fisheries management; (3) establishing and improving effective management of marine protected areas; (4) improving coastal community resilience to climate change; and (5) protecting threatened species.

Under the threatened species issues, the CT6 have agreed to develop a document called ***Assessment on Threatened Species in The Coral Triangle Region*** to present the status of populations, habitat conditions and management of endangered species, especially marine mammal groups, sea turtles, sharks and rays in the coral triangle region as preliminary data for reference in devising management steps and action plan of endangered species conservation in the CT6. Directorate of Marine Conservation and Biodiversity, as a focal point of Threatened Species Working Group in Indonesia has initiated and coordinated with all related stakeholders in developing the document.

I would like to convey my sincere gratitude and appreciation to those experts and contributors who have put their invaluable effort in the preparation of this assessment document. Finally, I hope that this document could serve as reference to strengthen the conservation efforts on sharks and rays, marine mammals and sea turtles in Indonesia.

Director of Marine Conservation and Biodiversity,

Andi Rusandi

LIST OF CONTENTS

LIST OF FIGURE

LIST OF TABLE

I
Introduction

1.1. Brief Information of Coral Triangle

The Coral Triangle is one of the greatest centers of biodiversity on Earth. This region has more species of corals, fish, mangroves, seagrasses, and many other taxa than any other marine area on the planet. It is now generally agreed that six countries form the core of the Coral Triangle; it comprises parts of Indonesia, Malaysia, Papua New Guinea, the Philippines, the Solomon Islands and Timor Leste. Within the Coral Triangle it is relatively easy to find areas harboring more than 605 species of hard coral – the building blocks of marine biodiversity (Source: Regional Plan of Action/ROPA CTI-CFF).

The Coral Triangle is home to 363 million people, 141 million of whom live within 30 km

(19 miles) of a coral reef (www.coraltriangle.org). It faces many threats, yet even though its habitats are fragile and show signs of breaking under the pressures exerted by humans, there is reason for hope. Governments, businesses and civil society, both in the region and around the world, are realizing the potential that they are losing, and working towards stopping the threats and to reverse the degradation (Source: coraltriangleinitiative.org).

The spectacular landscapes and natural riches of the Coral Triangle are under threat. Like reefs everywhere else on the planet, the Triangle is in critical danger because of climate change, overfishing/illegal fishing, unsustainable tourism, habitat degradation, irresponsible investments, extractive industries, poor governance. These problems are already happening and will worsen if suitable actions are not taken (source: www.panda.org).

Recognizing the critical need to safeguard the region's marine and coastal resources, in 2009, Indonesian President Yudhoyono inspired other leaders in the region to launch the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) through the signing of the Leaders Declaration during the Leader's Summit in 2009 by the leader from the governments of Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste (the 'CT6') representing the custodians of the Coral Triangle area (Figure 1). It is the first multilateral cooperation of its kind, one that focuses on food security through sustainable management of marine natural resources taking into consideration climate change impacts. The CT6 are working together to sustain extraordinary marine and coastal resources by addressing crucial issues such as food security, climate change and marine biodiversity.

At the Leader's Summit in 2009, these governments agreed to adopt a 10-year CTI-CFF Regional Plan of Action (CTI RPOA) to safeguard the region's marine and coastal biological resources. The RPOA has five (5) goals: strengthening the management of seascapes; promoting an ecosystem approach to fisheries management; establishing and improving effective management of marine protected areas; improving coastal community resilience to climate change; and protecting threatened species.

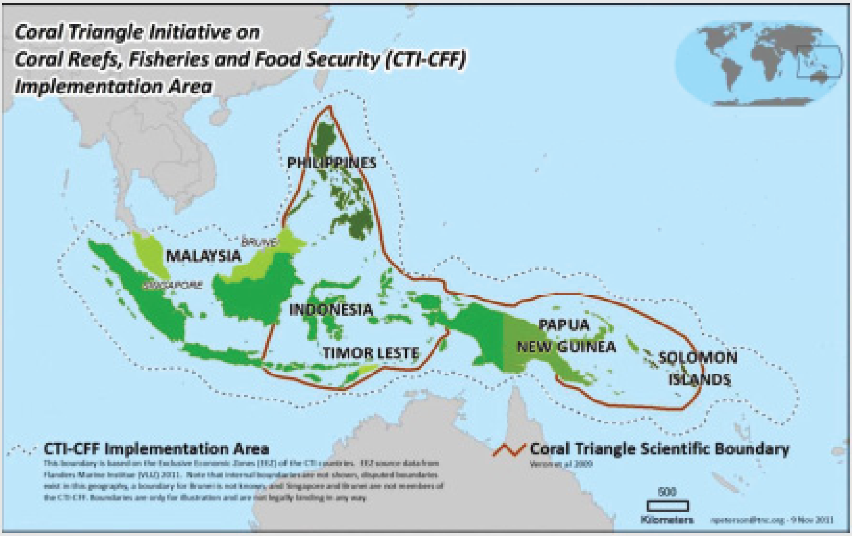


Figure 1. The Coral Triangle Area Including Six Countries: Indonesia, Malaysia,Papua New Guinea, Philippines, Solomon Islands, and Timor Leste.

Through the CTI-CFF, the Coral Triangle Member Parties have agreed to apply people-centered biodiversity conservation, sustainable development, poverty reduction and equitable benefit sharing. The CTI-CFF seeks to address both poverty reduction through economic development, food security, sustainable livelihoods for coastal communities and biodiversity conservation through the protection of species, habitats and ecosystems (Source: coraltriangleinitiative.org).

1.2. Brief Background on Threatened Species

Indonesia is one of the world's megabiodiversity countries. There are 557 species of Echinodermata, 309 species of crustaceans, 450 species of corals, 3476 species of marine fish, 13 species of seagrass, 981 species of algae, and 48 species of mangrove (LIPI, 2014).

In addition, Indonesia is a host for six species from seven species of turtles in the world, these six species of turtles have already fully protected.

Indonesian waters are known to be the main migration route for 35 species of marine mammals, especially in eastern Indonesia. More than a third of species of whales and dolphins (cetaceans) are found in Indonesian seas, including rare and endangered Blue Whales (*Balaenoptera musculus).* The main threats to this species include fishing, hunting, and habitat degradation.

The fish resources that currently become the concern of the government are sharks and rays. Until now there are 221 species of sharks and rays. Species that exist only a small part, have decreased the population, so the government of Indonesia take management action in the form of protection against some types of sharks and rays. However, current information shows that, almost all important economic sharks are facing threats of extinction (Fahmi, 2010; 2011; Allen and Erdmann, 2012). From the 44 families of sharks and rays, only about 26 species of sharks from 10 genera and 6 families that have important economic value in the fin trade in national and international markets.

1.3. Purpose of Assessment

Assessment of endangered species aims to determine the status of populations, habitat conditions and management of endangered species, especially marine mammal groups, sea turtles, sharks and rays in the coral triangle region as preliminary data for reference in determining management steps and action plan of endangered species conservation.

1.4. Methodology

The current assessment was done based on the agreement made in the 1st TSWG Meeting in Malaysia held in 2016. The data and information were gathering and compiled from some research results. The results of assessment were discussed through a focus group of discussion by involving representative from Indonesian government official staffs, researchers, non goverment organisations.

Studies of endangered species (group of turtles, marine mammals, sharks and rays) are based on literature results. Data and information on sea turtle species, marine mammals, and sharks and rays that are analyzed and presented in this report collected from 1997 to 2017, 2007 - 2017 and 2000 - 2016 respectively. For sharks and rays data are analyzed based on research results in national and regional levels. The reviewed information includes the distribution, abundance, population status and habitat of sharks and rays and the benefit value of threatened shark and ray species as well as its problems and challenges. Government regulations related to conservation and fishery management of sharks and rays are summarized to clarify the status of shark conservation in Indonesia.

1.5. Sources of Data

There are three types of data including sea turtles, marine mammals, and sharks and rays (Table 1), gathered from some report results published by various Institutions of Indonesia, such as: Agency for Marine and Fisheries Research and Human Resources Minsitry of Marine Affairs and Fisheries Republic of Indonesia, Indonesian Institute of Sciences, Non Goverment Organisations, Universities, and National News Papers.

Table 1. Type And Source Of Data Including Three Threatened Species Groups

No.	Threatened Species	Source of Data
1.	Sea Turtles	Reports, proceedings, journals, theses, national turtle conservation action plan documents, articles and pro files of turtle nesting coastal management in Indonesia
2.	Marine Mammals	National Action Plan: Cetacean Conservation Indonesia period I: 2016 -2020; National Action Plan: Dugong Conservation and its habitat (seagrass) in Indonesia period I: 2017 -2021; Pro ceedings of the Dugong National Symposium and Seagrass Habitat in Bogor 2016; and Preliminary Survey Report of DSCP Indonesia 2016
3.	Sharks and Rays	Data collection activities that conducted by enumerators at several landing sites of shark and ray that s cattered throughout Indonesia. Capture data of shark and ray were also sourced from observers who collect data on tuna longline ships that operating in Indian Ocean waters. The capture data of sharks and rays from various fishing gear both as target catch and by -catch were carried out by government agencies such as: Research Center of Fisheries, Agency for Research and Human Resources of Marine and Fisheries ; Center for Coastal and Marine Resources Management, Directorate of Marine Conservation and Biodiver sity; and non -governmental organizations, such as the World Wild Fund for Nature Indonesia, the Wildlife Conservation Society - Indonesian Program, and Conservation International - Indonesia. The sources of shark and ray data were also derived from the results of the joint research project activities of the South East Asia Fisheries Development Center, The Bay of Bengal Large Marine Ecosystem - Food and Agriculture Organization of the United Nation, and Commonwealth Scientific and Industrial Research Organi zation- Australian Centre for International Agricultural Research, Australia

II

Threatened Species In Indonesia

2.1. SEA TURTLES

Indonesia is a country rich in turtle species. Of the seven species of turtles in the world, six of them are in Indonesian waters and four of them can be found throughout the year laying on the coast of Indonesia, namely green turtles (*Chelonia mydas*), hawksbill turtles (*Eretmochelys coriacea*), leatherback turtles (*Dermochelys coriacea*) and olive Ridley (*Lepidochelys olivacea*), as seen in Figure 2.

Based on the results of turtle monitoring carried out on several major nesting beaches in Indonesia, there is a downward trend in turtle populations, especially green turtles, hawksbil and leatherback turtles. This is shown among others in Paloh Beach, West Kalimantan

Province; Jeen Womom Beach, West Papua Province and Pangumbahan Beach, West Java Province. The decline in the turtle population is due to the high threat of hunting for trade and consumption purposes; hatchability/low hatchling production, climate changes that cause sex ratio hatchlings tend to be certain sex turtles and high levels of bycatch.

The opposite is true for olive Ridley turtles, which based on turtle monitoring data on several beaches of olive Ridley turtle nesting in Indonesia it shows a trend of increasing female parent populations that land and lay eggs. This is indicated, among others, on the beach of Perancak, Serangan beach and several beaches in Bali Province. This condition occurs due to the lack of olive Ridley turtle hunting both for eggs, meat and carapace in the Bali region as well as the attention of several sea turtle conservation activists who are quite intensive in managing and maintaining their nesting habitat since 1997.

In several locations in Indonesia, there has been an increase in the number of sea turtle conservation activists and their habitat management. This condition is very helpful in population data collection, supervision of hunting and helping efforts to increase hatchery production. The management and activities of turtle conservation are carried out with various models ranging from community-based management such as at Perancak, Serangan, Kuta and Mampie Beaches where activities are directly run by local communities, based on government such as Pangumbahan beach, Sukamade beach, Ngagelan Beach, and other things; as well as collaboration-based management between the community and government such as on Sangalaki beach and Paloh beach. The description of turtle conservation management in several turtle nesting locations in Indonesia, population status and distribution, habitat management and conservation activists who are actively involved until the threats and challenges in each region will be described in the next subchapter.

2.1.1. Species Occurrence in the Region

Six out of seven the world turtle species are found in Indonesian waters, there are: green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (*Lepidochelys olivacea*), leatherback turtle (*Dermochelys coriacea*), loggerhead turtles (*Caretta caretta*) and flat turtles (*Natator depressa*). From the six species of turtles that live in Indonesia, four species are green turtles, hawksbill turtle, olive ridley turtle, and leatherback turtle, laying their eggs all year on Indonesian nesting beaches. The turtle abundance in Indonesia is characterized by the spread of nesting beaches, migration route, the waters of feeding ground and mating area (Figure 2).

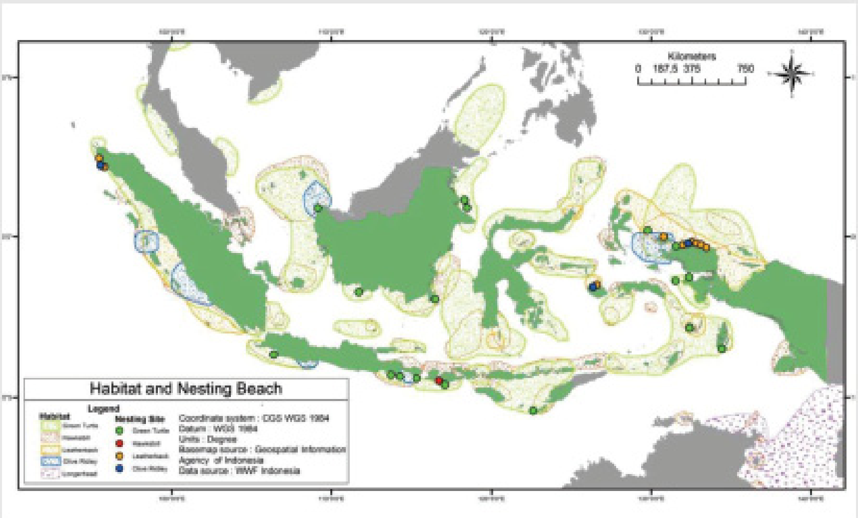


Figure 2. Map of Turtle Habitat And Nesting Beach In Indonesia

Turtle is one of the largest marine living reptiles (aquatic megafauna). Its existence has significance for socio-economic life in many societies, especially for coastal communities. However, the existence of all turtle populations has decreased significantly, even been categorized as endangered. Therefore, all sea turtles species are given protection. In Indonesia this protection is regulated in Law No.5/1990, Law No. 31/2004 and Government Regulation No. 7/1999 and No. 60/2007, while internationally has been included in Appendix 1 of CITES (Convention on International Trade in Endangereed Species) which means that turtles have been declared as endangered species and can not be traded in any form.

2.1.2. Abundance, Distribution and Population Status

Indonesia is a country that has sea turtle potential. Almost in most provinces in Indonesia has the potential of turtles or in other words is widely distributed from the western tip of Sumatra to the eastern tip of Papua. Green turtle, hawksbill turtle, olive ridley turtle, and leatherback turtle are the dominant turtle species that found in Indonesia both in feeding and nesting habitats.

However, the number of turtle populations in Indonesia is unpredictable considering that the monitoring activities of turtle populations are limited in nesting habitats and not all nesting habitat have turtle conservation management activities. Therefore the status of sea turtle population in Indonesia is only limited to the representation of female population that lay eggs and the number of hatchlings that are produced from a nesting beach.

Based on the data of turtle nesting in Indonesia the declining population status was happened. Almost in all nesting beaches show significant population decline graphs from year to year. The decline of turtle nesting population can be caused by several factors such as intrinsic factor (internal individual of turtle) and extrinsic factor that is natural and anthropogenic (human). However, extrinsic factors particularly anthropogenic factors are the main threat to the turtles. The threat of natural factors includes: the occurrence of coastal abrasion, climate change, as well as the threat of predatory animals. While anthropogenic factors include: the degradation of nesting habitat, marine pollution, by catch turtles, as well as the utilization of turtle itself such as meat, eggs and carapace. Because of these complex threats, serious handling to maintain the sustainability of turtle populations in nature is required.

In addition to monitor turtle populations in nesting habitats, the study of turtle genetic diversity populations has also been developed in Indonesia. Mitochondrial DNA techniques on green turtles in Indonesia show the population that lay their eggs in 7 nesting beaches in Sukamade Beach (East Java), Pangumbahan Beach (West Java), Sangalaki Island (East Kalimantan), Derawan Island (East Kalimantan), Piai Island (Raja Ampat), Enu Island (Aru), and Paloh Beach (West Kalimantan) are different from each other and declared as the population stock or management unit respectively (Purwanasari and Adnyana, 2010; Valez-Zuazo *et al.*, 2006; Mahardika *et al.*, 2007; Moritz *et al.*, 2002, Dhetmer *et al.*, 2006; Dio, 2014). Only the turtle populations at Paloh Beach are declared to have the same diversity as the turtle population in Sarawak (Moritz *et al.*, 2002).

Population genetic studies are not only conducted on green turtles. Nowadays, olive ridley turtle is also become the center of attention of sea turtle researcher in Indonesia, there are at least nine turtle nesting locations which have been traced to its genetic structure, including Bali (Wiradharma and Adnyana, 2010) and Aceh, Pariaman, Panggul, Serangan, Tuafanu, Kapoposang, Kwatisore and Yapen Island (Bahri, 2017). The result of the linkage between the turtle population structure of olive ridley turtle located in the western waters of Indonesia is more likely to have a relationship with the olive ridley turtles in India.

While for the leatherback turtle, the previous genetic research had been conducted in Papua and Sumatra (Dutton *et al.*, 2007) and (Maslim *et al.*, 2016). The pattern of connectivity of the leatherback turtle Sumatra has a migration path to the Indian Ocean and South China Sea. The haplotype that was found in Sumatra similar to the haplotype that found in Papua.

2.1.3. Habitat Status

Nesting turtle habitat is the location that become the benchmark of turtle population sustainability and become the priority of sea turtle conservation activities in Indonesia. Given the wide area of turtle nesting locations in Indonesia, the Ministry of Marine Affairs and Fisheries (KKP) has arranged a National Action Plan (RAN) of Turtle Conservation in Indonesia for period of 2016-2020, which has determined 12 priority provinces of turtle nesting (Figure 3) as the benchmark of turtle conservation success in Indonesia by 2020.

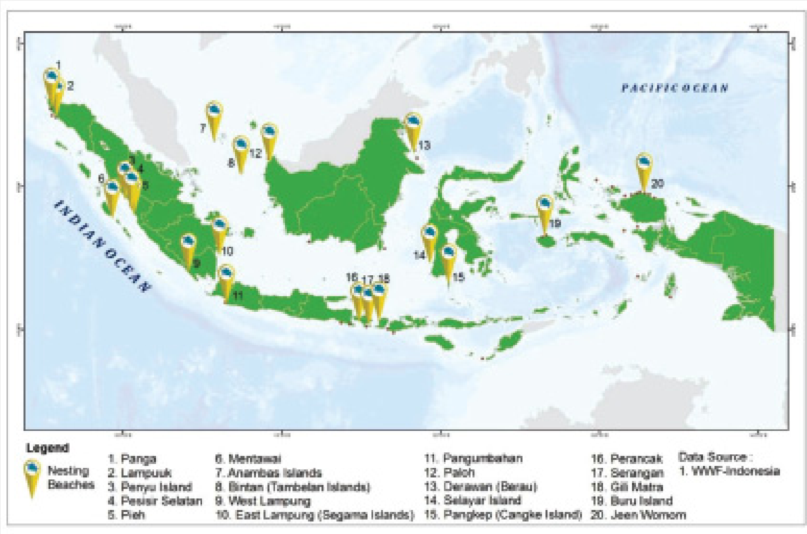


Figure 3. The Twelve Priority Provinces Monitored as The Benchmark of Turtle Conservation Success In Indonesia

The 12 priority provinces are: 1) Aceh Province, consist of Panga beach, Aceh Jaya Regency and Lampuuk Beach, Aceh Besar Regency; 2) West Sumatera Province, consist of KKPN Pieh, KKPD Mentawai and KKPD Pesisir Selatan Regency; 3) Riau Islands Province, consist of TWP. Anambas Archipelago and KKPD Bintan (Tambelan Islands); 4) Lampung Province, consist of KKPD Lampung Timur (Segama Besar and Kecil Island); 5) West Java Province, consist of TPP Pangumbahan Beach; 6) West Kalimantan Province, consists of Paloh Beach, Sambas Regency; 7). East Kalimantan Province covers the location of TPK Derawan; 8) South Sulawesi Province, consist of KKPD Pangkep Regency (Cangke Island) and KKPD Selayar Island; 9) Bali Province to consist of Perancak Beach and Serangan Beach; 10). West Nusa Tenggara Province to consist of TWP Gili Matra; 11) Maluku Province is located in the nesting location of North

Buru Island; and 12) West Papua Province is at TWP Jeen Womom. Some profiles or status of the nesting locations can be described as follows:

1. <u>Pantai Panga, Aceh Jaya Regency</u>

Panga Beach is located in Panga District, Aceh Jaya Regency. This district is located in the western region of Aceh which adjacent directly with the Indian Ocean. Panga Beach is a gently sloping beach, with marine spruce vegetation that located along the coastline for 15.56 KM and across 3 villages (Keude Panga Village, Kuta Tuha Village, and Alue Piet Village).

a. Current Status of Turtle Population in Panga Beach

There are at least two types of turtles that dominantly encountered in this beach, namely olive ridley turtles (*Lepidochelys olivacea*) and leatherback turtles (*Dermochelys coriacea*). The data record of turtles at the Panga Beach has not been done completely. From 2012 to 2016 at least 443 nesting turtles are found along Panga Beach (Table 2). These data are not representative of the total number of turtle nests but the number of nests that have been found and rescued from turtle egg hunting activities by local communities. However, the number of turtle eggs that have been rescued tends to increase from year to year along with the increasing frequency of monitoring and the number of personnel that involved in nest rescue (Figure 4).

Table 2. Data of Rescued Turtle Nest In Panga Beach During Period 2012-2016

No	Nesting Season (Year)	Finding (Nest)	Relocated (Nest)
1	2012-2013	85	2
2	2013-2014	97	5
3	2014-2015	138	11
4	2015-2016	123	10

Source: Aroen Meubanja and WWF Indonesia (2016)

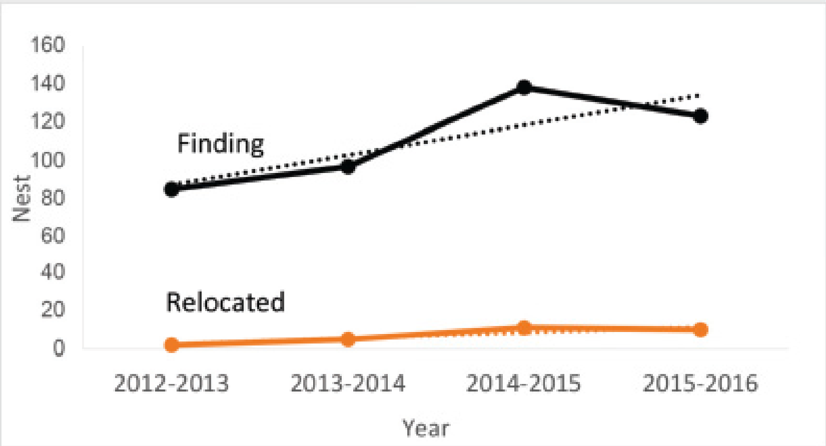


Figure 4. The Turtles Eggs Number Tends to Increase From 2012 to 2016
Source: Aroen Meubanja and WWF Indonesia (2016)

b. Issues and Problems of Turtle in Panga Beach

The habits of Panga Beach people in hunting and consuming eggs still happen, even turtle eggs in Pantai Panga are still traded in traditional markets at IDR 4.000-IDR 5.000/item. It is said that the people of Pantai Panga consume turtle eggs because they believe that by eating turtle eggs will increase their stamina, but the people began to change, they ate turtle eggs not because for stamina but because they like the taste and texture.

The hunting of turtle eggs that occurred in Panga Beach was not only from Keude Panga Village, Kuta Tuha Village, and Alue Piet Village but also from the hunters that came from the villages around Panga Beach. They were alone, but the hunting was done in teams or groups. When they got a nest that contains eggs, the nest was marked with wood and the eggs were removed, then the eggs were calculated and divided equally by the number of people in a team. This hunting activity is carried out continuously, resulting in the decreased of turtle nests every year.

c. Management Profile of Panga Beach

Recognizing that the hunting activities have had a negative impact, on December 6, 2012, people who concerned with the turtle population at Panga Beach established a group of turtle conservationists named Aroen Meubanja Conservation Team, with the motto "Asoe Laot Yang Kamoe Pinjam Beuna Sisa Keu Aneuk Cuco" or "The Sea That We Have Borrowed Must Have Leftover for Our Grandchildren ". The working location of this group is along Panga Beach.

Initially this group only consists of 6 members, but now as many as 21 people have been registered joined in this group. The member of this group contains former turtle egg hunters who eventually began to turn the profession into turtle conservation. As a turtle conservation the members of this group do not get wages from their conservation efforts, they all work on the basis of sincerity and desire to preserve the turtles for their children and grandchildren in the future.

To improve capacity in turtle conservation efforts, members of this group had participated in several training courses in the field of data collection and identification of turtles. The Aroen Meubanja group had received assistance in the form of a shelter that was built in Geude Panga Village, relocated turtle eggs location, cameras, and hatclings tank from DKP Aceh Jaya. Provincial DKP had also provided assistance in the form of data collection equipment.

Aroen Meubanja group took the initiative to make a turtle relocation in every village, this because the beach that become the nesting center is long enough. The relocation site, originally located only in Geude Panga, was scaled down and the fence was used as a relocation fence in two other villages. Aroen Meubanja group members also work together, to create a shelter in Kuta Tuha Village to facilitate members who patrol in this village.

2. Lampuuk Beach, Aceh Besar Regency

Lampuuk Beach is located in Lhoknga District, Aceh Besar Regency and geographically located at coordinates 5° 29 '37 " North Latitude and 95° 13' 45" East Longitude. Pasie Lange geographically is located at 05°30'507 "-095°12'19.2" is part of Lhok Lampuuk area which has white sandy beach and is the core area of turtle nesting.

Water Conservation Area (KKP) in Lhok Lampuuk, Lhoknga District, Aceh Besar Regency, is one of the areas that attract foreign and local tourists. Lhok Lampuuk Water Conservation Area (KKP) has two very strategic beaches. First, Lampuuk coastline with long coastline ± 2,500 m and beach width of 20-35 m which is made for fisheries based tourism and managed by local wisdom. Second, Pasie Lange beach which is a place of turtle conservation that managed with local wisdom.

a. Current Status of Turtle Population in Lhok Lampuuk Beach

Based on information from local community, Lampuuk Beach and several other adjacent coastal area, namely: Lhoknga Beach (southward) and Pasie Lange (northward), become nesting beache for a variety of sea turtle species such as: green turtle (*Chelonia mydas*), olive ridley turtles (*Lepidochelys olivacea*) and leatherback turtles (*Dermochelys coriacea*). But the people also said that the number of sea turtle that landed at each peak period continued to decrease and it is estimated that there are currently no more than 5-7 broodstock, both landed in Lampuuk beach and its surrounding (Lhoknga and Pasie Lange beaches).

b. Issues and Problems of Turtle in Lhok Lampuuk Beach

The decline in the number of broodstock that landed to lay their egg on the nesting beach is related to the disturbance level of turtle egg trade to be consumed and predation from lizard, pig, crabs to the turtle hatchlings. This condition also illustrates the ineffectiveness management of turtle nesting beaches and the real commitment of community action in the turtle conservation in many places have not been established and strongly built and, including in Lampuuk Beach and surrounding areas. In addition, natural factors such as coastal abrasion are very influential factor on turtle nesting location.

c. Management Profile of Lhok Lampuuk Beach

DKP Aceh Besar, Panglima Laot, Sahabat Laut (SALUT), KuALA Network, WCS-Marine Program, WWF-Indonesia, Lamjabat Foundation and Geng Lampuuk are institution or group that directly involved in turtle conservation in Lhok Lampuuk area, Lhoknga district. Several activities that had been undertaken to develop working programs for turtle conservation, such as: a) Planning of monitoring and captive areas in

Lhok Lampuuk; b) Establishment of a joint monitoring team (KuALA Network, Panglima Laut Lhok Lampuuk, KABARI Lampuuk and Lampuuk community); c) Training on monitoring and relocation of sea turtle eggs; d) Monitoring and relocation of sea turtle egg from Pasie Lange to Babah Dua Lampuuk; e) Intensify monitoring and supervision in Turtle nesting areas in Aceh coastal and marine areas and particularly in Lhok Lampuuk; and f) Building turtle breeding areas in Lhok Lampuuk for Turtle Research Center of coastal communities in Aceh south-west coastal. The result of this joint management makes the turtles that come to lay eggs can be secured and can be well maintained until the eggs hatch.

3. Pangumbahan Coastal Park

Pangumbahan Coastal Park is the largest nesting beach for green turtle in south coast of Java, administratively located in Ciracap Sub-District, Sukabumi District, West Java Province. The area of Pangumbahan as the habitat of nesting beach is 58.5 Ha with coastline length 2,300 m. Six posts were made along the coast that marked with permanent stakes, the function of this post for the management and supervision of the area. The area is divided into two zones, namely core zone and utilization zone. The core zone is a protected area where there is no utilization activity in any form, whereas the utilization zone is a permissible area of utilization such as tourism to see turtles lay their eggs. The expectation with this zonation is that turtle protection can run properly and the surrounding community can feel the presence of this turtle.

a. Current Status of Turtle Population

The dominant turtle species nesting in Pangumbahan Beach is green turtles (*Chelonia mydas*). The values of nesting turtle, number of nests, number of hatching turtle and number of harvested hatchlings each year from 2008 to 2016 is summarized in Table 3. The eggs that are found on the beach moved to a semi-natural hatchery and incubated until the hatch. Hatchlings are directly released into the sea without going through the process of enlargement. For nine years from 2008 to 2016 there were about 1.3 million nesting turtles and 1 million hatchlings successfully hatched and released into the sea. The peak season of nesting in Pangumbahan is occurred around October.

Table 3. The Ranges and Average Parameters That Were Recorded In Green Turtle Conservation Activities at Pangumbahan Coastal Nesting Beach In 2008-2016

No.	Parameters	Range (Average)
1.	Number of nest	575 – 2.952 (1.537)
2.	Number of egg	46.586 – 247.965 (141.627)
3.	Number of hatched eggs (item)	39.793 – 206.347 (106.859)
4.	Number of released hatchling (item)	39.793 – 206.347 (106.859)

Source: data processing of Pangumbahan Conservation Implementing Unit (UPTD, 2016)

Based on data recorded during 2008-2016 it shows a downward of the number of nests in the Pangumbahan area (Figure 5). The data show the highest number of nests found in 2008 while the lowest number of nests was found in 2015. It was similar in the number of eggs and hatchlings production (Figure 6).

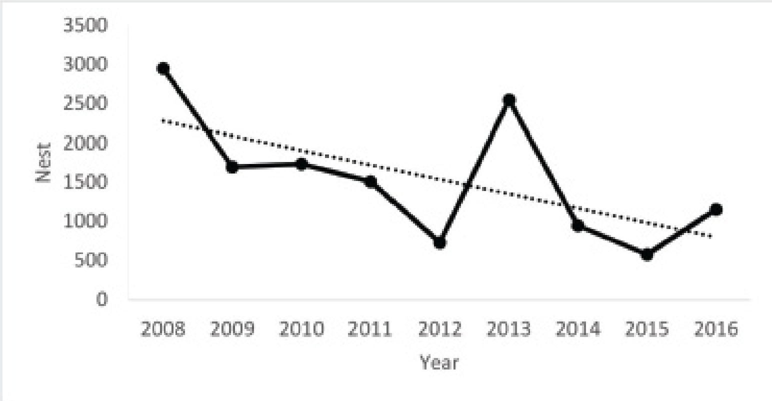


Figure5. Fluctuation of Turtle Nests In Pangumbahan Beach. Source: WWF-Indonesia (2007).

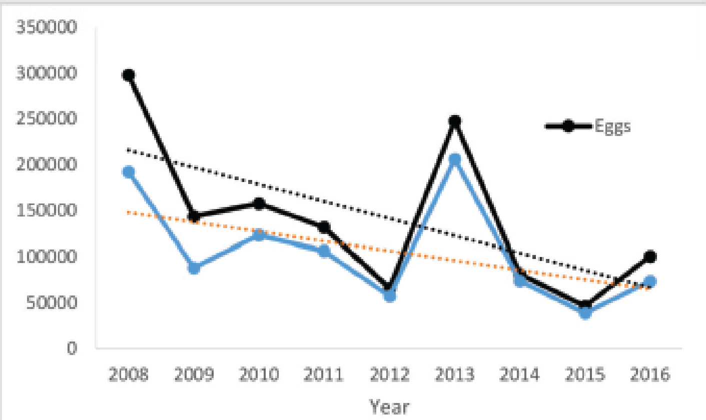


Figure 6. Fluctuation of Eggs and Hatclings In Pangumbahan Beach

b. Issues and Problems of Turtle

The main threats to turtles in Pangumbahan Beach are egg poaching and stealing. Based on the report from the Department of Marine Affairs Sukabumi District in 2009, turtle that landed to the beach were killed, hatchlings were stolen. All these cases were directly handled by the relevant authorities and got criminal penalties.

c. Management Profile

Currently, sea turtle nesting in Pangumbahan beach have been managed by government based. But before managed by government, the beach was managed by private sector. Pangumbahan nesting beach since the period 1973 - 2003 was managed by CV. Daya Bakti with auction system within each ten years. Every end period of auction, Decree of West Java Governor will be issued to extend the permit of nesting area management. The decree regulates the proportion of utilized and conserved eggs, 70% are utilized and 30% are incubated. Then the local government of Sukabumi Regency issued the Regional Regulation No.2 Year 2001 about Tax of swallow nest, sea turtle egg and seaweed (for turtle: 70% are utilized and 30% are preserved, tax obligation IDR 10,-/egg). This regional regulation is followed up by cooperation agreement between Sukabumi Regency Government with CV Daya Bakti No.660.1/Pj-13-Huk/2002, dated July 29, 2002 (valid for 15 years).

In 2005-2008, the Regional Regulation No.16 year 2005 on Turtle Conservation in Sukabumi Regency was issued, with 50% egg management were utilized and 50% were hatched for conservation (no tax collection). In 2008, the Letter of the Minister of Marine Affairs and Fisheries No.B-55/Men-KP/II/2008 dated February 14, 2008 was issued and contains a ban on the utilization of sea turtles and their parts. As of August 2008, egg management system came up with 100% of eggs were incubated. In this case, the management cost became the responsibility of Sukabumi Regency Government. In order for the policy to be known by other institutions, the Letter of Sukabumi Regent No 523/ 851.A/Dislutkan-08 was issued on April 30, 2008 regarding to Coastal Turtle Management of Pangumbahan and Letter of Sukabumi Regent No. 523/932.A/Dislutkan-09 was issued on April 16, 2009 concerning Turtle Conservation Managemet at Pangumbahan Beach. In this letter stated that the management of turtle conservation is directed to the ecotourism development based on turtle conservation.

As a consequence of the amendment and to fulfill the responsibilities, the Regent of Sukabumi established a turtle conservation area management institution, namely Regional Technical Implementation Unit (UPTD) of Pangumbahan Turtle Conservation based on Regent Regulation no. 49 of 2010. The main duties and functions of this UPTD is to implement some functions of the Department of Marine and Fisheries in the field of turtle conservation technical management. In operation, the UPTD is directly responsible to the Head of Department of Marine and Fisheries.

The government continues to optimize the role of conservation. Since January 1, 2017 UPTD Penyu Pangumbahan under the governance of Sukabumi Regency Government was taken over by the West Java Province Government under the Department of Marine and Fisheries. This condition changed the status of UPTD Pangumbahan Turtle into Central of Supervision and Conservation of Marine and Fisheries Resources in Southern Region (BPKSPWS) Pangumbahan. The main duty of BPKSPWS is conducting some of the operational technical tasks in the field of supervision and conservation of marine and fishery resources in the southern region, including control and supervision, conservation and empowerment of coastal communities.

4. Paloh Beach, Sambas Regency

Paloh Beach is the longest turtle nesting beach in Indonesia and directly adjacent to Malaysia. This nesting beach stretches along ± 63 km which is divided into four segments namely Nature Tourism Park (TWA) Tanjung Belimbing or known as Beach Selimpai along ± 10 km, segment of Mutusan river – Ubah river along ± 19.3 km, Ubah river - Bayuan along ± 23.7 Km and segment of Camar Bulan Beach - Tanjung Dato '± 20 km.

a. Current Status of Turtle Population

Types of turtles that commonly lay eggs on Paloh Beach are green turtles (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*). Sometimes this beach is also visited by leatherback turtles (*Dermochelys coriacea*) and olive ridley turtles (*Lepidochelys olivacea*) to lay their eggs, but the number is not significant. The number of turtle nests that recorded on the Paloh Beach during the period of 2009 - 2016 was 2,073 - 5,235 (Average: 3,663) nests. So based on monitoring results since May 2009 - December 2016 (Source: WWF Indonesia and Pokmaswas "Kambau Borneo") about 30 thousand turtle egg nests were recorded in Paloh beach. From 2009 to 2014 the turtle nests tend to be decrease (Figure 7), it may be due to the habitat degradation and appearance of climate change that needs to be observed more detail in the future. However, from 2014 to 2016, it seems that the turtle nests increase gradually, this is due to the increase of effort of data recording in the area located around Paloh Beach.

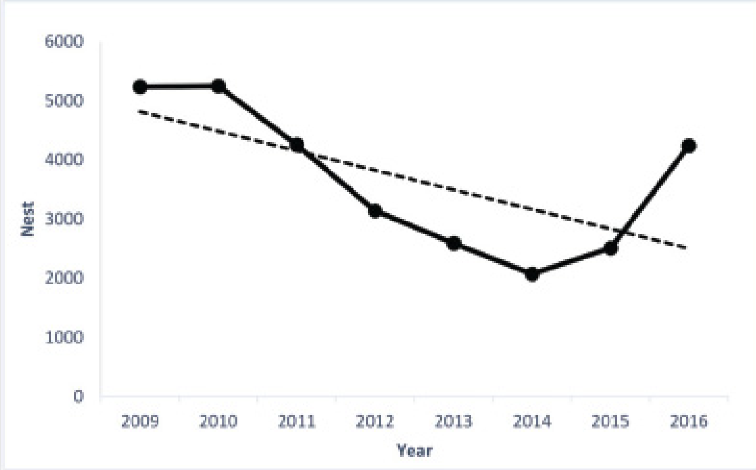


Figure 7. The Decrease of Turtles Nest In Paloh Beach. Source: WWF-Indonesia (2017).

Monitoring data in 2009 showed that 94% of turtle eggs nest were located in Sebubus Beach area and only 6% located in Temajuk beach. In 2010, this proportion was changed to 77% in Sebubus beach and 23% in Temajuk beach. Peak season data in 2011 showed that 96.4% of turtle eggs nest were found in Sebubus beach, compared with 3.6% in Temajuk beach. In 2012, the comparison of sea turtle nest proportion in Sebubus and Temajuk became 96.9% and 3.1%. In 2013 - 2016 the focus of monitoring was done in Sebubus beach so that 100% of data was obtained from observations in this beach. In general, the peak periods of nesting are occured in June, July, or August.

b. Issues and Problems of Turtle

From long time ago, turtle eggs from Paloh are a trading commodity in West Kalimantan and in Sarawak (Malaysia). These turtle eggs are consumed locally, and used as the main materials of the turtle eggs war festival. Festival that is marked by throwing turtle eggs between each participants are generally held early peak season of nesting (May), to express local gratitude for the abundance of turtle eggs in the region. However, due to the massive exploitation of turtle eggs until now, the population has been greatly reduced, so since 2005, along with the revocation of the Regulation on Regional Income Tax through Turtle Egg Auction by Sambas District Government, the festival was stopped. Another reason for the restriction of party activities and turtle egg auction by the local government is also because considered contrary to the laws and government regulation on the turtle protection.

Based on the monitoring results on the threat intensity in 2009, it showed that the nest eggs taken by the community in 2009 and 2010 were 99% and 95% of the total nest eggs found. The proportion of illegal takings were decreased dramatically in the following year (2011, 2012 and 2013) of which only 26%, 22%, 21.3 that were still missing. In 2014 there was an increase in the number of stolen turtle eggs to 30.5% but decreased again to 16.4% in 2015 and 15.1% in 2016.

c. Management Profile

In order to ensure the recovery process of turtle population in Paloh, since 2009, WWF Indonesia has developed a community awareness program, research and turtle monitoring activities which coupled with strengthening partnerships. This latter activity was carried out by building a coordination forum that consisti of PSDKP Pontianak team, BPSPL Pontianak, Police, Local Government of Sambas Regency and Department of Marine and Fishery West Kalimantan Province. Fundamental results that generated from this forum were the formation of Community Monitoring Group (Pokmaswas) "Kambau Borneo" which some of its members consist of ex-takers of sea turtle eggs. So now Pokmaswas Kambau Borneo is the main element of sea turtle conservation activists in Paloh that supported by WWF Indonesia and BPSPL Pontianak.

5. Nesting Beach of Derawan Islands, Berau District

Derawan Islands is located in the waters of Berau District, East Kalimantan Province. Geographically, the region is located at 00° 51`00 "- 0l ° 02' 33" North Latitude and 116° 01`00" - 119 ° 57`00" East Longitude, in west and north adjacent with Bulungan District, Makassar Strait in the east, and East Kutai Regency in the south. The total area is 4,649,058 ha, consisting of land 3,426,070 ha (73.7%) and waters 1,222,988 ha (26.3%). In the area of waters that extend from Pulau Panjang (in the North) to the Mangkaliat Peninsula (in the South) there are 31 small islands, of which 12 islands are turtle nesting sites.

a. Current Status of Turtle Population

Derawan Islands are the habitat of laying and feeding for green turtles (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*). Based on the number of eggs that was reported by the auction winners to the Regional Government through the Department of Marine and Fishery Berau regency, it was predicted that the number of eggs produced in all turtle islands (except Maratua, Kaniungan Besar and Kecil) in the period 1985 - 2000 was between 2,000,000 - 2,500,000 eggs per year. The largest proportion was obtained from 4 (four) islands namely Sangalaki (32.9%), Bilang-Bilangan (25.6%), Mataha (17%), and Blambangan (13.7%). Other four islands, namely Derawan, Samama, Sambit, and Balikukup, cumulatively accounted for only 10.8% (Adnyana, 2003). With such numbers, the green turtle population that laid eggs annually throughout the nesting island was estimated to be the largest in Indonesia, even in Asia (Adnyana *et al*., 2008). However, massive exploitation that was conducted prior to 2002 in all "turtle islands" thought to have adverse impacts on local turtle populations (Adnyana *et al*., 2008).

The number of sea turtle nests that was successfully monitored in Sangalaki Island ranging between 2,749 - 5,794 with average of 4,053 ± (SD) 897 per year. Monthly data showed a range of 93 - 812 with average of 337 ± (SD) 157 nests. The non-permanent of nesting peak period occurs in July, August or October. The declining trend of turtle population from year to year on the island, though not quickly (Figure 8). Meanwhile, in Derawan, based on calculated data from January 2004 - December 2011 showed the total of turtle eggs nest per year that were rescued and relocated to hatcheries ranged from 122 to 243 with average of 180 ± (SD) 44 nests. The number of nests per month, which were rescued from June 2003 to July 2012, was between 2 - 60 nests, with average of 16 ± (SD) 11 nests.

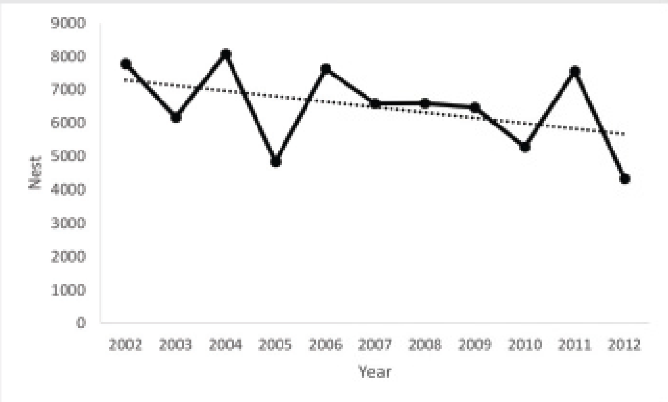


Figure 8. Fluction of Turtle Nests In Sangalaki During 2002-2012.
Source: WWF-Indonesia.

Based on eggs nest that is relocated to artificial hatcheries in Derawan Island, the number of eggs per nest found range from 25 to 155 eggs with average of 90 ± 20 eggs (n = 243). The success of hatching is between 46.7 - 100% with average of 87.1 ± 9.2% (n = 243), and total hatchlings release to sea is between 43.5 - 100% with average 86 ± 9.6% (n = 243). The incubation period of turtle eggs nest at hatchery location ranged from 43 - 76 days with average of 55 ± (SD) 6 days. This incubation period seems to vary according to the months of observation. The longest hatching time occurred in January, declining in the coming months to reach the lowest (fastest) mark in July, and rise again in the following months.

From the results of the tagging program implementation is known that the number of eggs from a female turtle per nesting season on Derawan Island ranged between 1 - 10 times. The percentage of the monitored female turtles that laying eggs only once was 75.8%, while more than once was 74.2%. The time interval between one and another laying eggs process ranges from 9 to 18 days. Among the time distribution, 88.9% were between 10 - 13 days. After completing the nesting process in one season, the turtle will again re-lay their eggs to the same location (remigration) in the next 1 - 6 years. Most of them (51.7%) will return in the next 3 years.

b. Issues and Problems of Turtle

Excessive exploitation, illegal fishing by foreign fishermen, and the unavailability of adequate conservation management mechanisms are some of the key issues that are identified in the turtle management in Berau Regency. To restore these animal populations, since nearly two decades ago, the government and various agencies/foundations such as Kehati Foundation, Bikal, Turtle Foundation (now represented by Berau

Turtle Foundation and/or Berau Sea Biota), Bestari, Kalbu, TNC and WWF Indonesia Foundation, either individually or in collaboration to initiate turtle conservation in Berau.

c. Management Profile

Yayasan Penyu Laut (YPL) and Biota Laut Berau (BLB) are a foundation that established by the Turtle Foundation to help turtle conservation programs and their habitats in the Berau Regency, especially in the islands of Mataha and Bilang-bilangan. Through cooperation with the Berau Regency Government, the Natural Resource Conservation Center, communities, other NGOs, and all stakeholders related to this Foundation exist until now in conducting monitoring activities on Mataha and Bilang- bilangan islands. While in Sangalaki Island is managed directly by BKSDA Kaltim SKW.Berau.

6. Perancak Beach (West Bali Beach), Jembrana Regency

Perancak Beach is located in the administrative area of Perancak Village, Negara District, Jembrana Regency, Bali. Perancak Beach is 98 km from Denpasar City. Apart from being a tourist attraction, Perancak Beach has a breeding location and turtle conservation.

The length of Perancak Beach coastline is about 4 km. Perancak beach directly adjacent to the Indian Ocean. Coconut trees vegetation belonged to the community are located along the coast. In addition to coconut trees, pandanus vegetation and grasses can be found on the Perancak beach. The slope of Perancak Beach is between 2.9 and 7.9. Perancak beach have black sandy beach and are dominated by fine sand fractions. Sand with such texture is the preferred location by Olive ridley turtles.

a. Current Status of Turtle Population

There are several types of sea turtles that lay in Perancak Beach such as olive Ridley turtles (*Lepidochelys olivacea*), green sea turtles (*Chelonia mydas*), hawksbill turtles (Eretmochelys imbricata) and leatherback turtles (*Dermchelys corlacea*). The current condition of the most dominating population laid in Perancak Beach is olive Ridley turtles. The laying season usually occurs from April to September every year. The trend of nests found to increse from 1997 to 2016 (Figure 9). There were 3,240 nests that were saved by the number of eggs reaching 259,616 eggs. The percentage of hatching eggs has an average value of 81.84% and the average release of hatchlings 97.77% of the total hatchlings that successfully hatched.

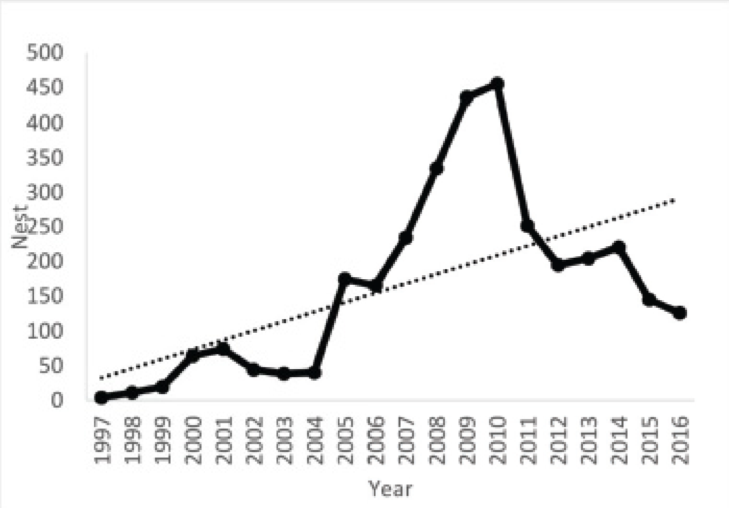


Figure 9. Fluctuation of Turtle Nests In Perancak Beach 1997-2016.

b. Issues and Problem of turtle

Activities carried out in the coastal area of Perancak cannot be separated from problems. Public awareness of not consuming turtle eggs and meat has begun to increase. This was shown by Perancak community participates in conservation activities. However, the condition of the turtle habitat begins to be degraded by the abrasion of the beach at the turtle nesting location. This is the potential to become a serious threat if not awared immediately.

c. Management Profile

The management of turtle conservation in the Perancak Beach area is the Kurma Asih group. This group is one of the groups that carry out tourism-based sea turtle conservation efforts in Bali. Established on June 11, 1997, the Kurma Asih group has continued to exist until now. At the beginning, the group members reached 50 people who actively monitored the turtles, but currently there are 15 people who are still surviving as members of the Kurma Asih group. Kurma Asih conservation group is located in Mekar Sari Hamlet, Perancak Village. History of the Kurma Asih turtle conservation group had been formerly turtle hunters in the Bali region. The name Kurma Asih itself means turtle lover. Since its establishment from 1997 to the present, Kurma Asih has been the Center of Education for the community around Jembrana and other communities who visit turtle conservation and rescue.

7. North Buru Nesting Beach, Kabupaten Buru

Some nesting beaches are found in the coasts of the villages of Wamlana, Waspait, Waekose and Waenibe in the Subistrict of Fena Lesiela, Buru District. This nesting beach of North Buru Beach covers ± 10.6 Km. The habitat condition for turtle nesting has black sand and is covered with coastal vegetation.

d. Current Status of Turtle Population

The dominant turtle species in this nesting beach are curved turtles (*Lepidochelys olivacea*) and leatherback turtles (*Dermochelys coriacea*). Based on data collected in 2017, it found 489 nests. Turtle layings are dominated by eatherback turtle, olive ridley turtle, and green sea turtle with number of 251 nests, 237 nests, and 1 nest, respectively. Other information obtained from monthly monitoring of 2017 (Figure 10), the peak of leatherback turtle nesting occurred in May 2018. While for olive ridley turtles the peak of nesting occurred in May-July 2017. Based on the nesting location of Waspait Village became a hot spot of turtle nesting area with a total of 325 nests, Village Wamlana 94 nests, and Waenibe Village 70 nests. Based on monitored nests, only 15 nests of 489 turtle nests produced hatchlings. It noted that five nests hatched in Wamlana Village, 7 nests hatched in Waenibe Village, and 3 nests hatched in Waspait. The resulting hatchability of 59.90% and hatchling survive 52.19% are noted.

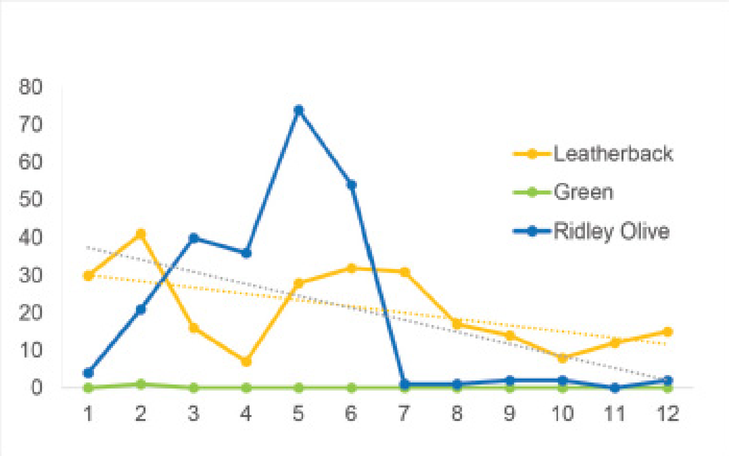


Figure 10. Fluctuation of Turtle Nests In Northern Buru in 2017. Source: WWF-Indonesia.

e. Issues and Problems of Turtle

Throughout 2017 there are still cases that threaten to declining turtle populations in northern Buru nesting beach. Some cases that have the potential to threat population declining include poaching and bycatch activity. In 2017 there were 9 cases (poaching, bycatch and sea turtle stranded) on the northern island of Buru which caused 10 individuals to die. One of them was stranded leatherback turtle, one individual bycatch hawksbill, one individual green sea turtle bycatch, five olive ridley turtles and two hunted leatherback turtles. In addition to the influence of human activities, the presence of predators such as dogs, pigs, biawak lizards and crocodiles are also a threat to population decline.

f. Management Profile

Starting in January 2017 WWF-Indonesia began monitoring activities by placing several field enumerators along the nesting beaches. Monitoring activities were carried out to obtain baseline data for turtle nesting along the nesting beaches (Waenibe, Waekose, Waspait and Wamlana).

8. Selayar island, Kepulauan Selayar District

Selayar Islands District is one of the islands in South Sulawesi. One location that is the turtle nesting area in Selayar District is Selayar Turtle Village. The location of Turtle Villages of Selayar District is Tulang Hamlet, Barugaja Village, and Bontomanai Subdistricts. Turtle village is approximately 12 km from the center of the Banteang, Selayar center city. The length of the coastline that enters the Kampug Penyu area is around 900 m.

a. Current Status of Turtle Population in Selayar Island

Turtle species that can be found are hawksbill, green turtles, and olive ridley turtles. The dominant and easily found species are Green Sea Turtles and olive ridley turtles. Turtles laying eggs in Penyu Village are starting to decline which is based on the results of recordings from 2013 to 2016 (Figure 11). The decline of nesting turtle occurred from 2014 to 2016. The highest number of nests was found in 2014 with a total of 74 nests, while the lowest number of nests was found in 2016, which were 45 nests. The peak season for turtles nesting in the Turtle Village area occurs from May to June every year

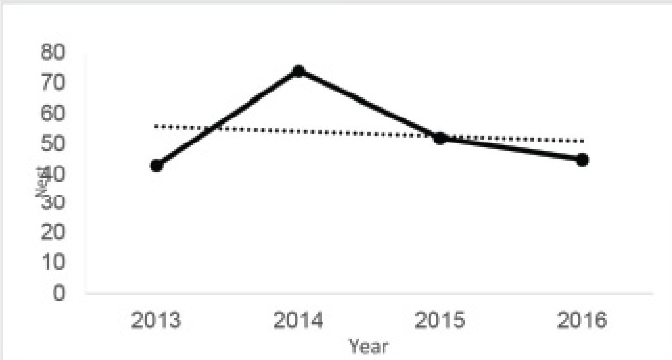


Figure 11. Fluctuation of Turtle Nests In Selayar Nesting Beach During 2013-2016 Source: WWF-Indonesia (2017)

b. Issues and Problems of Turtle in Selayar Island

In the past many people deliberately conducted turtle poaching. The motive for turtles poaching is to meet the life needs of hunters. But nowadays public awareness is increasing towards turtles. Collaboration from stakeholders and the community together protects turtles from threats of poaching and bycatch.

Other threats come from damage to the ecosystem. Beach sand mining activities are one of the causes of damage to the coastal ecosystem where turtles use it for laying. The northern part of the Turtle Village area has been subjected to abrasion effects due to the beach sand deposition. Based on observations from the managers of Turtle Village, sand mining activities at night is thought to cause the turtle nesting location to shift. Based on observations from the managers of Turtle Village, sand mining activities at night is thought to cause the turtle nesting location to shift.

c. Management Profile of Selayar Island

Turtle youth protector groups have been established since 2013. Members of the group are mostly former hunters who are aware of the decline in the turtle population. Turtle protector youth groups in their daily activities carry out activities such as monitoring, hatching, education, and other programs that support turtle conservation activities. The turtle monitoring is carried out along the coastline of the Turtle Village area. Sea turtle hatching activities are carried out by relocating turtle eggs from the nest to a place that is considered safer. The facilities available to support the hatching of eggs include the egg hulling area, the turtle storage pond, the building as the management office and the gazebo. Ecotourism activities were gradually developed, in addtion to beeing a means of educating the role of ecotourism asa well additional group income.

9. Jeen Womom Coastal Park, Tambrauw, West Papua

Jeen Womom Coastal Park is the biggest nesting beach of leatherback in West Pacific Area. The main laying location is between two beaches, one is namely Jamursba Medi (Jeen Yessa) beach in west and the other is Warmon (Jeen Syuab) beach, located about 30 kilometers in east (recently called as Jeen Womom). Jeen Womom coastal park is located in Abun district, Tambrauw Regency Administratively, Jeen Womom beach is conterminous with Kwoor District in the west and Waibem Village in the east, while in north is bordered by Pacific Ocean and in the south directly by Jamursba Medi Limited Production Forest. Jeen Yessa Beach has a greenish white sand beach. This coastal substrate was thought to originate from Pacific seabed sediment transport due to very high ocean dynamics during the rainy season in November - February.

a. Current Status of Turtle Population

The turtles coming to lay in the Jeen Womom coastal park are four species, namely: leatherback (*Dermochelys coriacea*), olive ridley (*Lepidochelys olivacea*), green sea turtle (*Chelonia mydas*) and Hawksbill (Eretmochelys imbricata). In each nesting season, an adult leatherback in the Womom Jason Coastal Park can produce 1-10 nests (7 nests in average). From data gatehred from 2011 to 2012, the number of nests ranged between 2,692-3,074 nests. It was estimated that there were 489 - 612 female individuals (Tapilatu *et al.*, 2013). Based on the research of a single nest in Jamursba Medi, the number of normal eggs ranged between 26 - 161 eggs (56.73-89.94%) with the average number of normal eggs in one nest was 75.3 (70.78%). Whereas the number of abnormal eggs ranged between 8 - 45 (11.11 - 43.27%) with the average number of abnormal eggs in one nest was 28.5 (29.22%).

Based on monitoring from 1981-2011 it can be seen that there is a downward trend in the number of turtle populations that laid eggs in Jeen Yesa (Figure 12). In 2012-2015 there was no monitoring and was obtained again in 2016. From monitoring activity of leatherback in 2016 it found out 1,186 nests. Compared to the same data in 2007-2011, there was a decline of 200 - 600 leatherback turtle nests per year.

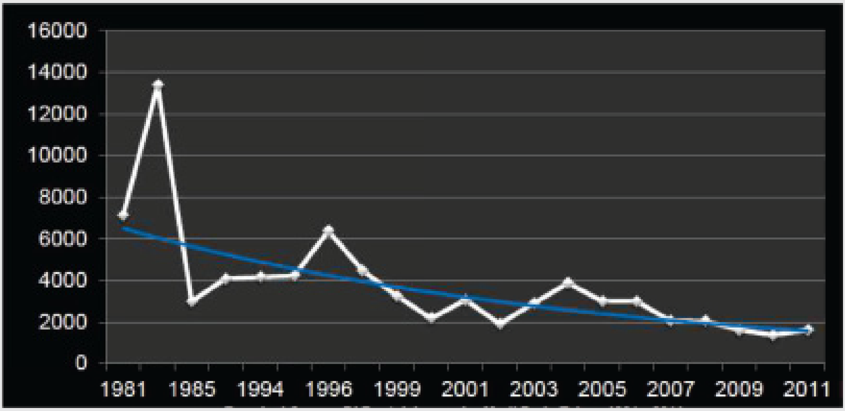


Figure 12. Fluctuation of Leatherback Nests In Jeen Womom Coastal Park Area During 1981-2011. Source: WWF-Indonesia (2017)

In addition to leatherback, monitoring activities in 2016 are also conducted for olive ridley, green sea turtles, and hawksbill. The total number of green turtle nests in a year was five nests, and it was known that the largest green sea turtle nesting beach was located in Raja Ampat. So it was alleged that Jeen Syuab beach was a minor breeding ground for green sea turtles. Meanwhile, the recorded hawksbillnests were only three in a year. For olive ridley, the number was quite high with the number of nests in a year reaching 282. Olive ridley nesting season in

Jeen Womom Coastal Park was in February - July every year with peak season in April 2017. The leatherback hatchlings are produced every season from hatcheries as well as natural hatching. In 2016, WWF succeeded in releasing 1,700 hatchlings from relocation in Jeen Syuab Beach.

b. Turtle Issues and Problems

Problems that occur in turtle's habitat in Jeen Womom Coastal Park are:

- Poaching

Poaching of turtles on both eggs and flesh are still rife outside the Jeen Woom Coastal Park area, while the poaching that occurs in the area only targets the eggs. However, if there is a olive ridley turtles coming to the inside and outside of coastal park area, the poacher immediately take both its meat and eggs. Poaching is done by local and foreign people. Eggs taken are for consumtion and for sale in the market.

- Abrasion

Based on the data of turtle monitoring from 2010 to 2012, it was known that the major cause of damaged nests and hatching failure in Jeen Womom Coastal Park was the sea water abrasion, occurring mainly in the segment of Jeen Syuab beach every December - February so the turtle nest was always relocated to save the eggs in sand.

- Development

The construction of road infrastructure along the northern coast of the Bird's Head Peninsula in Papua will threaten the nesting activity if it goes through the nesting beach, so WWF advocates for the road to not cross the nesting beach.

- Ownership of Custom Right

Native Community of Abun Tribe in Tambraw District has local wisdom related to the utilization of natural resources stating about the right to own property (property right). Property rights, or land tenure, in certain areas are controlled by clan and passed down from generation to generation. Utilization regulations are governed by the clan head with the assumption that the existing natural resources belong to a particular clan.

Each clan has land rights or commonly called customary land with an agreed area boundary. Land located in the area of Jeen Womom Coastal Park is managed by 12 clans which are spread in three villages.

c. Manager profile

The management of Conservation Area of Jeen Womom Coastal Park consists of governmental and non-governmental institutions, such as:

- UPTD / Local Government

The Technical Implementation Unit (UPTD) of the Jeen Womom Coastal Conservation Area is a responsible operational technical implementation under local Marine Affairs and Fisheries agency of Tambrauw Regency, West Papua Provincial Region which has authority in the affairs of Jeen Womom Park Conservation Area.

UPTD Jeen Womom Coastal Park was formed in 2015 through Tambraw Regent Regulation No. 5/2015 dated April 1, 2015 and revised by Regent Regulation No. 7 of 2016 on Establishment of Technical Implementation Unit of Jeen Womom Coastal Conservation Office at

Fisheries and Marine Office of Tambrauw Regency. Meanwhile, the human resources of UPTD were inaugurated On November 19, 2015 with the Decree of the Regent Number 821.2 / 12/2015 dated October 30, 2015. UPTD of Jeen Womom Coastal Park is a management organizational unit that determines the effectiveness of the management of marine conservation areas. UPTD is a tool of local government.

- NGOs / NGOs

In addition to the Local Government, there are three institutions working in Jeen Womom Coastal Park: WWF Indonesia, Indonesian Sea Turtle Foundation (YPLI) and University of Papua (UNIPA).

2.1.4. Gaps and Challenges

Based on data and information that are compiled from the management of turtle conservation in various nesting beach in Indonesia above, it is known that the turtle nesting population tends to decrease significantly, as an indication of the decline of turtle population in Indonesia. In general, the results study of turtle nesting habitat status can be known that the causa prima of turtle population decline in Indonesia can be grouped into five, namely: (1) direct harvesting (turtle and egg) for trading, (2) conversion and degradation of nesting and feeding habitat, (3) uncontrolled predators, (4) bycatch or death due to interaction with the various fisheries activities (especially long lines and nets), and (5) Uncontrolled utilization of non-esktractive turtles (tourism object).

Seeing the above conditions, the main strategy that is essentially needed and a challenge in order to overcome the five major causa is: 1) improve the effectiveness of turtle nesting habitat management in priority sites; 2) eradicate the trade in turtles, eggs and their derivative products; 3) reduce deaths from fishing activities; 4) enhancing community participation in turtle protection around the nesting sites; 5) enhancing strategic partnerships with various parties to ensure the achievement of turtle conservation goals; 6) implement a conservation-based turtle ecotourism; and 7) developing an integrated sea turtle information and database system in 2020. These seven strategies are an agreed Mission in an effort to achieve the 2020 turtle conservation vision: **"By 2020, turtle populations in 12 priority areas in Indonesia are sustainable and beneficial in line with conservation principles".**

To ensure the achievement of the seven strategies, realistic and specific targets are set, which serve as reference in monitoring of this national action plan implementation. The determined targets for each strategy are illustrated in Table 4).

Table 4. Strategy and Target of Sea Turtle Conservation In Indonesia During 2016 – 2020

No	Strategy	Target
1	Protect, rehabilitate and organize turtle nesting habitats within and outside conservation areas.	1.1 In 2020, increased effectiveness of the management from 12 turtle nesting habitat locations in Indonesia.
2	Increased efforts of socialization, supervision and law enforcement.	In 2020, reduced of illegal capture and trade of turtles and their derivatives in prioritized location at 50% compared to data in 2016.
3	Reduce turtle death rate due to interaction with fishery activities	In 2020, the number of by catch turtles in tuna longline fisheries by 30% compared to the baseline in 2014
4	Increasing community participation in turtle conservation management	4.1 By 2020, communities around turtle nesting priority areas play an active role in turtle conservation efforts
5	Enhance strategic partnerships with various stakeholders in turtle conservation management	5.1 By 2020, a partnership with various parties will be established in the turtles conservation and their habitats

Twelve (12) nesting location that include in Strategy-1 are:

1. Aceh Provice	:	Panga Beach, Aceh Jaya Regency and Lampuuk Beach, Aceh Besar Regency
2. West Sumatera Province	:	KKPN Pieh, KKPD Mentawai and KKPD Pesisir Selatan Regency
3. Riau Islands Province	:	TWP Anambas Islands dan KKPD Bintan (Tambelan Islands)
4. Lampung Province	:	KKPD East Lampung (Segama Besar and Kecil Island)
5. West Java Province	:	TPP Pangumbahan Beach
6. West Kalimantan Province	:	Paloh Beach, Sambas Regency
7. East Kalimantan Province	:	TPK Derawan
8. South Sulawesi Province	:	KKPD Pangkep Regency (Cangke Island) and KKPD Selayar Island
9. Bali Province	:	Perancak beach and Serangan beach
10. West Nusa Tenggara Province	:	TWP Gili Matra
11. Maluku Province	:	Pulau Buru
12. West Papua Province	:	TWP Jeen Womom

These sites are selected based on the viability of the turtle population in these areas and the high possibility of successful conservation management, but there are still some threats that need to be addressed to reduce damage and extinction in the habitat. Therefore, based on obtained data analysis and information, the 12 turtle nesting main locations are selected to be the main target of turtle conservation 2016 - 2020.

Thus, if the Vision (National Action Plan for the Period 2016-2020) can be achieved, besides turtle populations will be sustainable and beneficial to humans and natural balance, it can also be a source of alternative income to local communities and even become one of the foreign exchange country in the development of turtle-based ecotourism as has been done in Cayman Turtle Island (UK), Sabah Park (Malaysia) as well as Mon Repos and Heron Island (Australia). Therefore Indonesia with abundance of sea turtles with good management has possibility to become the world's largest turtle conservation country and become the main sea turtle based ecotourism areas as already successful in some countries.

2.2. MARINE MAMMALS

2.2.1. Species Occurrence in the Region

A total of 35 species of marine mammals are identified in Indonesian waters. Under the IUCN category, **Mahakam dolphins** should be a priority because they are included in **critically endangered categories**. Three species are categorized in the **Endangered** category (sei whales, blue whales and fin whales), three species fall into the **Vulnerable category** (dugong, finless dolphin, and sperm whale), and one species is categorized into the **Near Threaten** category (Indo Pacific humpback dolphins). Meawhile Bryde Whales and Omura Whales do not have IUCN status. Moreover, there are listed as Low Risk/Least Concern/LC or Data Deficient/DD. However, the principle of caution does not suggest the assumption that LC and DD species are free from threats. Complete data of IUCN status of marine mammals that present in Indonesian waters can be seen in Table 5.

Table 5. IUCN Status and Distribution of Marine Mammals In Indonesia

No	Species	Indonesia Name	Global Red List status (2008)	Distribution
1	*Balaenoptera acutorostrata*	Paus minke umum	Least Concern (	Ma, Pa, NT, Ti
2	*Balaenoptera borealis*	Paus sei	Endangered	Ja, Ma, Pa, NT, Sum, Ti
3	*Balaenoptera brydei*	Paus Bryde	Data Deficient	Ma, Pa, NT, Ti
4	*Balaenoptera edeni*	Paus Bryde kerdil	Data Deficient	Ja, Ma, Pa, NT, Sum, Ti
5	*Balaenoptera musculus*	Paus biru	Endangered	Ja, Ma, Pa, NT, Sum, Ti
	5.1. Balaenoptera m. Brevicauda	Paus biru kerdil	Data Deficient	Ma, Pa, NT, Ti
6	*Baleanoptera omurai*	Paus Omura	Data Deficient	Ma, Pa, NT, Ti
7	*Balaenoptera physalus*	Paus sirip	Endangered	EK, Ja, Ma, Pa, NT, Ti
8	*Delphinus capensis*	Lumba-lumba umum paruh Panjang	Data Deficient	EK, WK, Sum
9	*Delphinus delphis*	Lumba-lumba umum paruh pendek	Least Concern	EK, Sum, Na
10	*Dugong dugon*	Duyung	Vulnerable	NI, Sum, Ja, Ba,NT, Ka, Sul, Ma, Pa
11	*Feresa attenuata*	Paus pembunuh kerdil	Data Deficient	Ba, EK, Ma, Pa, NT, Ti
12	*Globicephala macrorhynchus*	Paus pemandu sirip pendek	Data Deficient	Ba, EK, Ja, Ma, Pa, NT, Sum, Ti
13	*Grampus griseus*	Lumba-lumba Risso	Least Concern	Ba, EK, Ma, Pa, NT, Ti
14	*Hyperoodon planifrons*	Paus hidung botol selatan	Least Concern	Ma, Pa, NT, Ti
15	*Kogia breviceps*	Paus sperma kerdil	Data Deficient	Ka, Pa, Ba (genus only)
16	*Kogia sima*	Paus sperma cebol	Data Deficient	Ma, Pa, NT, Ti, Ba (genus only)

No	Species	Indonesia Name	Global Red List status (2008)	Distribution
17	*Lagenodelphis hosei*	Lumba-lumba Fraser	Least Concern	EK,Ba, Ma, Pa, NT, Sul, Ti
18	*Megaptera novaeangliae*	Paus bongkok	Least Concern	EK, Ba
19	*Mesoplodon densirostris*	Paus Blainville berparuh	Data Deficient	Ma, Pa, NT, Ti
20	*Mesoplodon ginkgodens*	Paus berparuh gigi ginkgo	Data Deficient	Sul
21	*Neophocaena phocaenoides*	Lumba-lumba tanpa sirip	Vulnerable	Ka, Ja, Ma, Pa, Sum, NT, Ti
22	*Orcaella brevirostris*	Pesut Mahakam	Critically endangered	Coastal: EK, WK, Ja, Sum, Ja, Pa; Freshwater: MR
23	*Orcinus orca*	Paus pembunuh	Data Deficient	Ba, EK, Ma, Pa, NT, Ti
24	*Peponocephala electra*	Paus kepala melon	Least Concern	Ba, EK, Ma, Pa, NT, Sul, Ti
25	*Physeter Macrocephalus*	Paus sperma	Vulnerable	Ba, EK, Ja, Ma, Pa, NT, Sul, Sum,Ti
26	*Pseudorca crassidens*	Paus pembunuh palsu	Data Deficient	EK, Ja, Ma, Pa, NT, Sum, Ti
27	*Sousa chinensis*	Lumba-lumba bongkok Indo Pasifik	Near Threatened	EK, Ma, Pa, NT, Ti, WK
28	*Sousa sahulensis*	Lumba-lumba bongkok sahulensis	n.a.	Pa
29	*Stenella attenuata*	Lumba-lumba totol	Least Concern	Ba, EK, Ja, Ma, Pa, NT, Sul, Sum, Ti
30	*Stenella coeruleoalba*	Lumba-lumba strip	Least Concern	EK, Ja
31	*Stenella longirostris*	Lumba-lumba spinner	Data Deficient	Ba, EK, Ja, Ma, Pa, NT, Sul, Sum, Ti
	31.1. Stenella longirostris longirostris	Lumba-lumba spinner Hawaii/Grey	n.a.	Ba, EK
	31.2. Stenella longirostris roseiventris	Lumba-lumba spinner Asia Tenggara (kerdil)	n.a.	Ba, EK
32	*Steno bredanensis*	Lumba-lumba gigi kasar	Least Concern	EK, Ma, Pa, NT, Ti
33	*Tursiops aduncus*	Lumba-lumba hidung botol Indo Pasifik	Data Deficient	Ba, EK
34	*Tursiops truncatus*	Lumba-lumba hidung botol umum	Least Concern	Ba, EK, Ja, Ma, Pa, NT, Sul, Sum, Ti
35	*Ziphius cavirostris*	Paus berparuh Cuvier	Least Concern	EK, Ja, Ma, Pa, NT, Ti

Beasley *et al.* (2016), DSCP Indonesia (in press), Kreb *et al.* (2013), NPOA (2016), Rudolph *et al.* (1997), IUCN (2008).

Note: Ba=Bali, EK=East Kalimantan, Ja=Java, Ka=Kalimantan, Ma=Maluku, NI=Natuna Islands, NT= Nusa Tenggara, Pa=Papua, Sul=Sulawesi, Sum=Sumatra, Ti=Timor, WK=West Kalimantan

The vulnerability status of whales and dolphins that presented in this document is the result of evaluation that conducted by the IUCN as world conservation agency. This vulnerability status is a global status of vulnerability and not specifically describing the vulnerability status of marine mammals in Indonesia.

2.2.2. Abundance, Distribution and Population Status

The distribution of marine mammals in Indonesia is presented in Table 5. Meanwhile, the data on marine mammal population status in Indonesia is not fully known and very minimal. Several studies have been conducted in the waters of Komodo Island, Solor-Alor Waters, and Savu Sea (NTT); Lovina (Bali); Derawan Islands and Balikpapan Bay (East Kalimantan); Raja Ampat (West Papua); Wakatobi (Southeast Sulawesi) (Kreb & Budiono, 2005; Kreb *et al*., 2008; Kreb and Lim, 2009; Mustika *et al*., 2009; Kahn, 2015; Kahn, 2017; Siahainenia, 2010; Yusron, 2012); incidental observations that was conducted in the Kei Islands (Maluku) and surrounding areas (Syarif Yulius Hadinata 2017, personal communication, August 1); as well as a collection of documentation of stranded events that occur throughout the Indonesian provinces in the Coral Triangle area.

The study of the Mahakam dolphin population that has been done by RASI provides a maximum number of 80 individuals as an estimate of the Mahakam dolphin population until 2016 (Kreb *et al*., 2016). Other information from reports of stranded events showed that 600 individuals of marine mammals had been recorded to be involved in 346 stranded events that had been documented from 2000 to 2017 by WWF-Indonesia, Whale Stranding Indonesia and the Indonesian Dugong and Seagrass Conservation Program (DSCP Indonesia).

In year 2001 to 2007 a number of studies on dugong distribution and ecology were conducted in Balikpapan Bay, east coast of Kalimantan, south of Samarinda City. In 2002, a number of dugongs were observed 15 times in 4 months observation. In 2005, dugong was only seen as many as three times in similar field surveys. The number of 1,414 feeding trails were found in a seagrass that dominated by *Halodule uninervis* during the period of August-December 2005 (an average of 63 grazing track per day). It was estimated that there were 12 dugongs (at most) in the local population (de Iongh *et al.*, 2007). In 2005, in an interview survey with a total of 23 respondents who mostly worked as fishermen, 10 respondents of them said a decrease in the number of dugongs in Balikpapan Bay, 2 respondents said that the dugong population remained stable and 8 people did not know (Hutomo *et al.*, 2011).

In 1994, dugongs were observed swimming in groups in a survey in Arakan Wawontulap, Bunaken National Park. Approximately one hundred dugongs were supposed to be sighted at this seagrass bed over a period of one month. A local NGO, "KELOLA", which had researched dugongs in northern Sulawesi, estimated approximately 1,000 dugongs in the region (KELOLA, 1994 in Marsh *et al.*, 2002).

In 1975, a survey team from the Oceanarium Jaya Ancol caught around five dugongs near Ujung Pandang (Allen *et al.*, 1976; Hendrokusumo *et al.*, 1976). At that time, the area was estimated to support about 15 dugongs. However, in recent times, local fishermen state that the discovery of dugong is rare, whereas in the past dugong was easily found in that area (Hutomo *et al.*, 2011).

Based on data and survey results of Center for Coastal and Marine Resources Management (BPSL) Makassar in 2015 and 2016 that survey areas covered Central Sulawesi, South Sulawesi, West Sulawesi, North Sulawesi and Southeast Sulawesi, dugong was found in both live and dead conditions. In Central Sulawesi, one live dugong was found, in Tolitoli Regency for four incidents, Morowali with one incident, Donggala with four incidents, Parigi Moutong with two incidents where in the second incident in 2016 there were 10 dugongs that observed in the waters, Poso with one incident, Tojo Una with three incidents, Banggai with two incidents, Banggai Islands with two incidents, Boul with one incident. In the same year in South Sulawesi, one dugong was found in East Luwu, North Luwu, Pinrang, Pare-pare and Barru with one incident, Pangkep and Takalar with two incidents, and Selayar with three incidents. In South Minahasa, North Sulawesi, precisely in the Bunaken National Park dugong was found in the living conditions as much as one incident. In Southeast Sulawesi in 2015, one dugong was reported found in living conditions in Kolaka and two incidents in Buton.

A series of observations had been conducted in 2004 in Savu Sea, East Nusa Tenggara (Mustika, 2005). The surrounding communities said that the dugong population in Savu Sea had greatly decreased compared with the dugong population in the past two or three decades (Hutomo *et al.*, 2011). In 2016, one live dugong was found by WWF Indonesia team who conducted a survey in the coast of Mali Beach, Alor Regency. Based on the information from the community that there were five dugongs that often seen to be active in the water area (Juraij *et al.*, 2016).

Research on the distribution, migration and dugong eating pattern in 1990 and 1992 had been conducted in East Aru and Lease Islands by staff and students of Pattimura University and Leiden University. Aerial surveys were conducted in 1990 and 1992 around the waters of the Lease islands (Ambon and Haruku Islands, Saparua and Nusa Laut) in Maluku Province. The dugong population in the study area was estimated to range from 22 to 37 individuals (de Iongh *et al.*, 1995). From a survey that was conducted in 14 villages in East Aru, villagers mentioned that there had been a decline in the number of dugong between 1989 and 1990.

In 1981 there were 14 dugongs that observed from the air along the mainland coast and near Roon and Mioswaar Islands (small island clusters near Biak). Two dugongs are seen around the Auri coral reef at Cenderawasih Bay (WWF Indonesia, 1981). A more recent field survey conducted by the Wildlife Conservation Society (WCS) in 2008 showed that there were 24 dugongs on Raja Ampat Island (Hutomo *et al.*, 2011).

Several sightings of dugong as two individuals in Alor (Juraij *et al.*, 2016) as shown in Figure 13, 4 individuals in Tolitoli (Herandarudewi et al., 2016b), and only one individual recorded in Kotawaringin Barat (Herandarudewi *et al.*, 2016c). Dugong in Alor was recorded while interacting with turtles (Figure 13-B). In Bintan, dugongs were not seen immediately, but the team surveys were able to find and record the dugong grazing track around Bintan water (Figure 14) that proved the presence of dugongs in this area.

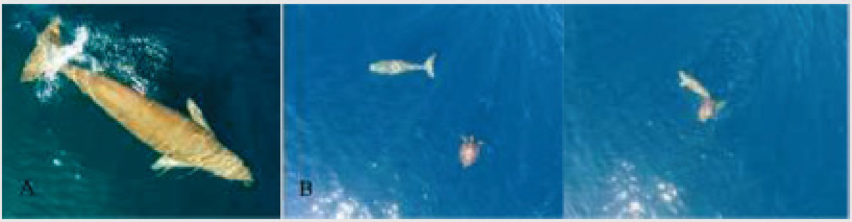


Figure 13. Identification of Dugong In Waters Around Alor. Source: Juraij *et al.* (2016).

Figure 14. Grazing Track of Dugong (Herandarudewi *et al.*, 2016).

WWF-Indonesia also conducted dugong and seagrass surveys in several other locations outside the DSCP implementation sites such as in Sangihe and Kei Islands. Based on Juraij (2016), the survey in Sangihe successfully documented the appearance of 2 dugongs in feeding habitat (seagrass beds) and 1 dugong in their playing habitat (coral reefs). By 2015, the Sangihe community documented the appearance of eight dugongs in feeding habitats and 2 in their playing habitats.

From some survey results, ordinary dugong only found alone or in small groups (4-8 dugongs). The nature characteristic of the dugong has an impact on the difficulty of documenting the appearance of these animals. In the IUCN Red List, dugongs are categorized as vulnerable, meaning dugong populations have decreased by ≥30% within 10 years or 3 generations.

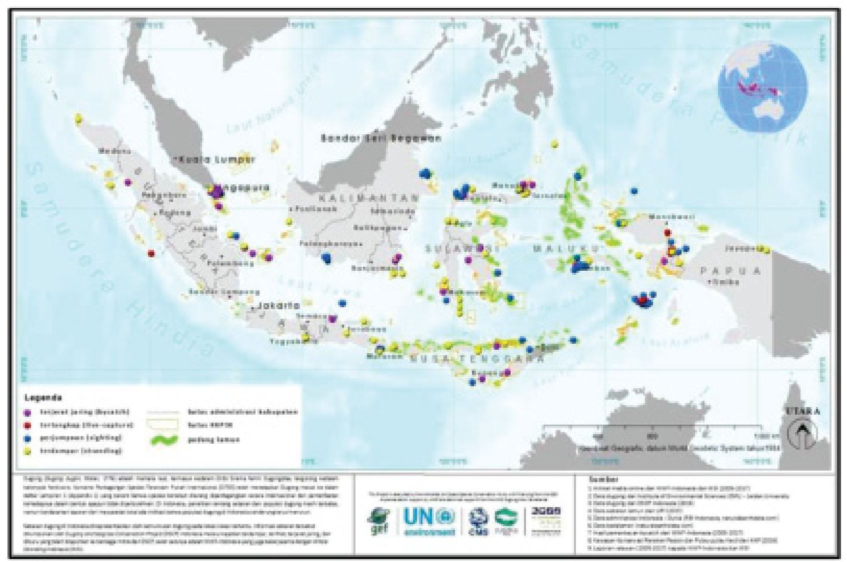


Figure 15. Dugong Distribution In Indonesia (DSCP Indonesia, 2016)

Dugongs are commonly found in warm waters along the coast, usually concentrated in shallow, wide and enclosed bay waters (National Geographic, 2011; Marsh *et al.*, 2002). Dugong can tolerate salinity of brackish waters, dugong is also found in vast but shallow streams in the mangroves and around the areas that protected from the winds in coastal waters of large islands where seagrass beds exist (Naiket *et al.*, 2008; Marsh *et al.*, 2002). Dugong is usually lived at the depth of 10 m, but in continental shelf with a permanent shallowness, dugong is known to swim more than 10 km from the coastline to a depth of 37 meters where deepwater seagrasses such as *Halophila spinulosa* are found (Marsh *et al.*, 2002). Shallow waters are used as small dugongs' place to minimize the risk of predators (Marsh *et al.*, 2002).

Generally dugongs in Indonesia tend to settle because the Indonesian sea temperature is more or less the same throughout the year. Most migrations are in areas with seagrass beds and controlled by tidal factors (Hutomo *et al.*, 2011). The geographical distribution of dugong is appeared in Figure 15.

In 1990 to 1996, dugong movements had been traced and monitored in a number of studies using VHF or satellite transmitters (Marsh and Rathburn, 1990; de Iongh *et al.*, 1998). These studies provided clues about migration and home range of dugongs. Four dugongs were captured in Maluku and monitored by satellite for 9.5 months. These animals moved individually and cover a large area, up to 65 km in two days. They returned to the same area regularly and stayed for 42 days (de Iongh *et al.*, 1998). Such localized movement or migration provided an important reason for the role of marine protected area networks for dugong protection.

In Bintan, although there is no recorded encounter with dugong, there are many feeding trails in the survey location indicating its existence (Herandarudewi *et al.*, in press). In addition through the method of observation with the drone were found about 30 *Orcaella brevirostris* that were swimming in groups. From the DSCP survey report in Alor, one dugong was encountered which was then observed with a drone was interacting with a turtle. In Tolitoli at the time of survey (2016) there were documented four dugongs interacting in mating, as well as the release of an adult dugong that unintentionally was netted in fishing nets (Herandarudewi *et al.*, In press). While in 2015, It is also conducted the release of a pair of dugong by the team of Indonesian Institute of Sciences (LIPI), WWF, RASI, Ministry of Marine Affairs and Fisheries, and Regent. So it can be estimated that dugong population in Tolitoli were more than seven. In the DSCP Indonesia survey in western Kotawaringin, a dugong was encountered, but not documented.

2.2.3. Habitat Status

Seagrass plants are the main food of dugong, the availability of seagrass in nature becomes the defining factor of dugong life development. Supriyadi (2016) estimated that the total area of seagrass beds from 33 locations in Indonesia is about 28,705.54 ha (Table 6). As a result of logging activities, the incidence of forest fires, the entry of agricultural wastes into the waters, soil erosion, pollution and coastal development causes a decrease in seagrass habitat (KKJI, 2014).

The preservation of dugong has a close correlation with the existence of seagrass beds, because seagrasses are the main food of dugong (KKJI, 2014). There is some evidence that seagrass beds all over the world are damaged and the extent and distribution is reduced by human activity. Human activities cause damage by coastal construction, eutrophication (excessive nutrient enrichment), siltation (aquatic), aquaculture and others (Marsh *et al.*, 2002). One of the most immediate threats is physical disturbance by humans. About 40% of the population lives in coastal areas. Activities such as dredging and reclamation result in reduction of water clarity and very damaging to the seagrass ecosystem. Widespread coastal eutrophication has also resulted in global deterioration of coastal water quality (Duarte, 2002).

Damage to seagrass ecosystems in Indonesia reached 30-40% (UNEP, 2004). Information about the damaged seagrass ecosystem is mostly obtained from the western part of Indonesia, but less than the eastern part of Indonesia. Banten Bay has lost about 26% of the total seagrass ecosystem caused by sedimentation due to coastal infrastructure development (Dewi *et al.*, 2016). Damage to the seagrass ecosystem in Cilacap is also caused by the same thing (Tyas and Vitdiawati, 2016). The seagrass ecosystem in Bintan Island is damaged by tourism growth and coastal infrastructure development (Juraij *et al.*, 2016). Other western part of Indonesia that suffered damage and decrease of seagrass cover among others, Kepulauan Seribu, Ujung Kulon and Tarbu, South Kalimantan (Dewi *et al.*, 2016; Salim *et al.*, 2016). The same thing happened in Wawonii Island, Southeast Sulawesi (Samadi *et al.*, 2016). Damage to seagrass ecosystems allegedly occurred in various locations in other parts of Indonesia, but until now still not recorded or published.

Development in the coastal areas and the destruction of sea grass habitat are also one of the causes of dugong population decline in Indonesia. The dugong conservation program must be in line with the efforts to protect the seagrass habitat (KKJI, 2014).

The area of seagrass beds in Indonesia is based on calculations on 33 locations with the seagrass condition that can be categorized based on the percentage of cover, ie healthy category if the cover is equal to or greater than 60%, less healthy with 30-59.9% cover, and unhealthy category if less than 29.9% (Table 6).

Table 6. Calculation of Seagrass Area In 33 Locations

No	Location	Area (ha)
1.	Pari Island , Seribu Islands	196
2.	Bintan Timur, Riau Islands	2,598
3.	Anambas, Riau Islands	51.03
4.	Belitung	3.06
5.	Bakauheni, South Lampung	43.77
6.	Nias, North Sumatra	184.03
7.	Central Tapanuli, North Sumatra	92.16
8.	Natuna, Riau Islands	1.5
9.	Kaur Regency , Bengkulu Province	149.08
10.	Mentawai , West Barat	42.6
11.	Lingga, Riau Islands	118.4

No	Location	Area (ha)
12.	Lombok, Gilimatra NTB	116.8
13.	Derawan Islands	47.86
14.	Komodo, NTT	1,767.4
15.	Selat Strait, Bitung	61.1
16.	Kema, Minahasa Utara	358.23
17.	Sanur-Nusadua,Bali	910.33
18.	Kabetan Island, West Sulawesi	733.1
19.	Toli-Toli Bay, Sulawesi Barat	266.73
20.	Kendari, South East Sulawesi	317.7
21.	Sikka (Maumere), NTT	994.1
22.	Kotania Bay, Central Maluku	1,174.7
23.	Raja Ampat, West Papua	37.9
24.	Banda Island, Central Maluku	70.44
25.	Padaido Islands, Biak	1,757.4
26.	Salawati, Irian jaya	3,259.4
27.	Rote Ndao Island, NTT	228.33
28.	Kupang, NTT	52.82
29.	Ngaf Islands, South East Maluku	54.27
30.	Biak Numfor	1,177.0
31.	Tobelo, North Maluku	316.13
32.	Ternate, North Maluku	402.57
33.	Wakatobi, South east Sulawesi	11,121.6
	Total	**28,705.54**

Source: Supriyadi (2016, Research Center for Oceanography - LIPI).

Seagrass bed condition has been mapped in 40 locations in Indonesia that grouped into West Indonesia water, Center Indonesia water and East Indonesia Water (Table 7).

Table 7. Condition of Seagrass Bed in Indonesia

Region	Number of location with category			Total
	Healthy	Less Healthy	Unhealthy	
West Indonesia	1 location	9 locations	2 locations	12 locations
Center Indonesia	3 locations	10 locations	1 location	14 locations
East Indonesia	4 locations	10 locations	-	14 locations

Source: Supriyadi (2016, Oceanography Research Center - LIPI).

In the wild nature, dugongs generally eat seagrass species that are subtle and not too dense, such as seagrasses of the *Halodule* and *Halophila* genus. It is suspected that even though they eat all seagrass species, they prefer seaweed species with high nitrogen content (Lanyon, 1991), low fiber and high calorie (de Iongh, 1996). Species that have high and low fiber nitrogen levels are generally fast-growing pioneer species, grown in intertidal and subtidal zones such as *Halodule sp.* and *Halophila sp*. Areas covered by these species are generally lagoons or closed bays that have a depth of less than five meters. Dugongs have been observed to eat seagrass in the area during the day or night and the seagrass traces that are clearlyeaten as seen in Figure 14.

2.2.4. Benefits and Value of Threatened Species

Marine mammals provide an extremely important ecological contribution to ecosystems on earth and humans that use or associate with these animals. For example, in terms of ecology, feces of sperm whales are carbon sinks for the oceans (Lavery *et al*., 2010). Disruption to marine mammal populations and other major predators led to a shift in predatory dominance leading to the disruption of the food chain (Baum and Worm, 2009). Healthy marine mammals also reflect the health of the oceans (Trumble *et al.*, 2013).

In terms of the economy, in 2008 whales and dolphins donated at least USD 2.1 billion from the income of 13 million tourists who participated in whale and dolphin tours in 119 countries (O'Connor *et al.*, 2009). In Indonesia, dolphin tours can be found in the waters of Lovina, Bali which is visited by many national and foreign tourists. Socially and economically, dolphins are also seen indirectly helping fishermen by herding fish into fishing nets (D'Lima *et al.*, 2013). Swim with Dugong has been inevitable in several locations. This is interesting because the dugong is large but quite calm in manner. Some locations where this activity was done, is included Alor, Sangihe and Manado. Based on the survey results of WWF Indonesia in 2016, potentially disruptive activities on dugong sustainability in Alor are tourism activities (Juraij *et al*., 2016).

Foreign and local tourists have started to know that in Alor, especially in Mali Beach can easily see dugong while diving and this activity is already occured. Some tourists have started to arrive and there are already down for diving. This tourism activity if not regulated properly and safely, will have a negative impact on the sustainability of this mammal. Dugong that comfortable live and do some activities in the waters of Mali, will move to find a more comfortable place, minimum disruption and has a favorite seagrass (Juraij *et al*., 2016).

The preservation of dugong outside its habitat, especially for tourism purposes (ex-situ) will also cause its own problems in the implementation. Khalifa *et al.* (2016) states that dugong that kept outside from the habitat will make changes in feeding patterns and behavior. It could have negative impact for dugong if not able to adapt to the new environment. The lack of technical guidance on dugong preservation in Indonesia can lead to poor management of dugong life.

2.2.5. Gaps and Challenges

Limitations of data and information

We have not got the holistic pictures of our marine mammal status, as no integrated research has been done so far. Some available data on population and distribution are just based on community reports of stranded incidents or trapped in fishing nets. Some of the population data comes from unintegrated monitoring and the methods used are not same yet. So, currently there is no basic data of national marine mammals data and information, the data are still scattered in several government agencies and other parties.

Preliminary adoption of the latest technology/techniques in the data collection of marine mammals

The number of marine mammal population in Indonesian waters until now is unknown, due to the limited study of population status. Marine mammal survey methods that are conducted by developed countries generally use aircraft, but because it required a large enough cost, then this method was difficult to apply in Indonesia. But at present, the use of drones in air survey modifications can be a cheaper and effective option (Figure 16).

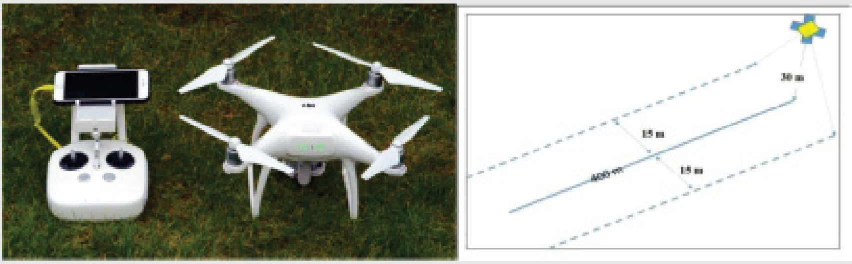


Figure 16. Drone Equipment and Scheme of Air Observation (Herandarudewi *et al.*, in press).

The highly recommended survey method is the questionnaire method, although the accuracy is not very good but this method is more likely to be implemented in Indonesia, because theefficient cost its needed. The questionnaire survey method can be more effective and efficient when modified by application technology that can be installed in some gadgets, and assisted its dissemination through social media which is used by society (Figure 17).

Figure 17. Utilization of Application to Collect Questionnaire Data (Herandarudewi *et al*., 2017)

2.3. SHARKS AND RAYS

2.3.1. Species Occurrence in the Region

Indonesian has the highest diversity of sharks and rays in the world, with at least 118 species of sharks from 25 families and 101 species of rays from 17 families that spread throughout Indonesian waters (Ali *et al*., 2013; Dharmadi *et al*., 2015). However, the number of sharks and rays may still increase because there are still new species in the identification process (Fahmi, pers.comm). Indonesia is also known to have the largest shark production from 20 shark-producing countries in the world and almost all sharks and rays have high economic value so that the capture is still ongoing and there will be more captured so the sustainability can be threatened. Most of sharks and rays are caught as a by-catch of some fishing gear such as longlines, driftnets, bottom gilnets, purse-seines, handlines, and hooks, but since the increasing demand for shark fin from the global market that was occurred around 1980, sharks and rays (especially *Rhynchobatus spp*.) became the main capture target of artisanal fisheries.

In addition, there are also some endemic shark species that present in Indonesia, one of it is a group of walking sharks (*Hemyscillium* *spp.*) or bamboo sharks (Figure 18). Five of the nine species of walking sharks can be found in Indonesian waters. Four endemic species of Indonesia include Raja Ampat walking sharks (*Hemiscyllium freycineti*), Bay of Cendrawasih walking shark (*H. galei*), Halmahera walking shark (*H. halmahera*), and Bay of Triton Kaimana walking shark (H. *henryi*). One other species of *H. trispeculare* is found in the waters of Aru Maluku, but this species also lives in the north and west coasts of the Australian Continent. The Indonesian endemic Raja Ampat walking sharks of the *H. freycineti*, were first found in Raja Ampat in 1824. In 2007, *H. henryi* was found in the waters of Kaimana and *H. galei* found in the Cenderawasih Bay (Allen and Erdmann, 2007), while *H. halmahera* was found in Halmahera waters in 2013 (Allen *et al.*, 2013).

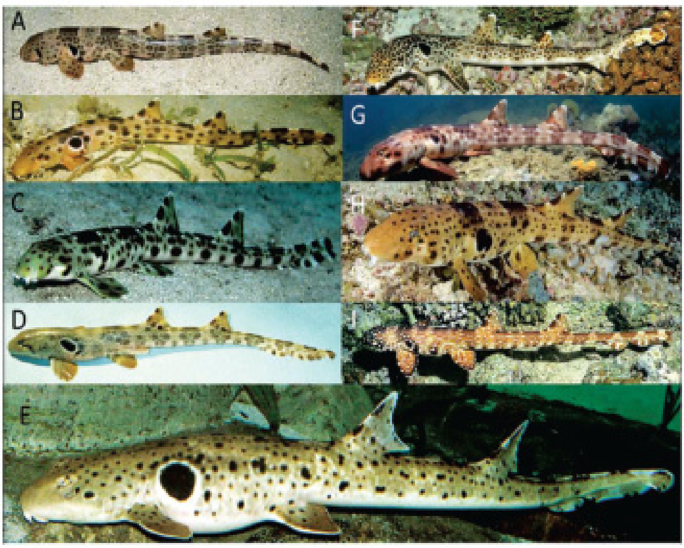


Figure 18. Several Species of Walking Shark That Are Found In Indonesia waters (A) *Hemiscyllium freycineti,* (B) *H. hallstromi,* (C) *H. galei,* (D) *H. trispeculare,* (E) *H. occelatum,* (F) *H. michaeli,* (G) *H. halmahera,* (H). *H. henryi,* and (I) *H. strahani*

In 2015, a cat shark (*Atelomycterus erdmanni*) was also described from the Lembeh Strait, North Sulawesi (Fahmi and White, 2015). This shark species can be found specifically from North Sulawesi to Ambon, where the shark is often found at night at depths of 3-62 meters. Conservation International monitoring team had encountered a type of shark that had a similar characteristic to *A. erdmanni*, but the shark was found dead and the similarity can not be preconcerted. This shows the high diversity of shark and ray species in Indonesia, where new species continue to emerge in the previous several years.

In the south-east waters of Indonesia, captured shark is dominated by family of *Carcharhinidae* as many as 27 species. The dominant captured species is *Carcharhinus falciformis* and *C. brevipinna*, with a proportion of 27.1% of the total number of captured sharks during the period of 2001-2006. While the ray catchment is dominated by 23 species of *Dasyatidae* family with the proportion of catchment reach 87.3% from the total catch in the same period. Some dominant rays consist of *Neotrygon kuhlii*, *Dasyatis zugei*, and *Himantura walga*, which are relatively small in size and *Himantura gerrardi* is larger with the percentage of 84.2% from the total landed catch. Most of captured sharks by longline include several species of *Alopias pelagicus, Carcharhinus amblyrhynchos, C. falciformis, Prionace glauca* and *Sphyrna lewini* which contribute for 62% of pelagic fisheries. The proportion of captured shark in tuna fishing nets was 55% of total catches in pelagic fisheries consist of *C. sorrah, Rhizoprionodon oligolinx* and *Scoliodon laticulatus* species and only one shark was caught by a tuna line with a proportion of 27% catch (Figure 19a, Dharmadi *et al*., 2008). While on the bottom longline fishery, captured shark is dominated by the type of bottle shark, *Squalus hemippinis* that contribute for 42% (Figure 19b).

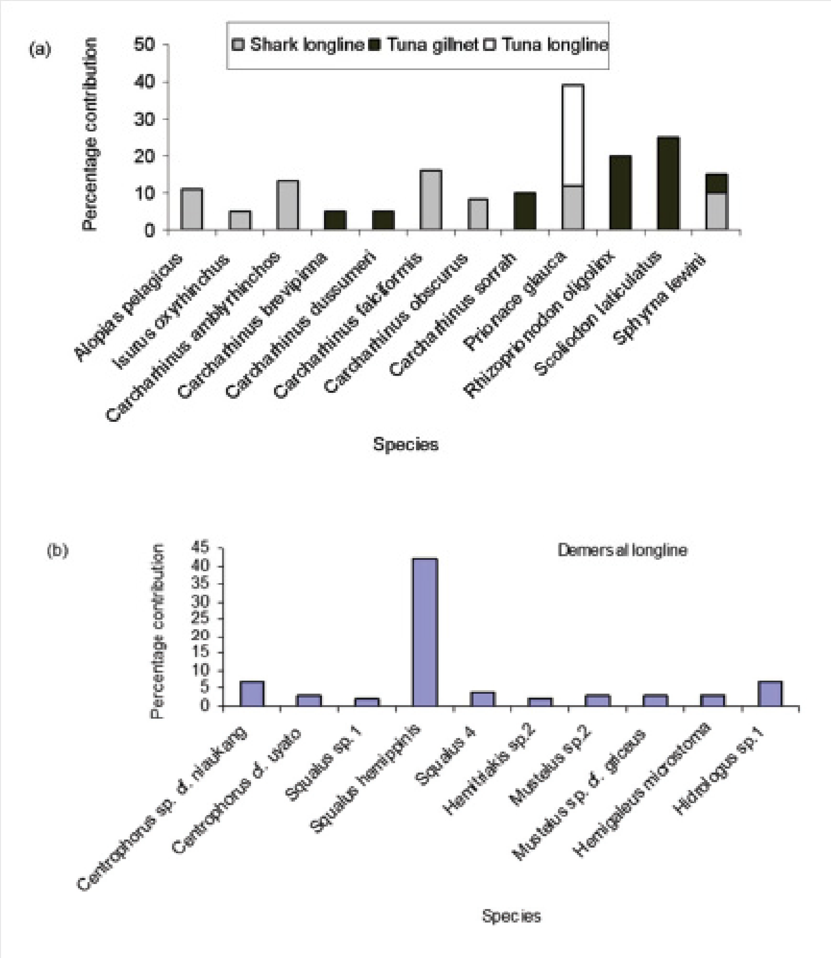


Figure 19. Percentage Contributions of the Most Abundant Species by Numbers to the Pelagic Fisheries (A) and The Demersal Longline Fishery In South-Eastern Indonesia (B)

The dominance of captured shark species based on fish landing sites and type of fishing gear is presented in Table 8.

Table 8. Most of Captured Shark Species Based on Location and Fishing Gears

Landing Location	Species	Type of Fishing Gear	Source
Cilacap	*Alopias pelagicus* and *Carcharhinus falciformis*	surface gillnets and tuna long-lines.	Dharmadi et al., (2012)
	Centrophorus niaukang, *Squalus* sp. and *Hydrolagus* sp.	bottom long-lines	
Palabuhan Ratu	*Carcharhinus falciformis* and *Prionace glauca*	surface gillnets and tuna long-lines.	
	Centrophorus niaukang	bottom long-lines	
Kedonganan	*Carcharhinus brevipinna* and *Sphyrna lewini*	drop lines	
	Squalus sp	bottom longlines	
Tanjungluar	*C. falciformis, Galeocerdo cuvier, Prionace glauca, Triaenodon obesus, Sphyrna lewini, C.limbatus*	Shark surface longlines	Dharmadi *et al.*, (2012), Simeon *et al.* (2017)
	Carcharhinus limbatus, C. sorrah, C. obscurus,C amblyrhynchos,	Shark botom longline	
Banda Aceh	*Carcarhinus falciformis* *Carcharhinus sorrah*	Shark longlines Tuna longlines	Dharmadi *et al.*, (2015)
Sibolga	*Scoliodon laticaudus* *Sphyrna lewini* *Carcharhinus sorrah* *Rhynchobatus australiae*	Tuna handlines Fish net, Botom gillnet Purse seine	
Eastern Indonesia	Halmahera waters :*C.amblyrhynchos* Arafura, Maluku, Timor sea :*Centrophorus* spp, *Squalus* spp., *C. limbatus*, *Rhinobatus* spp and *Sphyrna* spp. *Eastern Indonesia border of Australia waters :Nebrius ferrugineus, C. taurus, C. albimarginatus, C.altimus, and Stegostoma fasciatum*	Gillnet Longlines	Jaiteh *et al.*, (2016)

Landing Location	Species	Type of Fishing Gear	Source
Muncar	*Carcharhinus falciformis* *Sphyrna lewini* *Carcharhius limbatus* *Galeocerdo cuvier*	Longline	Ledhyane, *et al.* (2015)
Brondong, Lamongan	*Sphyrna lewini* *Galeocerdo cuvier* *Carcharhinius limbatus* *Chiloscyllium punctatum*	Dogol (local name, it operates like Trawl)	Fuad *et al.* (2015)
Indramayu	*Sphyrna lewini* *Carcharhinus sorrah* *Carcharhinus sealei*	Gillnet (Jaring milenium/Jaring Rampung)	Sriati *et al.*; (unpublish report)
Pengambengan	*Squalus hemipinnis* *Atelomycterus baliensis* *Squalus edmundsi*	Gillnet, Longline	Bpspl Report Denpasar (2016)
Prigi	*Squalus hemipinnis* *Squalus edmundsi* *Heptranchias perlo*	Gillnet	Bpspl Report Denpasar (2016)

From the analyzed data of oceanic sharks and rays group that are caught in Indian Ocean waters, it shows that some species of sharks and rays are considered as shared stock between Indonesia and Australia. These types of sharks and rays include the highly migratory species such as *C. falciformis, Prionace glauca, C. obscurus,* and *S. lewini* (Blaber *et al.*, 2009). This information encourages the need for a joint shark and ray resource management in the Indian Ocean between both governments. This is important because of its reproductive biology characteristics such as relatively slow growth rates of sharks and rays, long life, slow to reach gonad/genital maturity and low fecundity, a condition that illustrates that sharks and rays are particularly vulnerable to over-exploitation (Musick *et al.*, 2000; Prince, 2001; Stobutzki *et al.*, 2002).

From 2015-2016, the Center of Marine Fishery, Agency for Research and Human Resources of Marine and Fisheries of the MMAF has successfully mapped the potential of resources in 11 Fisheries Management Areas (WPP) in Indonesia. From trawl-based assessment in 4 different Fisheries Management Area (WPP) described the diversity of sharks and rays, especially deepwater species (Table 9, 10, 11 and 12).

Table 9. Survey Result of Trawl for Deep Ocean Shark and Ray In WPP 713

GROUP	FAMILY	SPECIES
RAY	DASYATIDAE	*Dasyatis kuhlii*
		Himantura uarnak

Source: BRPL (2016)

Table 10. Survey Results of Trawl for Deep Ocean Shark and Ray In WPP 718

GROUP	FAMILY	SPECIES
SHARK	SPHYRNIDAE	*Sphyrna zygaena*
	CARCHARHINIDAE	*Carcharhinus brevipinna*
		Carcharhinus dussumeri
		Carcharinus cautus
		Loxodon macrorinus
		Rhizoprionodon acutus
	HEMIGALEIDAE	*Hemipristis elongates*
	HEMISCYLLIIDAE	*Chiloscyllium hasselti*
	TRIAKIDAE	*Mustilus sp A*
		Mustilus sp B
		Mustilus sp1
RAY	DASYATIDIDAE	*Dasyatis annotate*
		Neotrygon kuhlii
		Dasyatis sp1
		Dasyatis sp2
		Dasyatis zugei
		Himantura gerardi
		Himantura jenkinsii
		Himantura sp1
		Himantura sp2
		Himantura toshi
		Himantura uamak

GROUP	FAMILY	SPECIES
		Himantura undulata
		Himantura varnale
		Taeniura lymma
	GYMNURIDAE	*Gymnura australis*
	NARCINIDAE	*Narcine westraliensis*
	RHINOBATHIDAE	*Rhinobatos typus*
	UROLOPHIDAE	*Urolophus sp1*

Source: BRPL (2016)

Table 11. Survey Result of Trawl for Deep Ocean Shark and Ray In WPP 711

GROUP	FAMILY	SPECIES
SHARK	HEMIGALEIDAE	Hemigaleus microstoma
	HEMYSCYLLIDAE	Chilosyllium punctatum
	SCYLIORHINIDAE	Ateleomycterus marmoratus
RAY	DASYATIDIDAE	Neotrygon kuhli
	GYMNURIDAE	Gymnura australis
		Gymnura sp1
		Gymnura sp2
	NARCINIDAE	Narcine sp1
	RAJIDAE	Raja sp1

Source: BRPL (2016)

Table 12. Survey Results of Trawl for Deep Ocean Shark and Ray In WPP 712

GROUP	FAMILY	SPECIES
SHARK	BATOIDEA	*Rhina ancylostoma*
	CARCHARHINIDAE	*Carcharhinus dussumieri*
		Carcharhinus sp1
	HEMISCYLIDAE	*Chiloscyllium griseum*
		Chiloscyllium indicum
		Chiloscyllium punctatum
		Chiloscyllium sp1
		Hemiscyllium sp1
RAY	DASYATIDIDAE	*Neotrygon kuhlii*
		Dasyatis zugei
		Himantura gerrardi
		Himantura sp1
		Himantura uarnak
	GYMNURIDAE	*Aetoplatea sp*
		Gymnura australis
	RHYNCHOBATIDAE	*Rhynchobatus djiddensis*

Source: BRPL (2016)

2.3.2. Abundance, Distribution and Population Status

Until now, the data collection of shark resources with identification to the group level is still conducted, which has provided a general description of certain types of shark species, for example groups of hammerhead sharks and groups of thresher sharks. The trends of shark group production shown in 11 Fisheries Management Areas (WPP) within 10 years (2005-2014), are presented in Figure 20. The production ranged between 8,005 and 76,881 tonnes. The higher shark production was usually found in FMA 572 and FMA 573 (Indian Ocean). Groups of thresher sharks group include: *Alopias pelagicus* and *A. superciliosus*; hammerhead sharks include *S. lewini, S. mokarran, S. zygaena*); and mako sharks consist of *Isurus paucus* and *I. oxyrhynchus* (DGCF, 2015). Some of these sharks are considered as rare and endangered species that has become a top priority in international shark conservation programs (Dulvy *et al.*, 2017).

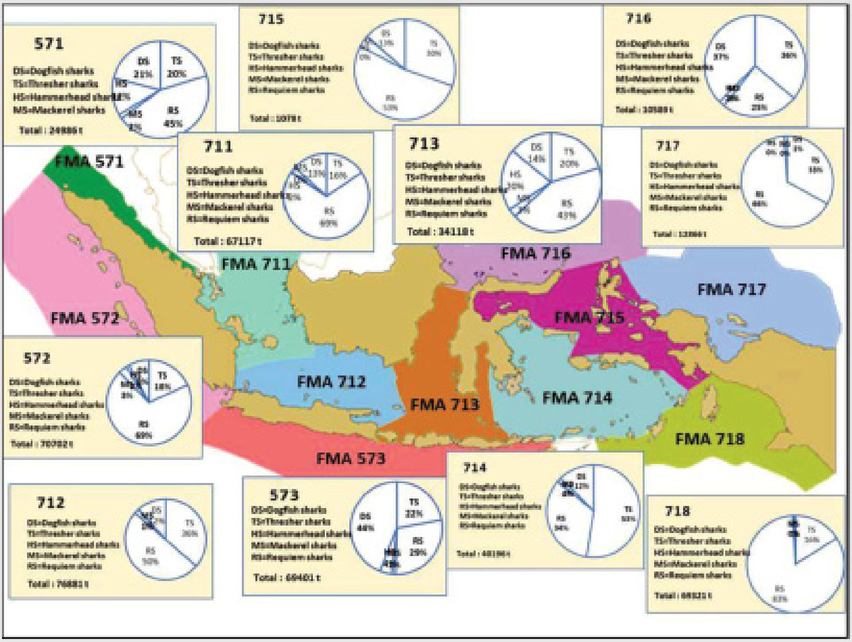


Figure 20. Distibution of Sharks Production (based on shark groups) in 11 Fisheries Management Areas (FMA) of Indonesia During Period of 2005-2014 (tons) Source of data: DJPT (2015)

Both groups of hammerhead sharks and thresher sharks were listed into CITES Appendix II as decision results of CoP-16 in March 2013 and CoP-17 in September 2016, meaning that the products of the two groups of sharks are still tradable both domestically and abroad with strict supervision. Other types of sharks included in the CITES II Appendix II in 2016 are the silky shark, ©. *falciformis*), while for the rays are all species that belonging to the Mobulidae family including *Mobula japanica, M. tarapacana, M.kuhlii, M.thurstoni, M. eregoodootenkee* that found in Indo-west Pacific waters. In the waters of Indonesia are commonly caught only 4 types of mobula namely *M. japanica, M. tarapacana, M. kuhlii, M. thurstoni*. In general the production of the three groups of sharks (mackerel sharks, thresher sharks, and hammerhead sharks) are shown to be fluctuating with a steady to decline, even in some waters areas there has been a drastic reduction in production, except for FMA 712 (Java Sea). In this FMA there was a significant increase of shark production in the 2008-2013 period, but shark production decline in the following year. Similarly, for FMA 572 (Indian Ocean, West of Sumatra and Sunda straits), there is an increase in shark production quite drastically in 2012 - 2013, then decreased in 2014.

Spatially, the production of hammerhead sharks, *Sphyrna lewini* that was caught in the Indian and Southern Indian waters landed in Cilacap fluctuated in the period 2011-2017, decreased in 2011-2013 and then increased again significantly after 2013, the production decreased again signiicantly (Figure 21). This is allegedly related to the inclusion of hammerhead shark into Appendix II CITES which is then followed up by the issuance of Regulation of Ministry of Marine Affairs and Fisheries about Shark Trade Banning in Appendix II of CITES out from the territory of the Republic of Indonesia, Regulation of Ministry of Marine Affairs and Fisheries No.34 / 2014, extension of Regulation of Ministry of Marine Affairs and Fisheries No. 59 / PERMEN-KP / 2015.

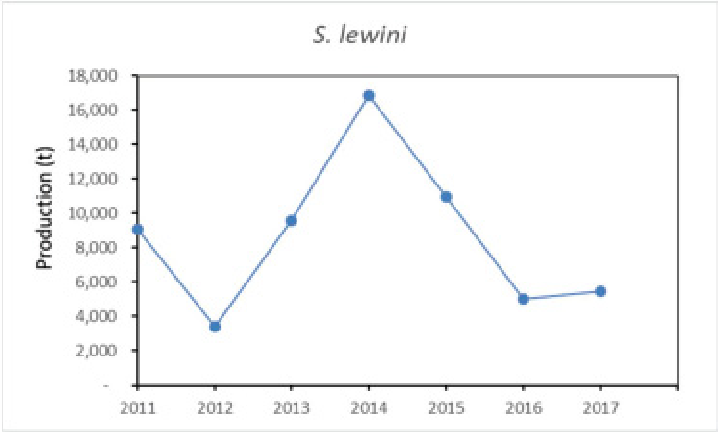


Figure 21. Production Trend of *S. lewini* Caught In Indian Ocean and South Java

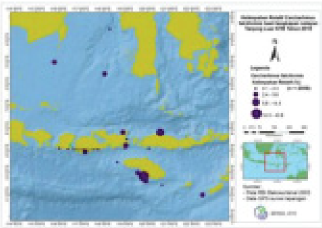
Related with the presence of shark populations, Froese (2004) states that one indicator of healthy stock conditions is the large numbers of mature fish. Immature fish capture will cause a decreased in the grown population. If the number of grown population continues to decline, reproductive capacity of *S. lewini* will also decrease. If this condition is happened continuously, then the stock will be extinct.

So far, research on the abundance or population of sharks and rays in Indonesia is still limited to certain species and to certain water areas. The abundance information on sharks and rays is available for whale sharks, manta rays and some types of oceanic sharks. in Indonesia that the whale shark is aggregating , such as in Cenderawasih Bay-West Papua, Kaimana-West Papua, North Maluku, Gorontalo Bay, Derawan and Talisayan-East Kalimantan, Probolinggo-East Java, and recently in Sumbawa-West Nusa Tenggara. The occurrence of the whale shark subpopulations in these waters is allegedly related to the availability of food and hydrographic conditions that appropriate for their survival. Groups of whale sharks that are migrating to certain waters are strongly thought to be driven by the presence of abundant source of food in these waters (Tania and Himawan, 2017).

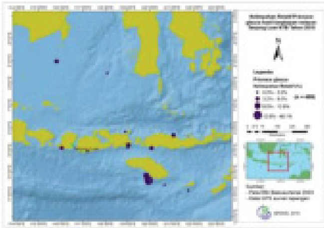
In contrast to manta rays and whale sharks, pelagic shark populations are generally known from the number of landed sharks based on the fishery aspect. Research that was conducted in Tanjung Luar showed the distribution of shark capture areas spread from the Java Sea, Makassar Strait, Flores Sea, to the Indian Ocean. The fishing areas were selected by fishermen based on seasonal considerations and the presence of inherited fish.

The calculation of stock and population of sharks in nature are very difficult to conduct, so there are several approaches to give models to describe the abundance of sharks in nature. Based on the number of landed sharks at Tanjung Luar, the CPUE (Catch per Unit Effort) analysis was conducted. CPUE gives an overview of the relative abundance index of exploited fish stock and the level of catch in a fishing area (Gulland, 1969). Based on the CPUE calculation, it is known that there is a decrease in the relative abundance index of shark that landed at Tanjung Luar in 2014-2016 due to increased utilization that indicated by the increasing number of efforts. It should be noted that the number of trips in 2015-2016 increased significantly, but not provide significant increases in catch result. This indicates that stocks in nature are limited, but fishing efforts are continued intensively (Simeon *et al*., 2017).

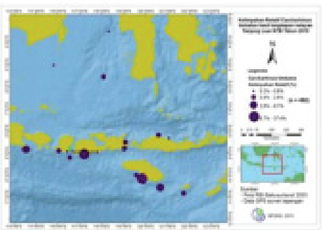
Distribution of several sharks in Indian Ocean waters that were landed in Tanjung Luar reported by Sentosa *et al*., (2016) in abundance index that shown in Figure 22.



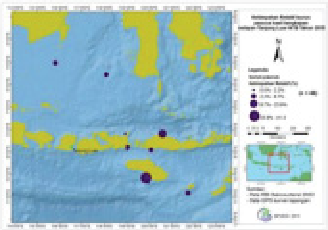
C. falciformis



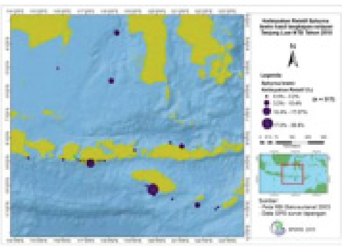
P. glauca



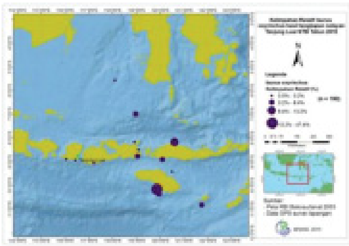
C. limbatus



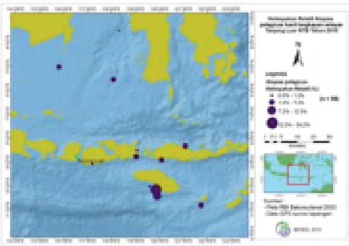
I. paucus



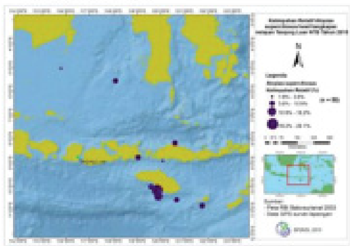
S. lewini



I. oxyrhynchus



A. pelagicus



A. superciliosus

Figure 22. Relative Abundance Indices of Several Shark Species Caught In East Indian Ocean

In general, information of sharks and rays distribution is still very limited in Indonesian waters. The availability of new information is limited to certain types of oceanic sharks based on the fishing grounds and landing sites. Here are some species of sharks and the distribution in Indonesia.

Whaleshark (*Rhincodon typus*)

Almost all Indonesian waters are a suitable habitat for whale sharks (Himawan, 2017). Indonesian whale shark population is a combination of several resident and seasonal aggregations, ranging from West Papua (Cenderawasih Bay, Kaimana, and Fakfak), East Nusa Tenggara (Savu Sea and East Flores), Gorontalo (Botubarani), East Kalimantan (Talisayan), East Java (Probolinggo) and Riau Islands (Anambas) (Himawan *et al*., 2015, Himawan *et al*., 2016; Kamal *et al.*, 2016). Identified whale shark individual in each aggregation area presented in Table 13. This information is not final and potentially will gradually increase through ongoing research effort.

Table 13. Identified Individual In Periodic Surface Aggregation of Whale Sharks In Indonesia

Water Area	Amount	Observation Year	Source
Cendrawasih Bay	131	2010-2016	Tania *et al*. (2016)
Kaimana	28	2013-2018	Conservation International
Saleh Bay	45	2017-2018	Conservation International
Savu Sea	22	2016	Misool Baseftin
Talisayan	36	2014-2017	BPSPL Pontianak (2015); Himawan (2017)
Botubarani	20	2017	Handoko *et al.* (2017), Himawan (2017)
Probolinggo	28	2016	Himawan (2017)
Anambas	11	2010-2016	Whale Shark Indonesia
Total	**321**		

Just as observed on other whale shark aggregation in the rest of the world, whale shark population in Indonesia is heavily dominated by male individuals, which detailed Cenderawasih Bay (96.94%, n = 131), Kaimana (92.86%, n=28), Saleh Bay (84.44%, n=45), Talisayan (93.33%, n = 36), Botubarani (100%, n = 20), Probolinggo (85.71%, n = 28). In Anambas waters (n = 11) but unknown gender. Based on the results of sex identification, whale sharks in Indonesian waters are dominated by male sex (80-90%, n = 266).

The estimated total length (LT) of whale sharks in waters of Talisayan, Probolinggo, Botubarani and Cenderawasih Bay ranges from 2.5-7 m with an average of 4.27 ± 1.065 m (Himawan 2017). Estimated total length (LT) of whale sharks that are identified in Talisayan waters have an average total length of 4.38 m for male individuals (n = 28). The largest male whale shark has an estimated total length of 7 m and the smallest 2.5 m. The female (n = 2) has an estimated total length (LT) averaging 3.25 m with the largest 3.5 meters and the smallest 3 meters. In Probolinggo waters, the estimated total length (LT) is 4.33 m for male individuals (n = 24). The largest male whale shark has an estimated total length of 6.5 m and 3 m. The female (n = 4) has an estimated total length (LT) averaging 4 m with the largest size of 6.5 m and the smallest 3.5 m. The estimated total length (LT) of the male whale shark (n = 17) identified in Botubarani Waters has an average of 4.85 m with the largest 7 m and the smallest 3 m. In Cenderawasih Bay, an identified whale shark has a total length (TL) of 3.96 m (n = 36) with the smallest 3 m and the largest 6 m. There is 1 individual female whale shark identified with total length (TL) 4 m. The total length of each observed individual whale sharks that appear in Anambas waters are not known.

Whale shark population in Indonesia is also heavily dominated by adolescent individuals, where very rarely female and adult individuals observed. Based on a long term observation on external morphology of whale shark claspers in Ningaloo Reef, Western Australia, Norman and Stevens (2007) described that male whale sharks are considered an adult when they are ~9m TL. Determining maturity on female whale shark is much more difficult than male, as the sign of maturity on female whale shark could only be observed through swollen abdomen as a sign of pregnancy (Acuña-Marrero *et al.*, 2014). From the observation from Galapagos Marine Reserve, Acuña-Marrero *et al.* (2014) also described that female whale shark could be considered adult when they are >9m TL, although the size of maturity could vary between locations due to different food abundance in each location.

As almost all whale shark individuals in Indonesia is generally consisted by individulas ranging from 2.5-7m TL, and very rarely individuals with TL above 9m observed, it is assumed that Indonesian waters could be a nursery habitat for juvenile and adolescent whale shark (Himawan, 2017).

The whale sharks occurrence in Indonesian waters is related to their foraging behavior (Himawan, 2017; Tania *et al.*, 2016). The occurrence of whale sharks in Cenderawasih Bay, Kaimana and Talisayan have a strong association with the existence and activity of the *Bagan* lift-net fisheries, especially by feeding on the anchovies that the fishermen are targeting (Tania *et al.*, 2016; Himawan *et al.*, 2015; Himawan *et al.*, 2016). Feeding activities of tourism in the form of skin and head of vaname shrimp in Botubarani affect the whale shark to continue to be near the surface of the waters (Himawan, 2017). The abundance of plankton in the Sawu Sea, Probolinggo and Anambas waters is allegedly to be a potential food for whale sharks in the areas (Himawan, 2017, Kamal *et al.*, 2016).

Table 14. Sub Population of Whale Shark In Several Areas of Indonesia (WWF and CI, 2017)

Waters Area	Number of individual
Cendrawasih Bay	131
Talisayan	34
Kaimana	28
Saleh Bay	45
Gorontalo	20
Probolinggo	28
Total	**321**

From latest research, there is a strong correlation between the presence of whale sharks and the abundance of their prey, small pelagic fish groups. This, and some hydrographic conditions, such as seasonal plankton blooms from upwelling and monsoon season further strengthen that the presence of whale sharks in Indonesia is mainly food driven. This has been proven in some locations in Indonesia which have higher whale shark populations due to the high fishing activity of the lift-net (bagan), for example in Cendrawasih Bay and Talisayan waters (Table 14). This could also mean that there's a strong overlap between whale shark habitat and the fishing ground of these bagan fishermen, which basically is areas which have a high productivity. Due to their endangered status, and also the strong economic argument from tourism, in May 2013, the Minister of Marine Affairs and Fisheries of the Republic of Indonesia based on Minister Decree Number 18/Kepmen-KP/2013, declare that whale sharks are fully protected. This regulation is signed not only to protect their population, but also to secure the economic potential that could be derived from tourism.

Information on the biology and reproduction of whale sharks is still very minimum until now, but since July 2015, researchers from Conservation International Indonesia (CI-Indonesia) have found a novel method to fixate a *finmount* satellite tag on the dorsal fin of the whale shark in Cenderawasih Bay, West Papua, which is learned by the unique association between whale shark in Indonesia with Bagan. This then allow the researcher to track the animal for almost 2 years, providing a long-term dataset for each individual whale shark's movement that. Before this method is invented, scientist has never been able to deploy satellite tag for a long time, especially in Indonesia where they are highly associated with bagan, where the tag could be easily tangled and detached from the shark after 1-2 weeks of the deployment.

From the number of satellite tags that have been deployed, the movement pattern of the whale sharks in West Papua could be grouped into 3, (1) "homebody" sharks that didn't move too far from the tagging location; (2) whale sharks forays out of the tagging area and returned, and (3) whale sharks that leaves the tagging location and does not (or has not) returned. One of the important things that we could see from this study is that, even though whale shark is considered to be a highly migratory species, most of the tagged whale sharks (especially those from Cenderawasih Bay) tend to stay within the bay for a long time (1-2 years). The tagging data now is available online in Conservation International's Whale Shark Tracker App (www.conservation.org/whaleshark) that also provides some information about whale sharks and CI-Indonesia's whale shark tagging program to raise the awareness for whale shark conservation (Figure 23).

Figure 23. Movement of Several Tagged Whale Sharks In Indonesia (Source: www.conservation.org/whaleshark)

Since 2015, CI-Indonesia now have deployed 47 finmount tag in West Papua and West Nusa Tenggara and this tagging program have given a great insight into the whale shark behavior in Indonesia. It has been observed that the whale shark in different area behave in a different way. In areas which have a relatively high productivity and food source throughout the year, the whale shark tends to stay in the same area (e.g. Cenderawasih Bay and Sumbawa), and in contrary, in areas with seasonal productivity and food source, the whale shark tends to foray outside in search for higher food source in another area (e.g. Kaimana). Even so, the whale shark is observed having a high site fidelity to respective areas – even in areas with seasonal productivity – which means each area still plays an important role in the whale shark's current life stage.

From all of the sharks that have been tagged, almost all of them behave and move differently. Only in the past year it has been observed that a couple of whale sharks are performing a relatively similar movement pattern. Not only that, it was just also recently observed that some whale shark is performing a seasonal movement to the same area on the same month in two different years. In the first year of the tagging program, all individual of whale shark seems to be performing random behavior, but this method finaly could document some behavior that weren't going to be able to be observed by conventional surveys relying on visual surveys or short-term tagging.

Analysis of the data from 15 tags (until May 2016) revealed that the sharks spent 28 – 100% of their time foraging (mean = 81%) and foraging mostly occurred in shallow waters over the continental shelf, while travelling occurred over deeper water beyond the edge of the continental shelf. For big animal that feeds on small nektonic fish, shrimps, and planktons, whale shark will spend most of its time foraging to fulfill their high daily energetic need. Spesifically to Cenderawasih Bay, the area is obviously a vital area for these sharks as the biggest documented whale shark aggregation in Indonesia, but surrounding areas seem equally important for the Cenderawasih population, as there has been high number of foraging activities documented in highly productive areas around the bay. The movements observed in this study are likely the result of a suite of both biotic (e.g. prey movement and availability), and abiotic factors (SST, currents, season, weather patterns, etc.).

From this tagging study, it was observed that the whale shark from West Papua have visited 7 neighboring countries around Indonesia (Papua New Guinea, Palau, Philippines, Timor Leste, Australia, Mariana and Federated States of Micronesia) and at least 9 Marine Protected Areas (MPAs), which are Cenderawasih Bay National Park, Padaido Islands Marine Tourism Park, Jeen Womom MPA, Dampier StraitMPA, Kofiau and Boo MPA, South Misool MPA, Sabuda Tataruga Marine Reserve, Southeast Maluku Regency MPA, and Kaimana MPA.

Whale shark populations that were once deemed as seasonal aggregations have recently been identified as year-round populations (e.g. Honduras, Maldives and Mozambique), demonstrating that whale sharks may have a higher site-fidelity than previously thought (Norman, 2016) and posing a strict protection in the main aggregation area is vital to safeguard the important habitat for the whale shark. Even so, the whale shark also performs long distance migration to high productivity area, as suggested by the tagging study. In order to ensure a healthy population of whale shark in Indonesia or furthermore for the Eastern Pasific population, it is critical that all of the important habitats of the whale shark are being protected by the implementation of network of MPAs or seascape approach.

Manta ray (*Mobula alfredi* and *Mobula birostris*.)

Genus Manta was previously considered monotypic but the genus was evaluated in 2009 and two species *Manta alfredi* and *Manta birostris* identified, with evidence of a third putative species, *Manta c.f. birostris* in the Caribbean (Marshall *et al.*, 2009). A focused genetic study has confirmed that M. birostris and M. alfredi are two distinct species (Kashiwagi *et al.*, 2012). Descriptions or photographs can be used to verify accounts to the species level. Recent study on phylogeny of mobula ray and devil ray using the next generation sequencing shows that both species of manta which previously placed in the genus Manta, now with are nested within the other Mobula species and sister to *M. mobular*, hence changing their name into *Mobula alfredi* and *Mobula birostris* (White *et al.*, 2017).

Manta Rays are large-bodied, pelagic, planktivorous rays. *M. birostris* grows to over 7 meters wingspan (disc width or DW; Marshall *et al.*, 2009) with anecdotal reports up to 9 meters (Compagno, 1999). *M. alfredi* grows to an average 4 meters DW, and a maximum of 5 meters DW

(Marshall *et al*., 2011b). Mantas are slowly growing and long-lived with low fecundity and reproductive output and long generation times (estimated at 25 years[1]). Longevity is estimated to be at least 40 years (Marshall *et al.* 2011b,c) and natural mortality is thought to be low (Couturier *et al.*, 2011). Mantas are among the least fecund of all elasmobranchs (Couturier *et al.* 2012), bearing only one pup on average every two to three years, with a gestation period of 10–14 months (Homma *et al*. 1999; Marshall *et al*., 2009; M. de Rosemont pers. comm.) and reaching maturity at ~10 years (Marshall *et al*., 2011b,c). Earlier age at maturity (~3-6 years) was estimated in males in one subpopulation in Kona, Hawaii (Clark, 2001). Later maturity (15 years or more) and lower reproductive rates (one pup every five years) have been observed for female *M. alfredi* in a subpopulation in the Maldives (G. Stevens, in prep.). With such conservative life history characteristics, a female manta ray can produce no more than 5-15 pups over her lifetime. Subpopulations are therefore exceptionally vulnerable to extirpation, slow to recover once depleted; the possibility of successful re-colonization is low.

Manta are distinguished by their large diamond-shaped body with elongated wing-like pectoral fins, ventrally placed gill slits, laterally placed eyes, wide terminal mouths, and paired cephalic lobes. Melanistic

---

[1] 'Generation length' is the average age of parents of the current cohort (i.e. newborn individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once. Where generation length varies under threat, the more natural (i.e. pre-disturbance) generation length should be used (Conf. 9.24 Rev. CoP15). Generation length for *Manta spp*. is best approximated as halfway between age at first maturity and maximum age. Thus female manta rays may be actively breeding for 30 years and the age at which 50% of total reproductive output is achieved would be approximately 24–25 years (Marshall *et al*., 2011b,c).

(black) and leucistic (white) colour morphs occur in both species (Marshall *et al*., 2009). Most *Manta spp*. show a counter-shading pattern (black dorsally and white ventrally) and have unique spot patterns on their underside that do not change over time and help identify individuals (Clark, 2001, Marshall *et al*., 2008, Kitchen-Wheeler, 2010, Deakos *et al*., 2011).

Manta rays are circumglobal in range, with the two described species sympatric in some locations and allopatric in others. *M. birostris* is the more widely distributed, inhabiting tropical, subtropical, and temperate waters, while *M. alfredi* is found in tropical and subtropical waters (Marshall *et al*., 2009; Kashiwagi *et al*., 2011; Couturier *et al*., 2012). In Indonesia, there are four widely known sub-population of manta ray in Raja Ampat – West Papua, Komodo National Park – East Nusa Tenggara, Nusa Penida – Bali, and Sangalaki – East Kalimantan. This four location has also been the hotspot for manta ray tourism in Indonesia, where combined making the second largest manta ray watching industry in the world (O'Malley *et al*., 2013).

As a result of a population that continues to decline due to ongoing hunting and also the strong economic argument from tourism that manta ray worth far more when alive from tourism compared to when they are captured from fisheries (O'Malley *et al*., 2013), the Ministry of Marine Affairs and Fisheries stipulated that both species of manta rays are fully protected based on Decree No. 4/Kepmen-KP/2014.

Some conservation areas are also found in the manta ray sub population of Nusa Penida-Bali, Raja Ampat Island-West Papua, Komodo Island, and Berau Island. Observations regarding the frequency of occurrence and number of individual manta rays have been conducted by Germanov and Marshall (2014) (Table 15). It is noted that in 2013 the most occurrence of manta rays occurred in the waters of Nusa Penida with the number of occurrences of 1,092 times.

Table 15. The Survey Effort In Nusa Penida, West Manggarai & Komodo, and Raja Ampat Regions Including Sighting Records and Number of Individuals Identified (Germanov and Marshall, 2014)

Region	Year	Nusa Penida & Komodo	West Manggarai	Raja Ampat	Total
Total sighting records	2006 – 2014	2,007	426	171	2.604
Yearly sighting records	2006 – 2010	83	-	-	83
	2011	84	49	-	133
	2012	544	37	-	581
	2013	1,092	329	53	1,474
	2014	203	11	133	327
M.alfredi	2006 – 2014	417	303	100	820

The following year marked the beginning of manta rays research that incorporate technology of satellite tagging in four main locations of manta rays sighting. The program to tag 33 individuals in Raja Ampat (West Papua), Nusa Penida (Bali), Komodo (East Nusa Tenggara), and Sangalaki (East Kalimantan) was the biggest achievement of manta rays tagging in Southeast Asia. The utilization of SPLASH tag with Fastloc-GPS technology was able to capture accurate location of tagged manta rays everytime they break out to the surface even in split second. This tagging program has successfully provided preliminary data on manta behavior and movements in Indonesia. There are three key findings, in particular, which will be useful for the management and protection of this gentle species.

The observation of manta behavior and movements in Raja Ampat unveiled the data of nursing ground for pregnant female manta rays and their juveniles in Wayag Lagoon, located in the heart of Wayag Islands. This discovery marks the first nursery and pupping ground in Southeast Asia. These young animals are observed to take shelter in the sanctuary of lagoon, but occasionally travel out of the lagoon into the deep sea for few hours before coming back to their "home." On the other hand, there are several major routes for mature manta rays. Some remain in the Dampier Strait area or around the Islands Chain in Northwest Raja Ampat (Wayag and Kawe, Seprang to North Waigeo). The movement of groups of mature manta from Dampier Strait to Wayag Lagoon was strongly assumed to give birth. This can be demonstrated in the figure below which shows data from manta movements around Wayag Islands, in 2015 (Figure 24).

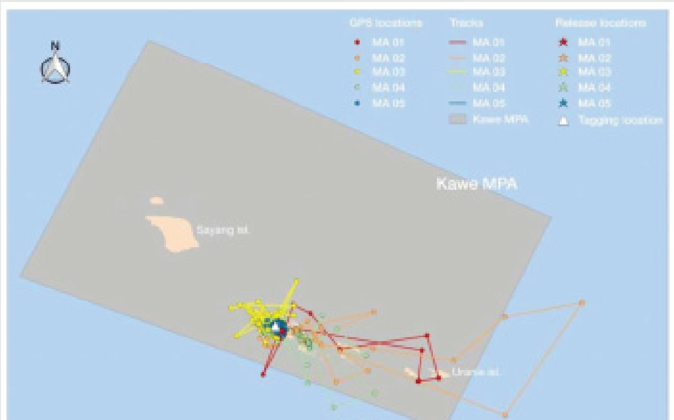


Figure 24. Tracking Movement of Juvenile Manta In Wayag Islands, Raja Ampat (Source: Edy Setyawan/SEA Sanctuary/Conservation International Indonesia).

The maps show tracking movements of five individuals of juvenile manta, each assigned in different colors. All of five individuals wandering around Wayag Islands (20 km^2), which is also located inside local marine protected area of Kawe, except for one individual that once wandered outside then returned. The figure encourages the effective management of marine local protected area and standard operation procedure for flourishing tourism activity in order of protecting manta habitat.

Although some observed manta rays perform long-range movements, in general the tagged manta rays throughout the program sites tend to remain at close range, which indicates that manta rays have strong residency rates inside the area. All of six tagged manta rays in Komodo showcased various movements, most of them are resided inside the area of national park, and some did a constant back and forth movement in the narrow straits that are exposed to the great currents between Rinca and Komodo Islands. In Bali, almost all mantas spend time only along the south of Nusa Penida Islands and never to the north.

The observation of manta movement in Nusa Penida (Bali) to the east, and the movement westward from manta Komodo, show that they are expected to go through one of the largest manta fishing grounds in Indonesia, namely Tanjung Luar, South Lombok, located between Nusa Penida and Komodo. This finding also recommends that the most appropriate management of manta rays to ensure the survival of these animals is area-based protection, through marine conservation area networks in each population location that can also accommodate migration routes from one marine conservation area to another.

Hammerhead sharks (*Sphyrna* sp.)

In Indonesia, there are three types of captured hammerhead sharks namely *Sphyrna lewini, S. mokarran, S.zygaena*, but the most commonly type is *S.lewini*. The distribution of these three types of hammerhead sharks is widely known throughout the tropical waters. In Indonesian waters, the distribution includes the Indian Ocean, Sunda Strait, Java Sea, South China Sea, as well as the waters around Sumatra, Sulawesi, Maluku and Papua. The population is allegedly declined due to unsustainable fishing activities. This type of fish is caught by longlines and gill nets both as a side catch and major catch, in addition also caught by dogol fishermen or trawl nets and gill nets that operate near the coastal area as a living place for juvenils.

Spacially, the production of hammerhead shark, *Sphyrna lewini* that are caught in the Indian Ocean and South waters and landed in Cilacap fluctuated during 2011-2015 period, in 2011-2013 production decreased but then increased significantly after 2013. This allegedly associated with type hammerhead shark that was put into Appendix II of CITES which was then followed up by the issuance of Regulation of Minister of Marine Affairs and Fisheries about Banning the shark trade in Appendix II of CITES out from the territory of the Republic of Indonesia, Regulation of Minister of Marine Affairs and Fisheries Number.34/2014, extension of Regulation of Minister of Marine Affairs and Fisheries No. 59/PERMEN-KP / 2015.

Hammerhead shark (*Sphyrna spp.*) that was caught in Indramayu (Muslih et al., 2015) as one of the by-catch vessels of more than 30 GT by gillnet. In the period 2014-2015 the number of *S. lewini* was most recorded in August. The size of captured male fish was dominated by 60-90 cm long. In November 2014 the length measures was 60-90 cm.

The population of *S. lewini* in the waters of the Java Sea and Kalimantan has had high catchment pressure. The catch result of *S. lewini*, which is dominated by young fish, is caused by the behavior of hammerhead sharks that often swim in group (Compagno, 1984), which will be caught in large numbers by fishermen. The first time of mature genitals (Lm) of female *S. lewini* is 163.9 cm, whereas the male fish matures genital occur in a smaller size of 142.1 cm. The value is lower than the first research results of matured genitals size *S. Lewini* by Jansons and Lyle (1989) that was 200 cm (female) and 150 cm (male). *S. lewini* that was obtained during most studies (> 80%) was below the Lm score.

Observations of hammerhead sharks (*Sphyrna spp.*) from 2014 to 2016 by Simeon *et al*. (2017) showed the distribution of length frequencies, 47% of hammerhead sharks (*Sphyrna lewini*) were caught before mature gonads (<Lm) or immature. The capture of hammerhead sharks in immature conditions means that captured hammer sharks were at a young age and have not had mature gonads at least in once spawning. This condition may lead to growth overfishing if the capture pressure continues. The growth overfishing occured when the catch was dominated by small fish or young fish on growth (Diekert, 2010; Saputra *et al*., 2009; Widodo and Suadi, 2006). Capture on small sizes can lead to high mortality and the rate of hammerhead sharks exploitation.

According to Froese (2004), one indicator of healthy stock conditions is the number of mature fish contained in large quantities. Immature fish will cause a decline in the brood stock population. If the number of brood stock continues to decline, reproductive capacity of *S. lewini* will also decrease. If this condition continues, then the stock will be extinct.

<u>Silky Shark (*Carcharhinus falciformis*)</u>

Silky shark (*C. falciformis*) is a type of medium sized shark that has characteristic of oceanic and pelagic, but generally more abundant in offshore waters close to the mainland and in layers near the surface, although sometimes is found in a depth of 500 meters (White *et al.*, 2006). The population is not known for certain yet because of the unavailability of the specific catch data for this type of fish, but is strongly analysed to have decreased due to the pressure of catchment in all size ranges (Fahmi & Dharmadi, 2013).

This type of shark has a very wide spread in the exposure area of the continent to the sea so it can be found in almost all areas of fisheries management of Indonesia, except the waters of Malacca Strait and surrounding areas (FMA 571). Based on its biological characteristic, this type of shark has a relatively large body size with a maximum length of 350 cm, the size at birth about 55-72 cm, and the size of the first adult between 183-204 cm (male) and between 216-223 cm for females, with number of birth 1 to 16 sharks (White *et al.*, 2006). Like other sharks in general, this type of shark tends to have a long live but have slow growth. The results of Hall *et al.* (2012) of *C. falciformis* sharks in Indian Ocean waters (FMA 573) indicates that this species of shark can reach an average age of up to 20 years, and reaches an adult level at the age of 13 years in male and 15 years in female. The growth coefficient (k) and the asymptotic length ($L\infty$) based on growth analysis using vertebrae are 0.066 and 299.4 cm (Hall *et al.*, 2012).

Table 1.26 shows the range of catch size from *C. falciformis* sharks that are landed at several fishery centers in Indonesia. In general, the total length of sharks that are caught in the Indian Ocean waters (FMA 572 and FMA 573) has a range of sizes between 65-300 cm, in FMA 713 between 58-282 cm, while in FMA 711 and FMA 712 ranged between 63-197 cm. The continental territorial waters of relatively shallow tend to be inhabited by young sharks, whereas large and adult sharks tend to be lived in open water or oceanic waters.

Table 16. Range of Catch Size from *C. falciformis* Sharks That Are Landed at Several Fishery Landing Centers In Indonesia

Location	Time	Size range (cm)	Captured general size	Fishing Gear	Source
Cilacap	February-April 2015	68 –300	128 - 157	Drifting longline	Setiawan and Nugroho (2015)
Muncar	May – December 2014	88 –318 (b) 104 – 300 (j)	145 – 205 (b) 145 – 205 (b)	Drifting longline	Damora and Yuneni (2015)
Muncar	September 2014 – March 2015	100 – 340	205 - 220	Tonda fishing line	Harlyan *et al.* (2015)
Tanjungluar	January – December 2014	45 –293	183	Longline fishing line	Chodrijah and Faizah (2015)
Tanjungluar	2002 and 2004	65 –280 (b) 69,5 – 245 (j)		Longline fishing line	Fahmi and Sumadhiharga (2007)
Palabuhanratu	2002 and 2004	85,5 – 145 (b) 90 –206 (j)		Longline fishing line	Fahmi and Sumadhiharga (2007)
Kedonganan, Bali	2002 and 2004	76 –95		Longline fishing line	Fahmi and Sumadhiharga (2007)
Cilacap	2002 and 2004	72 –151 (b)		Longline fishing line	Fahmi and Sumadhiharga (2007)

*) b=betina (female); j=jantan (male)

An indication of the population vulnerability from a species of fish in nature is showed by an imbalance of the numbers between males and females, as well as a decrease in trends of number of catches per unit effort (CPUE). Based on comparison data between the number of male and female sharks caught in some areas of Indonesian waters, generally still in a balanced condition. For example, the comparison of male and female silky shark that were caught by Tanjungluar fishermen in FMA 573 and FMA 713 in 2014 and 2015 is still in balance condition (1 : 1), this is consistent with data on the composition of male and female fish that were caught in the western region Indonesia on data collection in 2002-2004 with a ratio of 1: 1,03 (Fahmi and Sumadhiharga, 2007) and data collection that performed by Chodrijah & Faizah (2015) in Tanjungluar TPI during 2014 which showed a relatively balanced ratio of male and female fish. However, the results of sharks data that were landed at PPS Cilacap in the period of February to April 2015 showed a significant difference between the composition of male and female shark with 1: 4 (Setiawan & Nugroho, 2015), while the data that collected in PPP Muncar since September 2014 to March 2015 shows the male and female fish catch ratio was 1: 1.5 (Harlyan *et al*., 2015). On the other hand, the number of captured male silky shark was higher than the females in Prigi and Kedonganan Bali within the period of September-October 2014, with a ratio of 1: 0.59 and 1: 0.49 respectively (Nurcahyo *et al.*, 2015).

The difference of sex ratio in each region is also related to the catch effort that is done in each area. The results of the calculation of CPUE (catch per unit effort) on the catch of silky sharks using longline drift that operated from Tanjungluar during the period 2014 to 2015, indicate a decrease in total value of CPUE in 2014 to 2015 for catchment area in FMA 573, but there was an increase in FMA 713 (Table 17).

Table 17. The Catch Result of Silky Shark (*Carcharhinus Falciformis*) Per Unit Effort (Number of Hooks Per Trip) of Drifted Longline Fishery In Tanjungluar, Lombok within 2014-2015

CPUE (kg/hook, trip)	2014	2015
WPP 573	0,084	0,069
WPP 713	0,036	0,292

Thresher shark (*Alopias* sp.)

The thresher shark consists of three species are *Alopias pelagicus, A. superciliosus,* and *A.vulpinus*. In Indonesian waters both *A. pelagicus* and *A.superciliosus* are most often caught species. While the species of *A. vulpinus* although allegedly also been found in Indonesian waters but very rarely caught.

This type of shark is widespread in the territorial waters of Indo Pacific. Its spread includes the waters of the Indian Ocean, Australia, the northern western Pacific to the southern western Pacific, the central Pacific and the eastern Pacific region (Compagno, 2001). In the waters of Indonesia, *A. pelagicus* and *A.superciliosus* sharks are found in Indian Ocean waters, from western Sumatra to southern Nusa Tenggara, South China Sea, Pacific Sea, Makassar Strait, Sulawesi Sea, Banda Sea and Arafura Sea. *A. pelagicus* is often caught as a by-catch on tuna fishing nets and purse seines that operate in the Indian Ocean coast. The alleged population in nature for both shark species is still not available due to its high migratory species. Data on size and reproduction are not yet accurately available, although the data on both sharks are available both locally and nationally.

Alopias pelagicus is one of the most common types of sharks caught as by catch in tuna and pelagic fisheries. Nationally, within ten years (2002-2011) there has been a drastic reduction in the number of catches of this type of shark. The decline in the number of catch is influenced by many factors, such as the decrease in the number of fishing fleets and the possibility of alleged decline in population numbers. The range of common sizes that landed at the fish landing site varies depending on the type of used fishing gear. Data for the period of 2001-2007 at several fish landing sites in Bali, Lombok and Cilacap showed the range of total length of *A. pelagicus* shark that caught by fishermen was between 130-320 cm, but commonly caught sizes ranged from 230-250 cm. While the results of observations in Lombok in 2012, recorded the range of captured sizes is between 130-280, with the average size caught is about 230 cm. *A. pelagicus* is known to reach a body length of up to 365 cm and reaches an adult level at body size of about 240 cm (male) and about 260 cm for female (White *et al*., 2006b). Thus, *A.pelagicus* who was caught by fishermen from the Indian Ocean waters included a group of young - adults. The tendency to catch decrease of *A. pelagicus* in ten years (2002-2011) and also the catch of immature fish, become a threat to the sustainability of shark population in nature. Therefore since 2012, Indonesia has adopted IOTC 10/12 resolution to ban shark fishing from the Alopiidae. However, based on *A. pelagicus* catch data that landed in Cilacap shows a significant increase in the period of 2012-2015.

Observations of *A. pelagicus* in 2014 to 2016 by Simeon *et al.* (2017) which is landed Tanjung Luar show the average size caught with a length of 253 cm. If it refers to Froese (2004), it is known that the 16% distribution of length frequency from *A. pelagicus* is caught under immature conditions, 69% in adult conditions, and 15% in mega spawner conditions. *A. pelagicus* that is caught in size below the length of the first matured gonad (Lm) ranging from 10-20% has a medium-risk level to be over captured. If the capture pressure continues to increase and the proportion of immature fish increases, then this condition will increase the chances of the occurrence of the over capture condition. *A. dominus* dominant caught on size 233 - 303 cm. The proportion of mega spawner *A. pelagicus* is smaller than 20%, indicating that the population is likely to be affected by the capture of mature gonads (Lm). Based on the small proportion of mega spawner, *A. pelagicus* has a higher risk of over captured (Froese 2004).

Shark observations from 2014 to 2016 by Simeon *et al*. (2017) which were landed in Tanjung Luar indicated that the average of captured *A. superciliosus* has a 253 cm length distribution. Referring to Froese (2001), it is known that the 10% frequency distribution of *A. superciliosus is* caught on immature conditions, 55% in mature conditions, and 36% in mega spawner conditions. The type of *A. superciliosus* shark that is caught at a size below 10% Lm, which according to Froese (2004) shows that 90% of sharks are caught having at least once spawning time, resulting in lower risk of catch. Based on the proportion of mega spawner more than 30% indicates that the population of thresher sharks is in good condition with lower risk of catch (Simeon *et al.*, 2017).

Mako sharks (*Isurus* spp.)

Mako sharks consist of two species namely *Isurus paucus* and *I. oxyrinchus*. The spread of this species of shark is known to be very widespread in warm tropical and sub tropical waters (Compagno, 2001). In Indonesian waters, this type of shark was recorded in Indian Ocean waters, ranging from western Sumatra to southern Nusa Tenggara, South China Sea, Makassar Strait, Banda Sea and western Pacific Ocean. *Isurus oxyrinchus* is often caught in tuna longline fisheries as a by-catch or as a target in longshore marine fisheries operating in Indian Ocean coast. The alleged population in nature for this type of shark is still not available due to the migratory of the fish and the absence of accurate data of size and reproduction data. The catch data of these fish species are available both at the regional and national levels in Indonesian fishery statistics.

Isurus oxyrinchus is one of the most common shark species caught as a by-catch product in tuna and pelagic fisheries. In general, the catch result of maco sharks nationally tends to fluctuate, but there is an increase trend in the eight years (2004-2011). The average monthly catch of *I. oxyrinchus* sharks in the southern waters of Java is also relatively low, ranging from 0.2-0.8 tons per month in Cilacap and between 0.05-0.4 tons in Palabuhanratu. From these two sites, it has not shown any significant decrease in catches to these fish species.

Based on research results from 2001 to 2007 at several fish landing sites in Bali, Lombok and Cilacap, the total length range of shark *I. oxyrinchus* that caught by fishermen was between 130-250 cm, with a commonly caught size ranging from 180-210 cm. *I. oxyrinchus* is known to reach a body length of up to 400 cm and reaches an adult level in body length about 185-195 cm (male) and about 250-280 cm for female fish (Last *et al*., 2010). Thus, generally shark species *I. oxyrinchus* that caught by fishermen from the waters of the Indian Ocean is young and mature fish. The catch result of mako shark *I. oxyrinchus* in the period of eight years (2002-2011) was relatively stable even in the period 2011-2015 showed an increasing trend for both types of mako shark (*I.oxyrinchus* and *I.paucus*). In addition, the size of captured mako sharks is generally grown, indicating that the population in nature is still relatively stable because the recruitment process has not been disturbed. The indication of the population decrease of fish resources stock in the waters can be caused by several possibilities such as smaller size of caught fish, changes in catch composition and decreasing of catch.

Based on the landing of sharks in PPS Cilacap, two production trends from mako sharks/ mackerel that are caught in the Indian Ocean are found for species *I. oxyrinchus* and *I.paucus*. The production trend of *I. paucus* continues to increase while the production trend of *I. oxyrincys* tends to decrease in 2014 to 2015. On the other hand *I. paucus* that is landed at Tanjung Luar dominated by an immature shark, while *I. oxyrincus* is dominated by adult shark.

Approximately 60% mackerel shark species I. *paucus* shark caught before mature gonad (<lm) or immature, 36% in mature conditions and 3% in mega spawner conditions. The mackerel sharks are caught under conditions > 50% are caught at a young age and have not had mature gonads at least once spawning. This condition, indicating the utilization has been overcaptured or overfishing. More catches that occur in mackerel shark type *I. paucus* leads to growth overfishing. Growth overfishing occurs when the catch is dominated by small fish or young fish on not efficient growth and harvest size (Diekert 2010; Saputra *et al.*, 2009; Widodo and Suadi 2006). Frequency mode is of 33 Wildlife Conservation Society – Indonesia. Program of mackerel shark catch dominant at a small size of approximately 178.5-198.5 cm length.

Based on the distribution of length frequencies, 16% of mackerel sharks (*I. oxyrinchus*) were caught on immature conditions, 75% under mature conditions, and 9% in mega spawner conditions. Mackerel sharks were caught at Lm below 16%, which according to Froese (2004) showed that 84% of sharks caught had at least once spawn, resulting in lower overfishing risk

Other rays (Mobulidae)

Flat rays have a very important ecological role in the waters. Their role is as filter feeder with main food of zooplankton, kril (small shrimp), and small fish. Through these roles, flat rays hold the balancing of aquatic ecosystems (Deakos *et al.*, 2011). Therefore it is necessary to note the survival of the group. The greatest threat to population decline comes from fishing activities, which are driven by high economic value. This is indicated by a drop in the number of catches by 99% over the last 10-15 years (White *et al.*, 2006). The decrease in catch is inseparable from the increase in fishing activities as targets and by-catch (HTS). Flat rays have a high economic value and all parts of the fish body is worth selling. The body parts of fish that have the highest economic value are gills that are used as health supplements. The meat, cartilage, and skin are traded with a lower value. The increase in the economic value of the flat ray gills has changed the capture paradigm of HTS into a target in the main distribution area.

Mobula rays are commonly caught as a by-catch by gillnet fishing gear with target tuna or large pelagic fish. In WPP 573, there are three main landing locations of family Mobulidae in Lamakera-NTT, Tanjung Luar- East Lombok, and Cilacap-Central Java. In Lamakera, the family Mobulidae is generally caught with a spear. While in Tanjung Luar, although not a major catch target because there is no special fishing gear to capture Mobulidae stingray but become the expected catch. Generally Mobulidae in this area is often caught with tuna gill nets (baby tuna and skipjack) and a surface net commonly used to catch shark bait fish. Mobula rays that are landed in Cilacap also not a target catch, but are occasionally caught with tuna gill nets that operate in the waters of the Indian Ocean South Java. The most common type of mobula stingray in Indonesian waters is the type *M, japanica*. According to White et al. (2006), the Mobulidae Family in Indonesia caught in the drifting gill net fisheries to capture the skipjack was dominated by *M. japanica* (50%), *M. tarapacana* (24%), *Manta birostris* (14%), *M. thurstoni* (9%) and *M. kuhlii* (2%). While the research results of Novianto et al. (2015), in the tuna fishery drift net in the southern waters of Java from November 2013 to December 2014, indicated that *M, japanica* contributed 87%, followed by *M. tarapacana* (10%) and *Manta birostris* (3%). While the results of data collected by enumerators in Cilacap from August 2015 to February 2016, show that the stingray catch is dominated by *Mobula japanica* both for male Mobula (M) and female (F) rays.

The average annual estimation of the mobula catches landed in Lamakera, Tanjung Luar and Cilacap in the period 2001-2014 in the three locations, was drastically decreased. In Lamakera, the catch of mobula stingray that was conducted since 2002 until 2014 decreased by 75%. In Tanjung Luar the mobula stingray decline by 95%. While in Cilacap there was a decrease of catch based on species around 64% for 10 years (Table 18).

Table 18. Estimation of Annual Average of Catch Number Mobulidae Rays Landed In 2001 – 2014

a. Lamakera

	2002-6	2007-12	2013-14	% decrease
Mobulids	930	353	229	-75%
Manta spp.	605	229	149	-75%
Mobula spp.	326	123	80	-75%

b. Tanjung Luar

	2001-5	2007-12	2013-14	% decrease
Mobulids	1,295	1,003	80	-94%
Manta spp.	272	120	14	-95%
Mobula spp.	1,023	883	66	-94%
M. tarapacana	337		3	-99%
M. japanica	518		20	-96%
M. thurstoni	155		39	-75%
M. kuhlii	13		1	-93%

c. Cilacap

	2001-5	2006-13	2014	% decreased
Mobulids	1,059	924	383	-64%
Manta spp.	53		15	-71%
Mobula spp.	1,006		367	-63%
M. tarapacana	212		48	-77%
M. japanica	635		320	-50%
M. thurstoni	106		0	-100%
M. kuhlii	53		0	-100%

The manta rays and mobullas that are landed in these three locations are mostly the catches from East Indian Ocean and West Nusa Tenggara and southern Java waters. In 2001 to 2005 was the highest period in Mobulids rays. Comparison of catches from the 2001-2005 and the 2013-2014 periods shows that drastic decline in Mobula spp landed in three major locations in the WPP 573. Composition of captured Mobulidae Family in Lamakera that were conducted since 2003 consists of 60-70% *Manta spp*. and 30-40% of *Mobula spp*. Most of the fishermen that were interviewed in 2014-2015 reported that the number of mobula stingrays had declined in recent years and there was a decrease in average size. Based on information during the 1980s and 1990s, Lamakera fishermen often caught the mobulid rays in pregnant conditions, and in recent years only about 10% have been caught under condition of pregnant. Recently activity of stingray catch in the village took a long time with the catchment area further up to the waters of south Flores, because mantas and mobula are difficult to catch in the waters around Lamakera. *Mobula tarapacana* is reported as the most widely landed rays species, although the catch of this species has declined significantly in recent years with only about 20 individuals were caught in 2014 (M. Songge, pers.comm.).

At Tanjung Luar, *mobula spp* landing data was recorded daily during the period 2007-2014, and there has been a drastic decrease in *Mobula spp* catch. During the period 2007-2012, there was a decline in catches from all mobula groups. White *et al.* (2006) reported that *Mobula spp* landed in Tanjungluar was a by-catch. While the results of the survey in 2007, this rays group became the main catch target, and in 2010 some fishermen had started targeting the catch of manta rays and mobula. Since 2011, the decrease of stingray mobula in Tanjungluar has started to be felt by fishermen. Based on data collection that was conducted by Simeon *et al.* (2017) in 2014-2016, known that the number of *M. japanica* that being landed in Tanjung Luar has increased from 9 mobulas in 2014, increased to 66 in 2015 and 75 in 2016. Based on the research results in Tanjungluar in 2013 -2014, it was known that the change of catch type composition with *Mobula thurstoni* type has the biggest contribution (49%) of all Mobulids rays catch, followed by *M. japanica* and *M. tarapacana* respectively by 25% and 4%.

Mobulids rays which are landed at Tanjung Luar derive from the catch of gill net and floating longline (Simeon *et al.*, 2017). Meanwhile, Mobulids rays that were landed in Cilacap derived from catches of tuna gill net and tuna longline. In the 2006-2013 period, the total Mobulids rays catch in tuna gillnet fishery in Cilacap reached 665.4 tonnes with an average annual catch of 83.2 tons. The composition of the catch in the period consisted of 93% *M. japanica*, 2% *Manta spp.*, and 5% *Mobula tarapacana*. Based on the analysis of Lewis et al. (in press) comparing Mobula landing data in 2014 with 2001-2005 period data, indicating a decrease in the number of catches for the types of *Mobula japanica* and *M. tarapacana* by 50 and 77%, respectively.

The composition of the catch is dominated by *M. japanica* (both based on amount and weight) almost every month with peak production occurring in November. Then it is proved by *M. tarapacana* and *Manta birostris* with relatively small catch, each between 2-18 mantas and 2-5 mantas per month but occurs only in certain month between May - November for *M.tarapacana* and between June and September for *Manta birostris*. While total Mobula spp. production from catch in the same waters for period 2006-2013 showed fluctuate by month. Overall production began to increase since June-July and then decreased except in 2010 and 2013, the production of mobula stingrays began to decline occurred respectively in August and October.

The capture of mobula spp. in the period 2015 - February 2016 covering the three mobula species (*M. japanica, M.thurstoni, M.tarapacana*) increased in September, then decreased until January 2016 and slightly increased in the following month for *M. japanica* and *M. thurstoni*, while *M.tarapacana* has not been caught since November 2015.

The body width frequency can be used as a parameter to determine the growth of a species of fish (Sparre and Venema, 1999). Based on Mobula stingray catch data in the southern waters of Java in 2014, the male plampangan rays (*M. japanica*) are known to have a wide body range between 101 and 245 cm; while female plampangan rays range between 110 cm and 263 cm. For bluju rays (*Mobula tarapacana*), body widths range from 185 - 294 cm for male and 172 cm - 329 cm for female. Dharmadi *et al*. (2011) revealed in the same location in the period 2001-2006 the size of body width for both male and female rays with the lowest DW frequency was recorded in the size between 100-140 cm for the young group, and between 150-200 cm for the adult group, with frequency the highest body width was found in the size between 200-260 cm with 230 cm mode. Similar results were obtained during the study period of 2014, which found three age groups with a wide body-width mode of 120, 170, and 230 cm, respectively. This shows that the size of the plampangan rays (*M. japanica*) caught in different periods has no effect on the difference in size distribution in the same fishing area.

In addition to the indication of the smaller size of caught fish, the changes in the composition of the catch, and the reduced number of catches, the indication of a decrease in the fish stock population in a waters can also be affected to and decrease of catch per unit effort (CPUE). According to Rosenberg et al. in Farias and Geniz, (1998) the decrease in CPUE can also be indicated by the occurrence of shifting fishing grounds, and such conditions are one indicator of fisheries (Anonymous, 2010). Fluctuations in CPUE values for *M. Japanica* that were landed in Cilacap in 2010 had been reported by Dharmadi *et al.* (2012).

Furthermore Salim *et al.* (2016) reported the composition of Mobulids rays that were landed based on data collection for three months at the port and Muncar fish sales center, obtained three species with a total of 49 rays. The three species are *Manta birostris*, *Mobula japanica*, and *M. thurstoni*. The largest is *Mobula japanica* as much as 49%. Sex of landed mobula about 69% is female.

The disk width distribution of two species of *M. japanica* and *M. thurstoni* shows the variation of DW from *M. japanica* ranged from 120-253, while in *M. thurstoni* ranged from 136-220. Species *M. birostris* found only two individuals with DW 268 cm in females and 420 cm in males. The high number of female individuals that landed in May became an indication of the dominance of female numbers in nature. Based on observations that conducted in May, there were landed female individuals with pregnant conditions. This can be an indication of the presence of a group that enters the birthing phase, because based on White *et al*. (2006) research, most of the lampengan rays perform a reproductive cycle together in one group. Therefore, catching activities in this phase is not recommended because it can reduce the potential of reproduction process.

The growth pattern of *M. japanica* and *M. birostris* based on obtained data during the study is isometric. Weight growth is balanced with DW growth. The growth pattern shows no growth dominance between weight and DW. The pattern is possible because in the early phase of life the lampengan rays have a body shape that similar with the adults (Stevens *et al*., 2000). Assess from the economic aspect, the market demand for lampengan rays tends to be high. This is because Muncar is a processing area of *iwak pe* from lampengan rays. Therefore, the price of lampengan rays tends to be stable and higher than the target fish. The high price causes the tendency of fishermen to catch the fish. Regulation of capture relate with conservation also need to be considered especially in the genus *Mobula sp*. Based on the Decree of the Minister of Marine Affairs and Fisheries Republic of Indonesia Number.4/KEPMEN-KP/2014 are only fully protect manta rays. Under CoP CITES 17, the genus of *Mobula* has put into Appendix II, so the trade will be regulated based on quota. The importance of the ecological function of mobulids rays, causing the existence of lampengan rays need to be considered (Blaber *et al*., 2009). The threat to the sustainability of lampengan rays is derived from inhospitable fishing activities based on biological aspects. Overfishing is triggered by the high economic advantage of the lampengan rays as bycatch.

2.3.3. Habitat Status

There are ten types of shark and ray habitat in Indonesian waters, ranging from freshwater to the deep sea (Table 19). About 60.5% of the habitat from most species of sharks and rays is in continental area (<200 M). On the other hand, there are not many species of sharks and rays in Indonesian ocean. Some of ocean sharks can be found in continental area and their habitats are categorized to be in continental (SHO) or semi-oceanic (SSO). Some carcharinids, sphyrnids and all types of Mobulidae stingray are categorized into this habitat categorization. In Indonesia, the species can be found in eastern Indonesia including the Indian Ocean, the Western Pacific Ocean, Banda Sea, Timor Sea and sometimes in the South China Sea, Sulawesi Sea, Flores Sea, Arafura Sea, Bali Sea, Maluku Sea, Seram Sea and Makassar Strait. Several endemic species are found in Indonesian waters. Endemicity of some species may be restricted in certain areas or in regional areas such as the Western Indo-Pacific region. Most of the endemic sharks are demersal types with limited distribution. For example, two types of bamboo sharks, *Hemiscyllium galei* and *H. henryi* are limited in the waters of Cendrawasih Bay, Papua (Allen and Erdmann, 2008). Other endemic species of the bottle shark, *Squalus hemipinnis*, is allegedly to be found only in deep waters in eastern Indonesia, from southern Java to southern Nusa Tenggara (White *et al.*, 2007). The type of *Carcharhinus hemiodon* is a very rare shark and recorded ever found in Java, Kalimantan and Sulawesi, but has not been found for nearly 30 years (Cavanagh *et al.*, 2003) and was not found during elasmobranch study from 2001 to 2008. Because of its scarcity, *C hemiodon* is categorized as Endangered in the IUCN Red List of threatened species (Cavanagh *et al.*, 2003; Compagno *et al.*, 2005). Type of shark *Glyphis sp.* is a new species of family Carcharhinidae that recorded found in the waters of Sampit Bay, Kalimantan in 2005 (Fahmi and Adrim, 2007, 2009).

Table 19. Type of Habitat of Sharks And Rays In Indonesia Waters Based on Compagno (2002) And Last And Compagno (2002)

Type of habitat	Code
Obligate freshwater	FWO
Oceanic	OCE
Euryhaline freshwater/shelves	SHF
Continental/insular shelves	SHL
Shelf to oceanic	SHO
Shelf to slope	SHS
Continental/ insular slopes	SLO
Slope to oceanic	SOC
Shelf to semi oceanic	SSO
Wide range of habitats	WRH

The diversity of sharks and rays depends on depth, habitat and geographical conditions in the waters (Compagno, 2001). Habitat of shark and ray groups can be found in almost all types of waters (Last & Compagno, 2002). Some species of sharks live on the continent, from tidal areas to a depth of 200 meters, on continental area from a depth of 200 meters to over 2,000 meters. Some species of sharks and rays live in the high seas (oceans) or inhabit various habitats depending on the pattern of adaptation and behavior (Compagno, 2002, Last & Compagno, 2002). In general, the highest shark diversity in Indonesia is found from coastal waters to a depth of 150 m. The area of shelf in Indonesia includes around the islands of Sumatra, Kalimantan and Java, which are part of the Asian continent, while Papua Island is part of the Australian continent. About 51% of sharks in Indonesian waters are found in the continent. This means that most of the sharks are hunted by fishermen to get their fins, and located in these territorial waters. For example, of 31 shark species from the family Carcharhinidae, there are 20 species (64%) found in shelf waters (Table 20). Some species of sharks found in these waters such as *Carcharhinus amblyrhynchos, C. brevipinna, C. falciformis, C. limbatus* and *C. sorrah*.

Table 20. List Species of Sharks And Rays Known to Occur In Indonesia Waters

Family	Species	Type of habitat
Pristidae	*Anoxypristis cuspidata*	SHL
Pristidae	*Pristis pristis*	SHL
Pristidae	*Pristis pectinata*	SHL
Pristidae	*Pristis zijsron*	SHL
Rhinidae	*Rhina ancylostoma*	SHL
Rhynchobatidae	*Platyrhina sinensis*	SHL
Rhynchobatidae	*Rhynchobatus australiae*	SHL
Rhynchobatidae	*Rhynchobatus springeri*	SHL
Rhynchobatidae	*Rhynchobatus sp.1*	SHL
Rhinobatidae	*Glaucostegus thouin*	SHL
Rhinobatidae	*Glaucostegus typus*	SHL
Rhinobatidae	*Rhinobatos jimbaranensis*	SHL
Rhinobatidae	*Rhinobatos penggali*	SHL
Rhinobatidae	*Rhinobatos schlegeli*	SHL
Rhinobatidae	*Aptychothrema sp.*	SHL
Hypnidae	*Hypnos monopterygium*	SHL
Narcinidae	*Narcine brunnea*	SHL
Narcinidae	*Narcine indica*	SHL
Narcinidae	*Narcine maculata*	SHL
Narcinidae	*Narcine prodorsalis*	SHL
Narcinidae	*Narcine timlei*	SHL
Narcinidae	*Narke dipterygia*	SHL
Narcinidae	*Narcine sp.D*	SHL
Torpedinidae	*Torpedo nobiliana*	SHL
Hexatrygonidae	*Hexatrygon bickelii*	SLO
Plesiobatidae	*Plesiobatis daviesi*	SLO
Plesiobatidae	*Plesiobatis sp.*	SLO
Rajidae	*Bathyraja andriashevi*	SLO
Rajidae	*Bathyraja tzinovskii*	SLO
Rajidae	*Fenestraja sibogae*	SHS

Family	Species	Type of habitat
Rajidae	*Raja annandalei*	SLO
Rajidae	*Dipturus sp.*	SHS
Rajidae	*Dipturus johannisdavisi*	SHS
Rajidae	*Okemajei boesemani*	SHL
Rajidae	*Okemajei cf powelii*	SHS
Rajidae	*Okemajei cairae*	SHS
Anacanthobatidae	*Anacanthobatis borneensis*	SLO
Anacanthobatidae	*Anacanthobatis (Sinobatis)*	SLO
Urolophidae	*Bulbicauda*	SHL
Urolophidae	*Urolophus javanicus*	SHL
Urolophidae	*Urolopus kainanus*	SHL
Urolophidae	*Urotrygon sp.1*	SHL
Dasyatidae	*Trygonoptera sp.1*	SHL
Dasyatidae	*Taeniura lymna*	SHL
Dasyatidae	*Taeniurops meyeni*	SHL
Dasyatidae	*Dasyatis akajei*	SHL
Dasyatidae	*Dasyatis fluviorum*	SHL
Dasyatidae	*Dasyatis parvonigra*	SHL
Dasyatidae	*Dasyatis microps*	SHL
Dasyatidae	*Dasyatis zugei*	SHL
	Dasyatis ushiei	
	Neotrygon kuhlii	*SHL*

In its protection efforts, it is currently identified that several waters in Indonesia are critical habitat for several types of sharks and rays. Lunyuk Bay on Sumbawa Island, West Nusa Tenggara was identified as a care area for several types of sharks and rays, especially *S. lini* (Simeon *et al*., 2017). Some sharks are found to have an enlargement area from coastal waters to coastal waters. This is intended to protect the saplings from predators (Haupel *et al.*, 2007). Lunyuk is presently part of the Marine Protected Area area, so protection of young sharks is very possible.

2.3.4. Benefits and Value of Threatened Species

The existence of whale sharks that tend to settle in several waters locations in Indonesia can be developed into ecotourism whale sharks. Utilization of whale shark as a tourist attraction proved very successful as well as one form of ecotourism promotion efforts. The utilization of whale sharks for ecotourism has ecological, economic, educational and developmental impacts. The positive impacts of ecotourism on whale sharks from the economic side are evidenced by several researchers in the following countries and in Indonesia (Table 21).

Table 21. Economic Value of Whale Shark Ecotourism

Country	Economic Value	Source
Seychelles, Meksiko	4,99 million	Rowat and Engelhardt (2007)
South Africa	South Africa US$ 1,7 million	Dicken and Hoskings (2009)
South Africa	US$ 4,2 million	Hara *et al*. (2003)
West Australia	US$ 5,5 million	Catlin *et al.* (2005)
Indonesia	170-329 billion rupiah/year	Prabuning *et al*. (2015)

Although there are still many fishermen who rely on shark and ray fishing for their livelihoods, in some areas of Indonesia (including Raja Ampat, Bali and Komodo) the community is now aware about the benefit that healthy sharks and rays population could give them through ecotourism (Dharmadi *et al.*, 2015). For example, a single manta ray can produce US$ 1 million throughout their life span as a tourism asset, this value far greater than the value of the sale of meat and gills, which is around US$ 40-200 (O 'Malley *et al.*, 2013). This awareness has further shown in Raja Ampat, where manta ray and sharks are considered to be the main attraction for tourists. A conserved 1.220 square kilometer conservation zone has been established in the region and some of the local people, once involved in shark finning were hired as park guards.

The study of manta-based tourism at the global level, conducted by WildAid, Shark Savers and Manta Trust, has shown that Indonesia has the second largest manta tourism in the world, with an estimated economic profit of over US $ 15 million per year (O'Malley *et al.*, 2013). This benefit strongly supports the need to preserve this species, and the establishment of a full protection status will prevent the development of excessive use of shark and ray resources. Prabuning *et al.* (2015) reported that the diving and snorkeling tourism business to see sharks and manta rays in Labuan Bajo, East Nusa Tenggara has become an income for the local community, which can contribute Rp 170-329 billion in annual cash per year. Income from this business is estimated to reach Rp 3 billion/year with employee income in the company ranging from 17 million to 290 million/year. The ratio of local and foreign employees at the management level is 50-50%. Willingness to pay additional fees for protection of sharks and manta rays has the potential to raise funds up to 1.2 billion rupiah. Tourism based on sharks and mantas is an asset that can improve the welfare of local communities. Ecotourism-based activities on manta and shark can be applied elsewhere where sharks and manta rays and environmental conditions are appropriate and adequate.

Studies on the economic valuation of whale sharks, whale shark tourism, and marine conservation areas for whale shark habitats have been widely practiced. Some of these studies were conducted to calculate the ecotourism value of whale sharks (Cesar, 2004; Soliman, 2004; Norman, 2005; Padilla, 2005; Norman and Caitlin, 2007; Catlin, 2010; Cisneros, 2013; Cagua, 2014). Most research results indicate that the value of whale sharks lives in nature, and the value of environmental services from tourism, is greater than the value if captured and consumed. The implications of the importance of the economic value of whale shark tourism is the need to appreciate the value of whale sharks as well as their habitats, by managing and developing conservation areas, and capacity building for community to understand the importance of whale sharks and their conservation (Zuzy and Saputra, 2017).

During its lifetime, a manta ray can earn up to one million US dollars as an asset to the tourism sector, while the value of meat and its gills is between 40 to 200 US dollars for a fisherman (Eriksson, 2016). It is further reported that in the area of Nusa Penida, the majority of fishermen have many possibilities to engage in tourism business and therefore their economic situation has increased since the implementation of marine conservation area development. People's livelihoods from fishing activities have been sharply reduced, especially among the younger generation, due to the economic benefits of manta rays-based tourism.

If culturally we do not see the significant value of sharks and rays, from an economic perspective it is obviously worth. In fact, the long history of shark and ray capture, thousands of years according to Tull (2014), source from the economic motive, namely the need for the fulfillment of household needs for the intake of animal protein or income. For the two motives, the need for income is a stronger motive that encourages the intensity of shark capture. Historical records of shark and ray fisheries in Indonesia, mainly sharks, suggest that a significant increase in exploitation is driven by an increase in demand for shark fins in the international market, particularly countries with Chinese populations such as China (Tull 2014).

Response to international market demand stimulates Indonesian fishermen to develop the catching of sharks and rays as their livelihood strategy. In addition to reasons for increased demand, there are several other reasons that stimulate the development of shark fishing as livelihood stategy fishermen. Fox *et al*. (2009), for example, shows that the increase in fishermen who catch sharks in eastern Indonesia is driven by the drastic decline of other fish catches that had been the main target of fishermen in that area. One real example of this reason is the shift of fishermen in the village of Bajo Rote islands from catching sea cucumbers to shark fishing. In their paper, it was pointed out that in the 1990s, as demand for shark fin increase along with the improvement of the economic conditions of people in China which also coincided with the decline of catchments of sea cucumbers, has pushed almost all Bajo fishermen on Rote Island to change their ships and fishing gear from a sailboat without a machine to a slim body boat. They also changed the techniques and fishing gear from divers or gealing for sea cucumbers into longline use for sharks. Of course not all shark and ray fishermen are 'new' players who move from other fisheries as exemplified above. In some places, shark and ray fishermen are communities that have traditionally been fishermen with specialization of sharks and rays. Unlike shifting fishermen which means having a deep knowledge of the other fisheries, the hereditary fishermen are fishermen whose knowledge and skills focus on sharks and rays.

The development of shark and ray fisheries with the above reasons has brought certain social consequences. As well as the socio-economic character of fishermen in general, shark and ray fishermen have become part of patron-client relations. In this relationship, the fisherman becomes a patron whose life depends on his patron. In general, patron is a supplier of tools and production costs of a fishery business and also a catcher that will then sell the catch to the marketing chain above it. The patron is usually also a protector or the party requested assistance when the fishermen get social and economic difficulties in their household. This kind of relationship is also usually characterized by an unbanked debt relation between them, the fisherman usually being the party who owed to his patron.

The fisherman's dependence on his patron, not only for the production and distribution (marketing) of the catch but also the consumption and other needs of his household, has resulted in the loss of fishermen's control over his fishing business. Often, whether or not the fishermen go to the sea, what kind of fishing gear that is used, where and how long they go, is determined by their patrons. In this context patrons become very important in their position to be considered in efforts to improve fisheries management including conservation.

If the explanation above put the economic value and its social economic implications in terms of fishermen or production, we can also see the value of shark and ray fisheries from the other part of this sector ie consumption. In this case we are talking about the demand that also related to the culture of how people perceive sharks and rays as food, jewelry and other uses. As a food, Chinese culture associates shark fin as a high value food both because of its usefulness as a source of aphrodisiac and because of its consuming prestige. Chinese culture also associates the gills of plampangan rays (Devil Ray) as a consumption ingredient for health. Prevalence of shark meat is also found in Chinese, European and American cultures. Although shark meat is not a prestigious food, the demand from these countries shows that their culture does not forbid shark meat. In Indonesia, shark meat is also consumed although not the favorite fish. The people of Lombok, North Coast of Java, West Java and Aceh are shark meat eaters. In addition to its gills, stingrays are also consumed both in Indonesia and in exports. From Semarang, one businessman, for example, exports about a ton of fresh stingrays to Singapore and Malaysia. That means, the communities of both countries are culturally consider stingrays as consumable fish.

Three notes can be given to briefly describe the important value of shark and ray fisheries in a socio-cultural and economic context. First, shark and ray fishery is an important business for fishermen because of their economic dependency. This dependence is not only created because (1) traditionally, the fishermen are shark and ray fishermen, meaning that their cultural knowledge and social practices are based on shark and ray fisheries from generation to generation, (2) the limitations of the main target fish populations so that they must change the catch targets, and (3) increased market demand for sharks and rays. This suggests that the conditions and access to shark and ray resources as well as the dynamics of international market demand will significantly affect the economic condition of fishermen. Second, the long history of shark and ray fishery has made this sector an integral part of the socio-economic system of its community. Therefore the conditions and access to shark and ray resources will also affect the socio-cultural system of communities that traditionally focus on this fishery. Third, patron-client relationships in the socio-economic relationships between fishermen and their suppliers as well as their suppliers of production tools and capital, their marketing and social support agents, require patron engagement in efforts to improve the management of shark and ray fisheries.

2.3.5. Gaps and Challenge

There are still found gaps in the management of sharks and rays, especially in terms of capture and marketing chain systems. Sharks and rays are a major source of livelihood in some parts of Indonesia because of their high economic value products, such as fin, leather, gills, oil plus the high demand of shark fins in the international market. However, the marketing chain of sharks tends to be long and complex, making it difficult to develop a traceability system to trace the origin of caught sharks (NDFs). The right way to simplify the marketing chain needs to be developed. The high and uncontrolled pressure and exploitation of sharks and rays will have an impact on the extinction of their resources. Overfishing can cause problems, because unlike other real fish (teleostei), cartilaginous fish such as sharks have low fecundity. If overexploited, sharks have a higher risk of extinction than other fish groups. Thus, shark populations can only be protected by administering shark fisheries including safeguards to avoid declining resource stocks and population recovery (Camhi *et al.*, 1998; Musick, 2003; Cortes, 2000). In some areas of Indonesia, sharks are the main source of livelihood for local communities. Although shark resources can be renewed, if we do not utilize these resources carefully and wisely, they will become endangered.

In the future shark and ray management will face challenges in tracking the origin of products, determining the protection of critical habitats, and providing technology to reduce to eliminate by-catch.

High Rate of Shark Consumption in Big City Without Traceability of the Origin Product

WWF Indonesia (2015) reported that 71% of fishermen have no preference for sharks as target species in their operations. Only large tonnage vessels (> 10 GT) specifically hunt shark species. Nevertheless 91% of fishermen have ever acquired sharks in their operations as bycatch. Fishermen generally utilize all parts of sharks for sale. All parts of the shark are then sold separately by collectors to be marketed as needed. Shark fins are marketed in dry form, while shark meat is generally marketed in fresh form. Most fishermen do not utilize shark catches to fulfill their household needs. Shark catches typically come from ships with low tonnage that often can not cover operational costs. The biggest economic gained in shark trading is collecting. The total estimated purchase and purchase of shark fin by collectors reached IDR 2 billion every month, while for fresh meat reach IDR 40 million per month. In big cities, raw materials for cooking made from sharks come from fins, meat, lips, head, and shark bone. But in general the restaurant uses fins as the main raw material and most consumers do not know the species of sharks.

Limited data and information of sharks and rays

Many international environmental and conservation organizations are concerned about shark fisheries in our country, and even Indonesia is under pressure to manage shark fisheries properly or to ban its export of fishery products. The biggest challenge for shark and ray fisheries in Indonesia is how to design a sustainable shark fisheries management model that will ensure the sustainability of this marine resource so that it can be enjoyed by future generations. However, insufficient data and information on the potential biodiversity, biology, and level of shark exploitation in Indonesia serve as a rational basis for sustainable shark fisheries management strategies. Seki *et al.* (1998) and Stevens *et al.* (2000) suggest that basic biological information about elasmobranch (sharks and rays), such as species identification, size composition, gonad / sex and reproduction, is essential for the management of shark and ray resources.

The data collection of shark fisheries by species has proven to be difficult in Indonesia for various reasons, including the lack of field officers ability to identify various types of landing sharks (more than 100 species). Most landing sites need to be monitored (over 1,000 locations), the fact that many sharks are not landed intact, making it difficult to identify. In addition, shark catches are often not adequately recorded at small fish landing sites, adding to the difficulty of obtaining sufficiently accurate data. Fahmi and Dharmadi (2015) illustrate the problem of double counting, where individual sharks were recorded on landing and recorded also in the transhipment process. The Directorate General of Capture Fisheries-MMAF has recently reformed the format of national fisheries statistics to include shark species, such as *Alopias spp.* And hammerhead sharks (*Sphyrna spp.*), a positive development in fishery statistics. However, there is an urgent need to conduct type identification training in shark and ray data collection for fisheries officers in the field across the region, by providing an understanding of the importance of accurate data collection for their fisheries management policy materials.

<u>The low protection of critical habitats</u>

In general, shark and ray production in Indonesia based on national fisheries statistics shows an increase in the last decade (2005-2014). Production of sharks of 43.306 tons in 2005 increased to 49,020 tons in 2014 (12%) and ray production of 56,731 tons in 2005 increased to 70447 tons in 2014 (19%) (DGCF, 2015). However, some groups of shark production declined dramatically in some fisheries management areas, for example in FMAs 571-573. The decline is believed to be due not only to offshore fishing that is overly intensive, but also reduces the recruitment and reproduction potential of the reproduction caused by the catching of young sharks and in pregnant conditions. Prince (2005) notes that, given its biological nature, the risk to population in shark fisheries will decline sharply. The protection of long-lived adult sharks is the first step in managing shark fishery in sustainability. However, the immature and mature size sharks (mature genital or pregnant), in the long time may result in a decrease in catch and income volume for fishing communities. This is a difficult decision for the government to control fishing in this region, due to the considerable economic impacts on fishing communities. The government is obliged to ensure that resources will not be exhausted and can continue to benefit local communities in the long term. Thus, it is important to find a balance between the interests of people who exploit sharks in coastal areas and the need to protect these parts of coastal areas as care areas. To achieve this, accurate data on appropriate care sites for different shark species are required. This location should then be declared a conservation zone or shark sanctuary, while fishing communities can still utilize resources in other coastal areas. In addition to the direct effects of shark fishing, destruction of shark habitats can be caused by illegal use of fishing methods, such as explosives, chemicals (eg potassium cyanide), and banned trawlers in Indonesian waters. This is necessary so that these practices are restricted. The Government of Indonesia should take a prudent approach not only to the management of sharks and manta rays but also to fishing for other species now included in CITES Appendix II. Currently, shark fin fishery and trade remains one of the main challenges in wildlife conservation in Indonesia. Tackling this problem is not easy, because it involves environmental, economic, social, political, cultural and conservation issues. Moreover, as long as there are buyers who are actively trying to buy fins, the exploitation of shark and ray resources will continue. Addressing these issues will require a holistic approach, including strengthening law enforcement in the field and in the importing country.

Young sharks are usually found in coastal waters, which is usually an intensive fishing area for artisanal fisheries (Fahmi and Dharmadi 2013). Stricter policies are needed to regulate the utilization of fish resources, especially young sharks in coastal waters, taking into account the value of these resources to local communities. In addition, the type of fishing gear used by fishermen is generally not selective, so many young sharks are caught as a by product. Building knowledge and awareness among fishermen about the importance of releasing young and pregnant sharks is essential for the sustainability of its resources and will have a positive impact on the livelihoods of sustainable fishing communities. However, circumspection should be taken in the development of long-life shark fisheries management, avoiding the catch of young sharks and protecting adult shark breeding areas.

Efforts to encourage protection of shark populations have not yet been pursued holistically. The current shark management priority refers to the regulation of inputs and control outputs in the fishery and trade sectors of its species. Conservation efforts, however, in ensuring their critical habitat has not been maintained so far. Limited information on critical habitat becomes one of the challenges. However, nursery habitat protection efforts have been initiated by the Government and Partner Institutions.

At least there is a Conservation area that is being encouraged to strengthen its management in adopting important shark habitats such as Cendrawasih Bay National Park, Wakatobi National Park, Komodo National Park, East Flores SAP Reservation, KKPD, Nusa Penida, Raja Ampat Regency. Other areas that have not include in Conservation areas are Taliyasan Waters and Gorontalo Waters for whale shark protection.

<u>Limited Mitigation Technology to Reduce Bycatch Sharks</u>

As has been known, bycatch is one of the biggest threats in the decline of shark populations in recent decades. Zaenudin (2011) stated that 72% of caught sharks are by-products. In reducing shark bycatch can be done in various ways, one of them through developing mitigation technology to reduce shark bycatch. The productivity of the fishery sector has its own portion in the business industry in Indonesia. Various fishing gear is modified and designed in such a way as to be more efficient in catching target fish. One of the most widely used fishing gears, is in tuna fishing is the longline tuna. In recent years, the use of longlines is of concern. The reason is that the use of longlines not only captures tuna, but also by-catch species, especially sharks.

III
Issues and Threats

3.1. SEA TURTLES

3.1.1. By-Catch

Turtles have a place to live and find food in waters which is also a fishing ground. This intersection region causes the turtle to be caught unintentionally in fishing activities as shown in Figure 25.

Figure 25. Bycatch Distribution In Several Waters In Indonesia (Source: WWF Indonesia, modified).

Bycatch turtles are occured by small scale and industrial scale fishing activities. Industrial scale fishing is usually occured by longline vessel. Bycatch collection by vessel with longline fishing equipment was conducted by WWF Indonesia from 2006 to 2013. The data collection was done in Benoa Port (Bali) and Bitung Port (North Sulawesi). Most of the turtles caught by the Indonesian tuna longline fleet were olive ridley turtles (78.1% or 490 turtles with hook rate: 0.0572) and followed by green turtles (7.8% or 49 turtles with hook rate: 0.0057), hawksbill turtle (5.3% or 33 turtles with hook rate: 0.0039), loggerhead turtles (5.3% or 33 turtles with hook rate: 0.0039), leatherback turtles (1.9% or 12 turtles with hook rate: 0.0014), and flat turtles (1.6% or 10 turtles with hook rate: 0.0012). The distribution of turtle bycatch by fishing activity using longline is shown in Figure 26 .

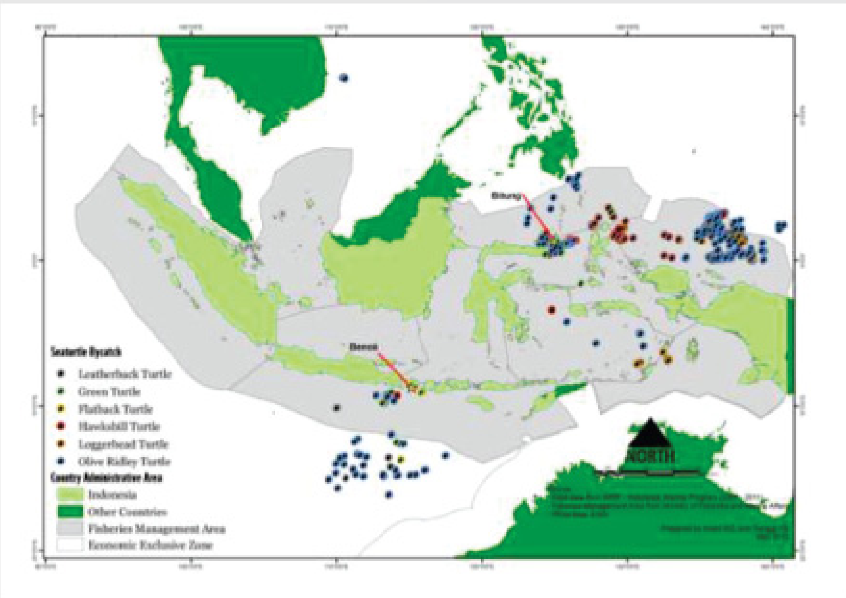


Figure 26. Locations of Turtles Captured by Tuna Longline as Results of Observation During 2006-2014

Based on the maturity level of each type of turtle as measured by carapace curve length (CCL), 95.1% of the captured turtles in the tuna longline fishing gear are still in the juvenile sub adult category and only about 4.9% that have entered adult age.

In addition to bycatch by industrial scale fishing, bycatch is also occured due to small-scale fishing gear. Until now information of baycatch due to small scale fishing gear is still limited. However, threats to bycatch tend to be high, especially in the capture area around turtle nesting habitats. Some of the information has been documented such as in Sulawesi, Paloh (West Kalimantan) and West Nusa Tenggara.

Based on the results of WWF Indonesia documentation since 2003 in 13 regencies/cities namely 10 regencies/cities in Southeast Sulawesi Province, 2 regencies in South Sulawesi Province and 1 regency in Central Sulawesi Province concluded that the dominant turtle bycatch was occurred in waters of Morowali, Konawe and Selayar with bycatch turtle size per unit of vessel each year ranges from 20-30 individuals/unit/year. The most fishing gear that catch turtles as bycatch in many places are purse seines, basic gill nets and sero.

A preliminary study of by catch is conducted in 9 fish landing sites in West Kalimantan. From 304 respondents only 206 mentioned the types of caught turtles. The types of turtles that caught unintentionally by the respondents are the species of hawksbill turtles, green turtles, leatherback turtles, olive ridley turtles, flat turtles and loggerhead turtles (Figure 27). Based on the 206 respondents mentioned that 41.75% of the species of caught turtles were hawksbill, 28.6% green turtles, 19.9% olive ridley turtles, 6.8% loggerhead turtles, 2.43% flat turtles and 0.49% leatherback turtles

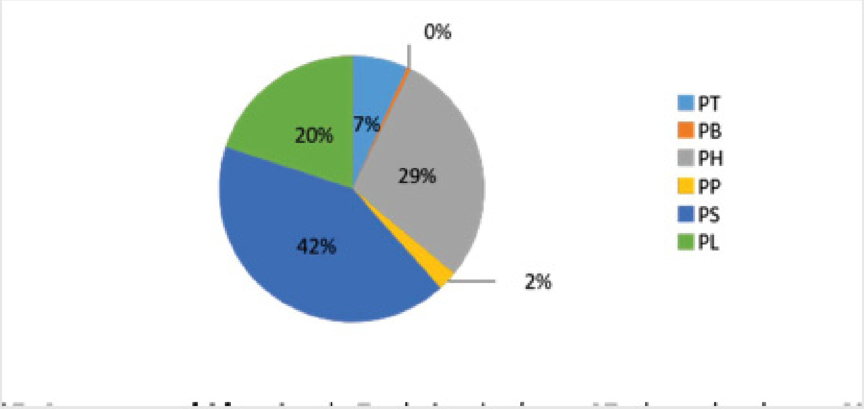


Figure 27. Percentage of Often Caught Turtle Species (note: PT = loggerhead turte, PH = Green turtle, PS = hawksbill turtle and PL = olive ridley turtle).

The captured area of rare, endangered and protected biota in the waters of Paloh, Sambas Regency, was many occured in the region of Tanjung Kemuning to Temajuk. The concentration of fishing by fishermen tends to be closer to the coast, where the targets are white pomfret and black pomfret as the main catch. Result of coordinate data collection at the time of fishing activities observation, where the used coordinate are coordinates from the captured of rare, threatened and endangered (ETP) biota, is presented in Figure 28.

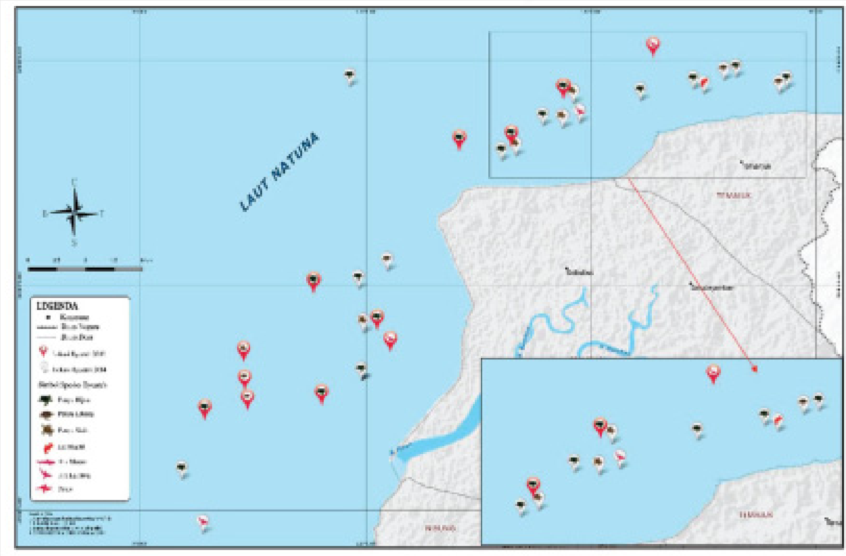


Figure 28. Captured Area of ETP Biota In Waters of Paloh, Sambas Regency 2014 – 2015

Information related with bycatch was determined in West Nusa Tenggara Province. The locations are directly linked to the migration path of green turtles and lekang turtles. The track is known in the northern parts of Lombok and Sumbawa and Atlas Straits. Based on the apparent frequency of ETP animals below, it shows that in all fishing locations, turtles with the highest encountered are found around waters of Kenawa and Paserang Island (Figure 19). Composition of identified turtles in survey location consist of three types of turtles with captured composition in the last one year (2014) were hawksbill turtles (52.084%), green turtle (46.88%) and lekang turtle (1.04%) .

The average bycatch of ETP biota in each location based on fishing gear is known as the largest bycatch potential is noted in Merpak Village - Central Lombok (Table 22) where at least of 747 turtles/year were recorded. Based on the ETP biota bycatch analysis and fishing gear that occurred in the last 1 year it is known that the utilization of the Float Gillnet and the Permanent Gill Net have the highest bycatch interaction (Table 23).

Table 22. Estimation Number of Bycatch ETP per Fishing Gear

Location	Fishing Gear	Average turtle bycatch /year
Lunyuk (Sumbawa)	Gillnet	105
	Drifting Longline	1.67
	Bottom longline	-
Labuhan lalar (West Sumbawa)	Drifting Gillnet	49.5
Pototano (West Sumbawa)	Bottom longline	75
Hu'u (Dompu)	Fixed Gill Net	33.6
Rompo (bima)	Drifting Gill Net	180
Merpak(Central Lombok)	Drifting Gill Net	81.11
	Fixed Gill Net	539.84
	Bottom longline	118.33
	Drifting Longline	7.50

Tabel 23. Prosentase Bycatch ETP per Fishing Gear

Fishing Gear	Green Turtle (%)	Hawksbill Turtle (%)	Olive Ridley Turtle (%)
Drifting Gill Net	51.11	38.00	100.00
Fixed Gill Net	28.89	36.00	-
Circle Gill Net	2.22	-	-
Purse Seine	6.67	-	-
Drifting Longline	4.44	16.00	-
Bottom Longline	6.67	10.00	-

3.1.2. Pollution (e.g. oil & gas exploration, etc.)

The rapid development of the world in the use of chemicals can pollute the aquatic ecosystem. The contamination directly or indirectly affects aquatic ecosystems that negatively impact the existence of sea turtles. According to Chilvers *et al.* (2005), oceanic pollutants are often found such as herbicides, pesticides and toxins or other pathogenic viruses. Environmental pollutants including heavy metals and organochlorine pesticides have been identified in the blood and tissues of various turtle populations, and are associated with negative effects on immune function and other health parameters.

Several cases have been occurred in Indonesia, for example in Bali. In a report prepared by Dio (2016), post-mortem examination of stranded turtles in Singaraja Bali, it was found that there were pollutants in the form of toxins/potas that damage the digestive tract of the turtle body. This was allegedly due to the use of toxins for local fishing activities.

From the few cases of turtles that have been reported to be stranded both dead and alive in Indonesia, demanded some veterinary scientist to analyze the cause of the incident. At least during the year 2009-2017 there were 37 stranded turtles (Table 24), which most events were found on Bali Island.

Tabel 24 . Stranded Incident of Sea Turtles In Indonesia (Dio, 2017)

Location	Year	Species				Status		Total
		cm	dm	ei	lo	M	H	
Singaraja	2017	X					X	1
	2016	X				X		1
Jembrana	2017	X			X*	X*	X	2
	2016				x	X		1
Nusa Penida	2016	X					X	1
Tabanan	2014	X				X		1
Bima	2012		x				X	1
Flores	2017		x				X	1
	2016			X		X		1
Maratua	2014			X		X		1
Balikpapan	2016	X					X	1
Kutai	2016	X				X		1
Derawan	2017	X				X		1
Polman Sulbar	2017	X				X		3
	2016	X				X		2

Location	Year	Species				Status		Total
		cm	dm	ei	lo	M	H	
	2013	x				X		1
Pinrang	2010	x					X	1
Minahasa	2016		x	x		X		2
Sulut	2017				x		X	1
Banyuasin	2016	x					X	1
Jogja	2009		x		x		X	2
	2012		x			X		1
	2015	x				X		1
	2016				x	X		1
Cilacap	2010	x				X		1
Kebumen	2017				x		X	1
Probololinggo	2017	x					X	1
Pontianak	2014	x					X	1
Pangandaran	2017		x			X		1
Merak	2017	x				X		1
Kaimana	2011		x			X		1
Total Incident of Stranded Turtle								**37**

3.1.3. Climate Change

The threat to turtle conservation is not only caused by human activities (turtle egg trade and adult turtle catching), but can also be caused by factors outside of human control, such as global climate change. Some of the impacts of climate change that can threaten the sustainability of turtles are:

1) Increasing of turtle nest temperature causes a change in the genital composition of hatched turtle.

2) Sea level rise causes turtle nests soaked in sea water that can bring damage of sea turtle eggs

3) Extreme weather and changes in current patterns may cause damage to nesting habitat, and

4) The symptoms of ocean acidification will affect the food chain in the sea.

Information on the changes in the sea turtle genital composition due to the temperature of turtle egg nest in Indonesia is not widely known. In 2005 and 2010, the WWF Indonesian Program had conducted research with the aim to identify the sex ratio of green turtle (*Chelonia mydas*) and leatherback turtle (*Dermochelys coriacea*) produced at Sukamade Beach - East Java; Sangalaki Island - East Kalimantan and Jamursba Medi Beach - West Papua. From this study it was known that the sex ratio of each area was unbalanced or dominated by a certain sex. In Sukamade beach was produced 75% male hatchlings in the nest below the vegetation, 100% female in the nest on the open beach, and 87.5% of males in the hatching nest. Whereas in Sangalaki was produced sex ratio of 100% male hatchlings in the nest below the vegetation, 72.22% males in the nest on the open beach and 94.44% males in the hatching nest. In the Jamursba Medi Beach was produced 90.9% male from open nests.

Based on correlation analysis showed a very strong relationship between sex ratio with incubation temperature with significance of 0.01 and correlation coefficient of 0.995. This means that environmental factors (climate change and vegetation damage) can affect air temperature and nest temperature, thus affecting the turtle egg nest incubation process that can affect the formation of gender bias (unbalanced).

3.1.4. Marine Debris

Marine debris and ghost net is one of five major pollutans in the world (Anzecc, 1995). The issue of concern over the impact of marine debris has evolved in a number of international studies and conferences. Only little information about marine debris data in Indonesian waters.

All types of potential marine debris can bring negative impact to the presence of turtles, plastic is the most common example found in coastal around the world. According to Coe and Rogers (1987) and UNEP (2005) estimated plastics dominate the potential of marine debris with about 50-90%. Plastic waste, including fishing gear (long line) is one of the most dangerous marine debris for marine animals (Chatto, 1995; Laist, 1997). It is estimated that over one million birds and 100,000 marine mammals and sea turtles have been died each year from entangled in nets, or by consuming plastics (Laist, 1997). Recent studies of plastic contamination to aquatic megafauna suggest that plastic particles/fibers are found in the digestive tract of *Mesoplodon mirus* whale in Ireland (Lusher et al., 2015).

Marine biotas that tend to eat floating organisms are more potentially to be exposed to ghost net in the oceans. Large fishing vessels with net fishing gears have the potential to leave their nets in Indonesian waters, this condition can add large amounts of plastic waste in

Indonesian waters. This will definitely provide a serious threat to sea turtles in Indonesian waters.

Information from UNHAS and UC Davis on plastic contaminants reported in 2014 revealed that fish and consumption bivalves have ingested plastic particles (Tahir and Rochman, 2014; Rochman et al., 2015). Clark et al. (2016) has conducted depth study of microplastic interactions and food algae (prey items) and other organisms in the food chain structure. Ory *et al*. (2017) on the flying fish eat plastic that resemble with copepods. Clark *et al*. (2016) has conducted depth study of microplastic interactions and food algae (prey items) and other organisms in the food chain structure, the presence of micro and nano plastic particles in the copepod digestive tract (Clark *et al*., 2016) and oyster larvae (Cole *et al*., 2014) whereas according to Jambeck *et al*. (2015) and Clark *et al*. (2016) states that the number of plastic particles in the oceans has exceeded the number of phytoplankton.

3.1.5. Irresponsible Tourism

Sea turtle tourism activities wrapped in ecotourism are currently carried out in several nesting beaches in Indonesia. The purpose of turtle ecoutourism is to provide education and encourage people to work together to protect turtles from the threat of population decline. However, turtle tourism to the community has the potential to become a problem if it is not carried out according to the concept of responsible tourism. Sometimes tourism managers take advantage of the release of hatchlings in certain moments, resulting some delays in releasing hatchlings. It is known that hatchlings have a limited amount of food reserves that are used to survive early stages in the open sea. Another practice is the release of hatchlings during the day or when predators of turtles or hatchlings are actively foraging. Another thing that often happens is when the release of hatchlings continues, tourists often touch and play hatchlings before being released.

3.1.6. Illegal Trade

Currently, trade of turtle egg in large quantities can still be found in South Kalimantan. Existing data indicate that there are at least 10 open trading turtle spots that take place throughout the day in the region of Banjarmasin and Kotabaru, even the local government of Kotabaru still give concessions permit to sea turtle eggs.

In addition to South Kalimantan, Bangka Belitung Province also still trade turtle eggs in the western region of Indonesia. The traded sea turtle eggs come from nesting beaches in several small islands in Bangka, for example Dua Island and Klasa Island. The majority of traded turtles in Bangka are green turtles and Hawksbill turtles, with a selling price of IDR. 3,000 - 5,000 per egg. The location of trade is spread out in Bangka, one of the largest trade is in Kurau Village PA Lempat Village which occur in every turtle nesting season starting from May until the end of August.

To meet the demand of the Balinese people in order to complement the needs of religious ceremonies, this has resulted in the demand for turtles which eventually became the largest market of turtle trade in Indonesia. According to WWF and IUCN (1984) data, green turtles were collected throughout Indonesia to meet demand in Bali. From 1969-1999 at least 30,000 green turtles were traded in Bali annually. In the case of trade in Indonesia, in 2002 revealed the green turtle trade in Tanjung Benoa -Bali, mostly from Aru (Enu) nesting beaches with a percentage of 24%. While information from Akira and Adnyana (2012) mentions a green turtle trade in the traditional market "Teluk Kempi Bima". A total of 35 individual turtles were analyzed for their origin and most of them were from Nortwescape (28.77%) and Sangalaki (22.34%).

In the last year, this issue was still occured, as evidenced by the arrest of illegal exporters of turtles from East Java and Central Sulawesi to Bali, at least in 2016 as many as eight times arrested by Polair/Law enforcers are occurred, with the number of turtles 175 individuals (Dio, 2017). Furthermore Dio *et al.* (2017) conducted a genetic search (Forensic DNA), of which 136 were able to be analyzed. It shows that the traded green turtle in Bali Island came from Berau East Kalimantan with percentage of 61.95% (Figure 29).

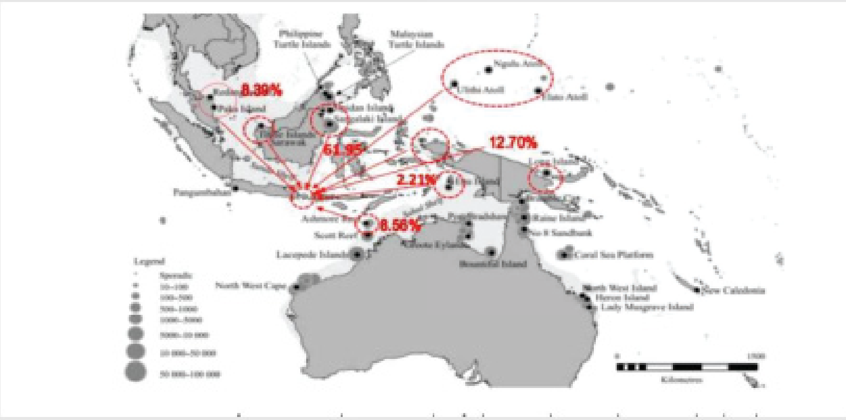


Figure 29 . Proportion of Green Turtles as Result of Thwarted Smuggling in Bali Island During 2015 – 2016

In addition to Bali Island illegal turtle trade is also occured in Kei Kecil and Saumlaki, Southeast Maluku. In some cases, trade of meat, carapaces and turtle eggs are still a major commodity in traditional markets. In other Maluku areas such as Buru Island also engage illegal trading of turtles, eggs and carapace.

The turtle eggs hunting are also still happened in almost all turtle nesting beach in Indonesia. Through routine monitoring activities that conducted in several turtle nesting beaches proved to be quite effective in reducing the rate of turtle egg hunting.

3.1.7. Poaching

Poaching of adult turtles for trading purposes are still occurs in some areas of Indonesia. This poaching is done by local fishermen and some by foreign fishermen. The catching of sea turtles by local fishermen is generally intended for domestic trade and consumption, while turtles that caught by foreign fishermen are generally marketed to their home countries.

Foreign fishermen who have been caught do turtles catching in Indonesian waters are from Hainan. In the period of 2005 -2007 at least three times recorded cases of sea turtle catching by Hainan fishermen. In all three cases, the number of captured turtles reached 1,000 dominated by green turtle species.

The largest location of turtle egg hunting is the Riau Islands region where the nesting habitat of green turtles and hawksbill turtles are found quite significant and spread over hundreds of uninhabited small islands. The location is widespread causing the lack of supervision, so that the hunting of turtle eggs in the region is still ongoing with the main marketing targets are West Kalimantan and Malaysia.

3.1.8. Trade and Utilization (e.g. Tradisional Use)

Traditional uses are found in several places in Indonesia for example in Kei and Bali. One approachment to reduce turtle utilization is through non-extractive/consumptive uses through religious approaches, such as through Bhisama in Bali.

In Bali the utilization of green turtle by Bali community is to meet the three interests of the needs of religious rituals, illegal trade for consumption and the interest of hatchings release (Adnyana *et al*., 2010). As a result of this exploitation is a drastic decreasing of turtle population to 80% compared with the number of population in the previous 15 years (Adnyana, 2005; Generous and Adnyana, 2003). The fact that the type of green turtle is experiencing the highest exploitation compared to other turtles because the green turtle meat is the most widely consumed by certain communities.

In the case of Bhisama Bali, religious approaches reduced the value of turtle use from 10,000 turtles per year in 1999 to around 40-60 per year for the period 2014-2016. It may be difficult if the numbers become the limit for the number of turtles that can be utilized. One alternative approach is to 'tighten' the purpose of its utilization. In the case of Bhisama, turtles can only be used for high-level religious events, not for meals or for parties. While in Kei initiative of King Nufit to limit the number of catches by using only two turtles in each year (WWF Report in IUCN, 2016).

To enforce conservation step it is necessary to have a holistic approach when thinking about leatherback turtles in Kei, as leatherback turtles in Kei will not be separated from the turtle populations of Jamursba Medi and Warmon, can also be threatened due to turtle eggs stealing and leatherback populations in the Western Pacific that are threatened by side catch.

3.1.9. Habitat Degradation

The tourism industry of Serangan Island-Bali is known to have existed since the 70's but in 1995 Bali Governor through Bali Turtle Island Development (BTID) investor reclaimed the island to increase the area of

Serangan land to 4 times from 111 ha to 481 ha (Parwata, 2015). Due to the reclamation of several problems that arise one of them is the biophysical and socio-economic changes. The occurence of biophysical changes has caused environmental damage such as changes in current patterns, siltation, coral reef damage, seagrass an d sea abrasion where the Serangan beach is one of the turtle nesting beaches in Bali.

The reclamation of Serangan islands is an example of the destruction of coastal habitats of turtle nesting in Indonesia. According to the TCEC data 2016, for the last 16 years the green turtles that have laid their eggs on Serangan Beach are only 1 individual. This is an indicator of damage to nesting beach habitat caused by reclamation.

3.1.10. IUU Fishing

This matter is not relevant, therefore it is suggested to be drop.

3.1.11. Habitat Conversion

Reclamation that occurred in Bali in 1995-1998 changed the spatial layout of the island. Information states that this area was once as a habitat for green turtle nesting. At this time there is a change in the use of land into other functions of land (Banjur Kubu and changes in settlements into vacant land), changes in the sea into a new function on land (city parks, markets, turtle conservation, watersport, Pura batu Api and Pura Batu Karep), sea change into an old function on the land (expansion of Pura Sakenan, Pura Segara, Pura khayangan, Pura Tanjung Sari, Pura Puncaking Tingkih). The existence of other reclamation is 17.5 out of 20 km of coastline controlled by Bali Turtle Island Development (BTID) (Parwata 2015).

3.1.12. Overlapping/Conflicting National Policies and Regulation

In implementing conservation of natural resources in Indonesia there are laws that have the potential to overlap between ministries. The existence of Law No. 5 of 1990 concerning conservation of biological natural resources and their ecosystems and Law No. 31 of 2004 as ammanded by Law No. 45 of 2009 concerning fisheries where both of these laws have the authority to manage marine conservation. In the realization in the field there are many overlapping regulations and cause double supervision. It should be observed as a consideration of the authority of conservation management to work without any problems in implementation.

Moreover, the Issuance of Trading Business License No. 138/16/04 /SIUP-MIKRO/VII/ 2012 by the Government of Kota Baru Regency Department of Cooperation, Small and Medium Business of Industry and Trade indicate the existence of irrelevance of regulation. According to Government Regulation No. 7 of 1999 the turtle has been declared as a fully protected biota, there is no use of turtle products including its derivatives. In 2015 the Minister of Marine Affairs and Fisheries reaffirmed the restriction on the use of turtle products and their derivatives by issuing Circular Letter No. 526/MENKP/VIII/2015.

3.2. MARINE MAMMALS

3.2.1. By-Catch

By catch of gill nets is the leading cause of death from 75% odontocetes (whales and dentin-dolphins) and 64% mysticetes (baleen whales) worldwide (Reeves *et al.*, 2013). However, other fishing gears (eg. troll line, trawl, purse seine) is also allegedly to be the cause of Cetacea by catch (Read *et al.*, 2006). Surveys of cetacean by catch in

Indonesia are still in the early stages. Currently there is only information on the management and catchment incidents of East Kalimantan (Kreb *et al*., 2013, Whitty, 2015), Indian Ocean (Zainudin, 2009), Paloh (West Kalimantan) and Adonara (East Nusa Tenggara) (Mustika *et al*., 2014a). Kreb *et al*. (2013) explained that two thirds of cetaceans stranded in East Kalimantan are caused by gillnets. There are 34 incidents of catchment in Paloh and Adonara in 2013; the purse seine is the main cause of 75% of the by catch in Adonara (Mustika *et al.*, 2014a). However, these figures are not sufficient to reflect the catchment conditions in Indonesia.

On the other hand, the case by catch in Dugong is generally caused by gill net, sero (tidal trap), blast fishing and cyanide fishing. Gill nets are one of the fishing gear used to catch fish by cutting the path of fish movement. One of the most frequently used gill nets is a net for sharks. De longh (1996) in Marsh *et al*. (2002), states that many cases of dugong are caught in the shark net.

Tidal trap (sero) is a fishing gears made of wood or bamboo that is installed in tidal areas. Sero is a fishing tool that has a strong and large construction, the size can reach up to 100 meters long. This fishing gears use the tides, when the flow tide water will enter the sero and fish following the inflows but when the ebb tide sero will dry from the water then the fish are trapped in it. The process also gets the by catch of dugong. It is commonly found in the Bintan area, many dugongs trapped in sero (local language, kelong) (Hidayat *et al*., 2016; Juraij, personal communication, 2015). In addition, one of the conservation agencies that maintain dugong states that the dugong that they keep is from a wounded dugong trapped in sero (Banten Bay and Buton). The dugong was then given treatment by the veterinarian team and then maintained ex-situ (Sea World Indonesia, personal communication, 2009).

The modification of marine mammal-friendly fishing gear and increased awareness to the public to be able to release back if seeing marine mammals caught in fishing nets is expected to press threats to dugong sustainability in Indonesia. Figure 30 illustrates the distribution of captured marine mammals in several locations with type of gill net and tuna longline.

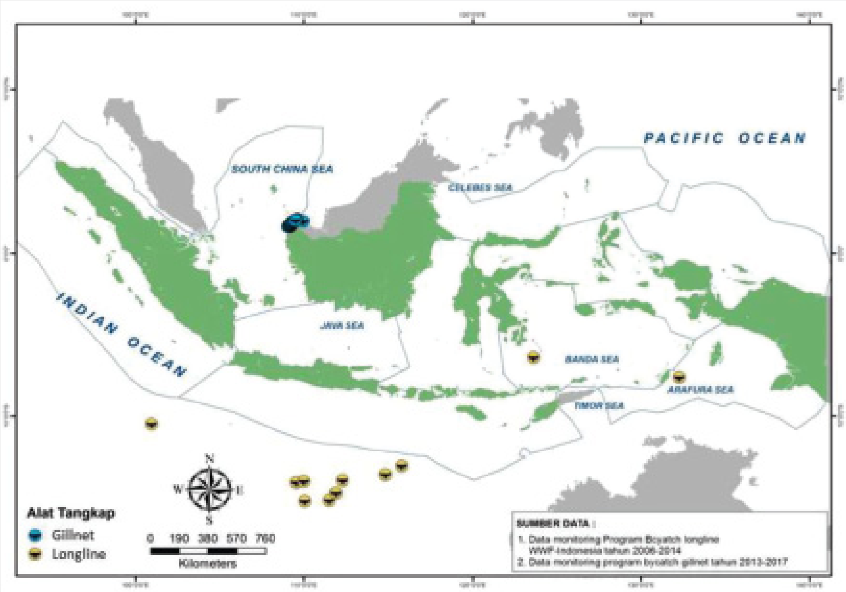


Figure 30. Map of Marine Mammals Bycatch (WWF & MMAF, 2017).

3.2.2. Pollution (e.g. oil & gas exploration, etc.)

Many environmenta lists have long been shared about the impact of contamination on the health of marine mammals, especially cetaceans (de Guise *et al.*, 1995, Trumble *et al.*, 2013, Fair *et al.*, 2010). Reeves *et al.* (2003) listed some sources of chemical pollution, such as Polychlorinated

Biphenyls (PCBs) and other organochlorines, Polycyclic Aromatic Hydrocarbons (PAHs), as well as oil spills and dumping mine waste into deep waters. Although there has been no research on this issue in Indonesia, the number of mines and industries along rivers and coastal areas indicates that this issue is a threat that has not been scientifically detected. However, there are indications of pollution in the Mahakam river from the coal industry as well as the runoff of fertilizers and herbicides (Stauch, 2011). Several individual dolphins in the same river were also seen with white patches of skin (pigmentary changes) in 2000 and 2007 (Kreb, personal observation).

3.2.3. Climate Change

Although the impacts of climate change are very difficult to detect in marine mammal populations, increasing of droughts and floods makes climate change more relevant for freshwater dolphins because it reduces habitat extent and increases the likelihood of conflicts with humans (Reeves *et al*., 2003p; Kreb *et al*., 2010). Damage to coral reefs due to global warming can also trigger a decline in fish species and the dolphin suspicion that depends on the existence of coral reefs, such as the Indo-Pacific bottle nose dolphins (Kreb and Budiono, 2015). Although this issue has not been studied in Indonesia yet, the precautionary principle has caused the need to put climate change as one of the potential threats to marine mammals.

3.2.4. Marine Debris

Marine debris, especially plastic and fishing equipment that has been damaged/lost, is a major threat to more than 260 species of fish in the sea, including marine mammals (Kiessling, 2003; Allsopp *et al*., 2006). Each year, between 4.8 to 12.7 million metric tons of plastic floats or are discharged into the sea; this figure is quadrupled by 2025 (Jambeck *et al*., 2015). Plastics are often found in the abdomen of a variety of marine fish including marine mammals (de Stephanis *et al.*, 2013; Januniaux *et al.*, 1998), probably because the fish think the plastic is food. Missing and useless fishing gear (referred to as 'ghost net') also often causes sea mammal trapping in worldwide (Reeves *et al.*, 2013). Still a lack of studies on the number of ghost webs in Indonesian waters, but the numbers must also be high. Marine debris can also come from land (eg ditch, land solid waste, or waste heap) or from the sea (eg commercial fisheries and recreational fisheries, military and commercial vessels, etc.) (Allsopp *et al.*, 2006), so as to know the existence of ghost net including distribution and its volume need to involve many parties, both at national and regional levels.

3.2.5. Irresponsible Tourism

Captivity is a common form of ex-situ tourism (Newsome *et al.*, 2005; Higginbottom, 2004). Captivity usually involves confined dolphins and dugongs for the entertainment reason. Captivity in general can provide temporary benefits for tourists as they can observe many marine mammals within a particular area. Dolphin-assisted therapies have also recently become more prevalent, although the effectiveness of these treatment methods is questionable (Marino and Lilienfeld, 2007). Captivity can be bad for marine biota, especially if the biota is a long-distance migratory species (Carter, 1982). The IUCN Cetacean Specialist Group states that "Cetacean taking from nature, for entertainment or research, is similar to planned or incidental killing, because the biota that is confined (or killed while captured) can no longer help the sustainability of their nature population" (Reeves *et al.*, 2003).

Since the last decade, more and more dolphinarium tourism facilities have emerged in Indonesia. Although the numbers are still less clear, more dolphinariums are found in Indonesia, especially in Java and

Bali. Most of these dolphinariums do not have professional ethics yet and it is rare to have a veterinarian to oversee their well-being. The dolphinarium closure campaign led by the Jakarta Animal Aid Network and RASI Foundation has still not produced results, although this activity has been banned in many countries, including developing countries such as Bolivia, Chile, Costa Rica, India, and Nicaragua (Kirby, 2014). Therefore, it is important for Indonesia to review the preservation of the dolphinarium industry in this country. In addition, Dolphin-assisted therapies also need to be examined further.

Whale and dolphin tours are increasingly prevalent between 2001-2008, especially in developing countries (Hoyt, 2001; O'Connor *et al.*, 2009). The first dolphin sightseeing tour in Indonesia is in Lovina (northern Bali), where the activity began in the late 1980s by local fishermen that guided backpackers to see the dolphins (Hoyt, 2001; Mustika, 2011).

Dolphin tours in Lovina are growing quite rapidly, to attract at least 37,000 tourists per year with an expenditure of USD 4.1 million per year for the period 2008 - 2009 (Mustika *et al.*, 2012). However, so far there has been no study to provide input as a policy step in the management of dolphin tourism in order to maintain the ecological conservation of dolphin tours in Lovina (Mustika *et al.*, 2014b) including the level of tourist satisfaction (Mustika *et al.*, 2013).

More over in Indonesia, Lovina is not the only location to observe Cetacea. The tourists also started visit other areas of Bali (eg Bondalem and Bukit Peninsula), Lampung (Kiluan Bay), and East Kalimantan (Mahakam River) for small scale dolphin tours. The liveaboards also sailed the waters of Alor, Banda and Raja Ampat (West Papua) to invite tourists to dive and see whales and dolphins.

In Alor swimming with Dugong tour is very interesting (DSCP Indonesia, 2016). So far, all of these tourism activities have no rules, because Indonesia does not have a guide for tourism that interacts with marine mammals, so its management steps is required.

Similar concerns also occur for swimming tours with Cetacea. The kayak users are also seen trying to interact with orca in Kaimana (West Papua). Although there is no record of the effect of this activity on cetaceans in Indonesia, researchers in other countries have shared their concerns (Timmel *et al.*, 2008). Therefore, swimming and kayaking activities with Cetacea are also seen as a threat to these animals. Animal feeding (including cetaceans) has also been shown to have negative effects on animals, for example in terms of mother and child relations (Mann and Kemps, 2003).

There is anecdotal information about tourists who trying to feed the dolphins in Indonesia. Such activities should be carefully examined and mentioned in the RAN document, travel guidance documents, etc. Sustainable tourism is one focus of the CTI Regional Plan of Action for marine mammals (CTI-CFF, 2009b). Therefore, as with the recommendation of IUCN (Reeves *et al.*, 2003), in-situ tourism is included as a threat that needs to be studied in depth so that the purpose of rare fish utilization can be well managed without harming the ecology of rare fish.

3.2.6. Illegal Trade

In addition to by catch and ghost nets, the commercial fishing industry also poses a threat through the capture of large marine biota leading to the collapse of the marine food chain and changes in species composition (Reeves *et al.*, 2003). Commercial fisheries can indirectly cause a predator-prey shift in the sea (Ibid). This threat is difficult to measure and takes a long time to measure it. However, it is important that this be included as a potential threat to marine mammals in Indonesia.

3.2.7. Hunting

Local hunting for marine mammals is still occurring. Species of whales and dolphins are widely hunted in the name of the tradition preservation in Lamalera. Hunting dugong by harpun has been reported from Bintan, West Kotawaringin, and Toli-toli (Herandarudewi *et al*., in press). Socialization of legislation and law enforcement will be an important key to implementation.

3.2.8. Trade and Utilization (e.g. Traditional Use)

Several incidents of dugongs were captured and maintained by the local people as happened in the villages of Santigi, Tolitoli-Central Sulawesi (DKP Tolitoli, 2016) and in PulauKokoya-North Maluku (www.bbc.com/indonesia), and made as attractions in Kiat Village, Fakfak Regency – West Papua (www.arsip.gatra.com).

It is generally known that the purpose of dugong hunting is to be sold either in live form or in the form of a product of dead dugong (meat, fangs and tears) as shown in Figure 31. The dugongs hunting for sale are a request of a private individual with a motive for personal pleasure or as a tourist attraction. This was conveyed by the dugong hunting actors in Bintan (Hidayat *et al*., 2016; Juraij, pers. com, 2015), and in Buton (Herandarudewi, pers. com., 2016). Dugong hunting for the sale of its products is widely recorded, among others, dugong hunting in Bintan (Hidayat et al., 2016; Juraij, pers. com., 2015), Kotawaringin Barat (Alkadrie, 2016; Kiswara, pers. com, 2016), Cendrawasih Bay (Tania *et al*., 2016), Banggai Islands (Moore *et al*., 2016).

Figure 31. Hunted Dugong in Cendrawasih Bay that Were Sold (Tania *et al.*, 2016).

Dugong meat utilization by the local community is one of the main dishes in major religious events and customs in Cendrawasih Bay (Tania *et al*., 2016). Dugong fangs are used for decoration, cigarette pipe or as a medicine. Tears dugong trusted as a tool of love or business prosperity. There is no justification of theses assumptions. Based on information from various sources, the perpetrators of dugong catch have a lach education and information that dugong is a protected biota, but in some cases of perpetrators have already know it (KKJI, 2014).

3.2.9. Habitat Degradation

Development along the river, particularly the opening of swamp land or river border forests for oil palm plantations and coal industries, is a major concern for the survival of freshwater dolphins, such as the Balikpapan dolphins in East Kalimantan (Kreb et al., 2010). Mahakam Bay in the same province is also an example of unsustainable estuary and coastal development that disrupts local populations of

Cetacea (Kreb and Rahadi, 2004). Although no studies have been undertaken elsewhere in Indonesia, the two studies in East Kalimantan still provide a strong foundation for this issue to be included as a threat that needs to be addressed in this RAN Cetacea. IUCN Recommendations (Reeves *et al.*, 2003) and CTI-CFF (2009b) also support the inclusion of coastal and river development issues into this document.

Mortality of dugongs that were hit by a ship has been reported from Balikpapan Bay and Ambon (de Iongh, 1996; de Iongh *et al.*, 2007). One report was submitted that there was a dugong baby who tranded and found to be injured in his body allegedly of being hit by a ship propeller (Khaifin, 2016).

3.2.10. IUU Fishing

It is not applicable for the protected species.

3.2.11. Habitat Conversion

There is no case relation to habitat conversion for this species group.

3.2.12. Overlapping/Conflicting National Policies and Regulation

- **Fish Bombing**

Although many awareness campaigns to reduce fish bombing in Indonesia have already been conducted, this activity is still a threat to marine resources in Indonesia (Fox and Caldwell, 2006; Pet-Soede and Erdmann, 1998). A handmade bomb is used to catch tuna in the waters off the Solor-Alor coast in East Nusa Tenggara (Zakarias Atapada, WWF Indonesia, pers. com, 2013). Because Cetacea is widely seen in the waters of Solor-Alor and Savu Sea (Kahn, 2003), information on tuna bombing activities makes fish bombing one of the main threats in eastern part of Indonesia. The IUCN Conservation Action Plan (Reeves *et al.*, 2003) awares of the dangers of underwater bomb explosions, even though these threats are more related to the oil and gas industry. Underwater explosions can damage the ear bone of Cetacea (Ketten *et al.*, 1993), a "death penalty" for cetaceans because they "see" with ears in the water. The explosion can also cause cetaceans trapped in fishing nets (Todd *et al.*, 1996), possibly due to disorientation. Before further information on the impact of fish bombing on cetaceans, the precautionary principle recommends that fish bombings must be included in the list of threats to cetaceans in Indonesia.

- **Directly catched for consumption or fish bait**

This issue concerns two different activities. The first is whale and dolphins hunting for local consumption, such as in Lamalera Village on Lembata Island and in Solor Timur on Solor Island (Barnes, 1996; Barnes, 2005; Mustika, 2006). The second activity concerns the hunting of dolphins for shark bait in East Lombok (Hilton, 2012).

Villagers of Lamalera on Lembata Island have been hunting for toothed whales, especially sperm whales, for more than 500 years (Barnes, 1996, Barnes, 2005). Since about 2004, it has begun to note that hunters began to hunt dolphins in motorboats, the number of hunts reaching over one hundred whales per year (Mustika, 2006). Initially, Lamalera villagers were open with the arrival of researchers and NGOs. But around 2009, there was a conflict between several NGOs and local communities, so villagers closed the doors for conservation programs (Kompas, 2009, Yos/Fer, 2013). Now, with limited access to the village, the number of hunting per year is also not known for certain. Thus, the sustainability of these whale activities is also less clear. This problem is exacerbated by the commercial baleen whale and dolphins hunting in Solor Island (Mustika, 2006). Although Solor fishermen still open of dialogue, there has not been enough progress in efforts to stop Cetacea hunting in that place.

Unlike traditional whale hunting, the issue of dolphin hunting for shark baits is a newly documented phenomenon in East Lombok (around the end of 2012). However, this activity is very worrying because not only fishermen hunt the protected taxon (Delphinidae), but also because this activity is done to support shark hunting. It is necessary to socialize to the community that the species are protected species. In some cases the occurrence of catch of protected species is caused due to the ignorance of the community against regulations that protect the species.

- **Ship Collision**

Many studies have shown the fatal impact of ship collisions on whales and dolphins (Laist *et al.*, 2001; Camargo and Bellini, 2007; Vanderlaan and Taggart, 2007). In addition to collisions, underwater noise from high frequency or high speed ship engines such as speedboats can reduce the presence of cetaceans in some areas (Marsh *et al.*, 2003; Pidcock *et al.*, 2003). Kreb and Rahadi (2004) recorded changes in Mahakam dolphin behavior in the Mahakam River and coastal areas of East Kalimantan due to the large number of ships passing the river.This is also found some deaths of Pesut Mahakam due to collision with speedboats and coal tankers. Although the research on this subject is still lacking, as with the recommendations of freshwater dolphin experts (Kreb *et al.*, 2010), IUCN (Reeves *et al.*, 2003) and CTI (CTI-CFF, 2009b), ship collisions were included as a threat that needs to be studied more deeply.

- **Competition and Sorting**

In some countries, fishermen choose cetaceans to be killed because they see cetaceans as competitors in terms of fishing, or as revenge for damaged nets (Reeves *et al.*, 2003). Although there is no anecdotal information that indicating in Indonesia, the decline in fish stocks (Mullon *et al.*, 2005) and poverty can make fishermen catch Cetacea to be killed. Therefore, based on the principle of circumspection, this issue is included as a potential threat to cetaceans in Indonesia.

- **Interference from industrial operation and military**

As appropriate with acoustic biota, marine mammals rely heavily on their auditory senses to hunt prey, navigate and socialize (Reeves *et al.*, 2003). It was only in the last century that they began to have rivals in the sea, which were man-made sounds coming from ships, hydrocarbon exploration, seismic surveys and military sonar. Extremely strong sounds can cause various impacts, ranging from minor changes in their vocalizations (Parks *et al.*, 2011) to ear damage (Ketten *et al.*, 1993) and decompression diseases (Jepson *et al.*, 2005) causing death (Parsons *et al.*, 2008). Pathologically, acoustic trauma may not directly kill whales and dolphins (McCarthy, 2002). The fact is the ears of the biota are damaged, they are stranded, and they then die (Ketten *et al.*, 1993; McCarthy, 2002). Acoustic disorders can cause cetaceans to decompress due to changes in dive profiles, then embolism, then stranded and die (Weilgart, 2007). Nevertheless, human activities that cause such disturbances and deaths must remain accounted for.

The reason for national security makes measuring by using military sonar in Indonesia is almost impossible. However, other sound sources such as ships and offshore exploration can be more easily researched. Indonesia has a target to increase oil and gas production, especially since the outflow of Indonesia from OPEC in 2008 (Kahn, 2010). Therefore, Indonesia rich seabed still often become the object of hydrocarbon mining (Ibid). More seismic surveys occur to explore the potential of hydrocarbons. The intensity of this kind of exploration is quite alarming, so the IUCN Asia Regional Office has showed their concern to the Ministry of Marine Affairs and Fisheries about the impact of this industry on cetaceans, especially in Raja Ampat in West Papua (letter dated March 2, 2010 sent by the IUCN Asia Regional Office in Bangkok). It is true that oil and gas companies in Indonesia have started putt Marine Mammal Observers (MMOs) on their exploration vessels but this is not mandatory. However, the increasing underwater seismic exploration in the country (Kahn, 2010), the absence of a strategy for military sonar and the sounds of ships, as well as recommendations from IUCN (Reeves *et al.*, 2013) and CTI-CFF (2009b) make this issues to be included as a threat in this document.

- **Stranded marine mammals**

Based on collected data by Whale Stranding Indonesia (www.whalestrandingindonesia.com) from 1987 to mid 2017, stranded events are increasingly being observed and reported to the relevant authorities, in this case the Ministry of Marine Affairs and Fisheries, in line with the increasing desire of the general public to assist rescue efforts of stranded marine mammals.

It has been recorded at least 314 cases of marine mammals (including the Mahakam dolphins) that stranded in Indonesia since 1987, where in 2017 and 2012 were the years with the highest recorded incidents (41 incidents in 2017 and 32 incidents in 2012) (Figure 22). The increasing awareness of the general public about this stranded incident has also led to a growing number of incoming reports.

If accumulated data of stranded incidents per month can be seen that stranded incidents reached their peaks in January and August (Figure 32). It should be noted, however, that the data in WSI is data based on incident reports, not on observation. Thus, there is a location bias, where the locations of many observers (eg Bali and East Kalimantan) have a lot of data, while isolated locations such as Maluku and some islands in Nusa Tenggara have less data. The use of social media such as Facebook, Twitter, Instagram, and Whatsapp is very helpful for data collection of stranded incident from the region. If a few years ago more incidents were recorded because many NGOs or governments worked there, the presence of social media led to more parties participating.

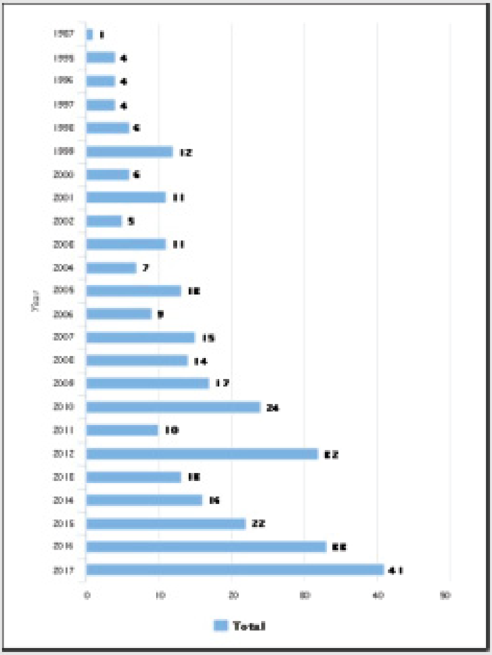


Figure 32. Number of Stranded Incidents per Year Since 1987 to 2017 (Source: WSI)

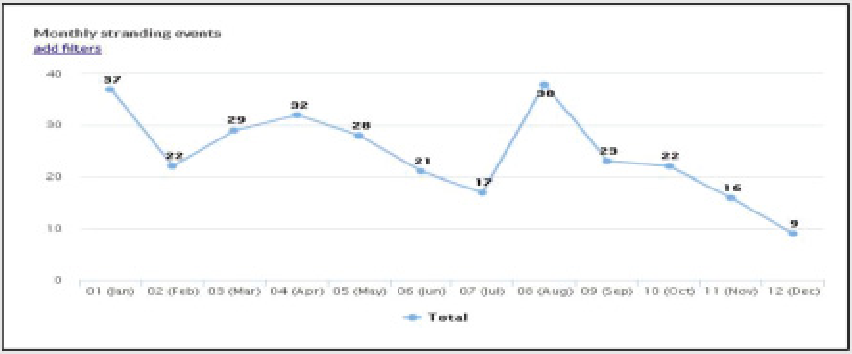


Figure 33. Stranded Incidents per Month (Source: WSI).

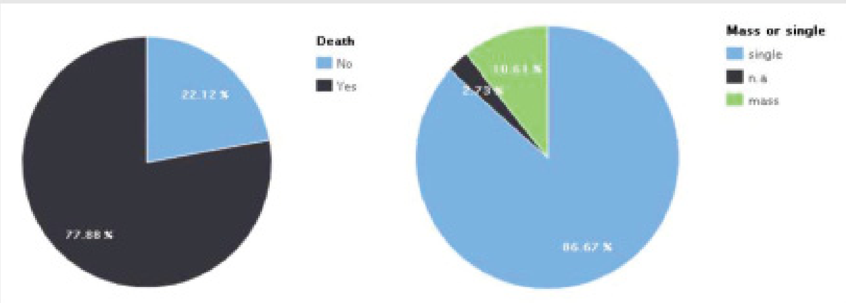


Figure 34. Percentage of Live and Death Condition (i) as Well as Single and Massal Straned (ii) from Stranded Incidents Record In Indonesia (Source: WSI)

In 2017, records of stranded incident in Whale Stranding Indonesia showed that only 22.12% of marine mammals were stranded in living conditions, the remainder were die (Figure 24(i)). Figure 24(ii) shows that 86.67% of stranded incidents in Indonesia are single stranded cases.

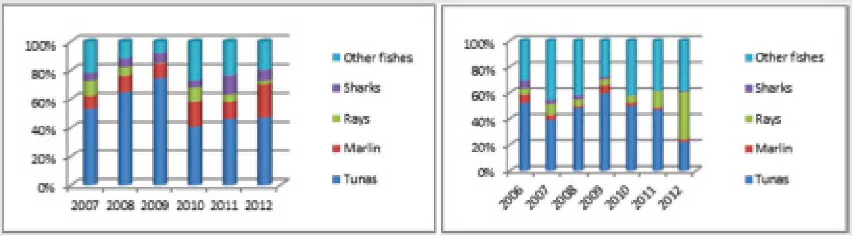
3.3. SHARKS AND RAYS

3.3.1 By-Catch

By-catch is one of the biggest threats for shark and ray fisheries in Indonesia and the fisheries in the world. Although regulations issued by regional organizations such as RFMO have banned catching some rare and endangered species of sharks and rays, the regulations appear to have received less attention from fishing actors, and yet no effective action has been taken to deal with this problem appropriately (Gilman *et al*., 2007). In the late 1980s and early 1990s, an estimated 300,000 metric tons of shark, or nearly a third of global quantities, were the result of unregulated bycatch landings (Bonfil, 1995).

In Indonesia sharks and rays are often caught by purse seine, tuna gillnet, and tuna longlines, but the bycatch of sharks and rays in pelagic fisheries is a serious problem that needs to be considered in managing shark and ray fisheries. The bycatch study on the following shark and ray fisheries is focused on tuna fishery industry using longlines and nets in offshore waters. The main landing bycatch of tuna fisheries among others in PPS Cilacap, PPS Benoa, and PPS Bitung. Composition of catch and type, production trend, species dominance, and proportion of shark and ray catch on tuna fishery are presented in Figure 25.

The catch of shark and rays on tuna longline fisheries based in PPS Bitung and PPS Benoa for the period 2007-2012 are presented in Figure 25(i). The composition of shark and rays catched in Bitung were each relatively equal between 5-10%, while sharks and rays landed in Benoa were recorded at 0-5% and 5-40% of the total catch (Figure 35 (ii)).



(i) (ii)

Figure 35. Catch Composition of Tuna Longline Based at Bitung (i) and Benoa Fishing Port (ii) in 2012

The composition of shark catches from tuna longline and tuna gillnet that landed in Cilacap for 2006-2013 is presented in Figure 36, Figure 37 and Table 25. There are at least six species of sharks (*Sphyrna lewini, Carcharhinus falciformis, C.longimanus, C.sorrah, P.glauca, Alopias superciliosus,* and *A.pelagicus*) that identified caught by longline tuna, but some of them were unknown because incomplete. Blue shark (*Prionace glauca*), are the most dominant shark species caught in longline tuna that reach 53.1% of the weights (Figure 38 and Table 25).

Whereas the catch of tuna nets is dominated by Pelagic thresher shark (*Alopias pelagicus*) (Figure 39 and Table 26). The proportion of this species is the largest among 50-70% of total catches in tuna gillnet fisheries. There are eight identified shark species, but some other shark species are unknown because they have been cut off by the fin and without head. Smale (2008) reported that at least 15 species of sharks were captured in offshore waters in the Indian Ocean, where the Blue shark and silky shark are the most commonly caught species. Blue sharks are caught not only in Indonesian waters but also in tuna longline fisheries in other countries waters. This suggests that the problem of shark and ray bycatch occurring in fisheries in offshore waters has become a global problem so the management must involve several countries. Various mitigation efforts to prevent or avoid captured sharks and rays as bycatch on tuna longline fisheries have been done but have not provided the expected results. The main obstacles are lack of supervision in the field and the lack of compliance from the fisheries entrepreneurs in implementing the regulations stipulated under IOTC resolution as outlined through Minister of MMAF Regulation No.12/PERMEN-KP/2012 and No.26/PERMEN-KP/2013 on Sharks caught as bycatch on tuna Fisheries should be intact landed at the port and not cut off the shark fin and throw it at sea, not making the catch for pregnant sharks and small shark especially the thresher shark type (*Alopias spp.*). Must be released alive if possible or report to the port office if landed in dead condition.

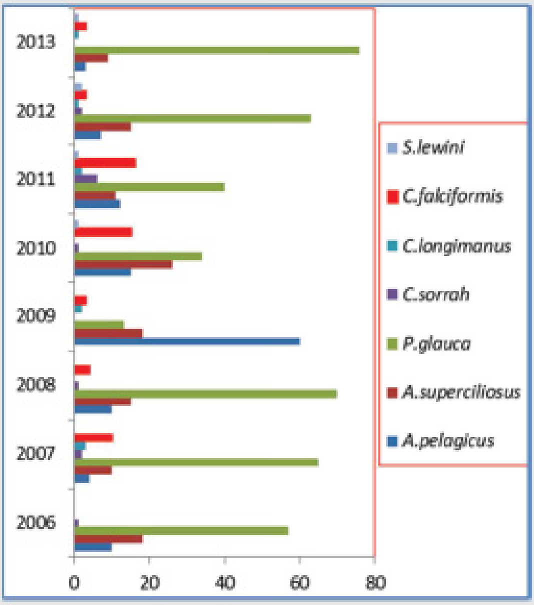


Figure 36. Species Composition of Bycatch Sharks Caught by Tuna Longline Landed at Cilacap-Central Java

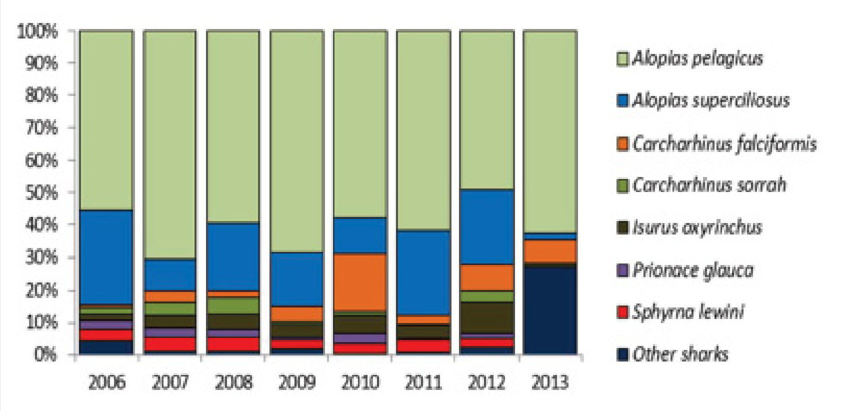


Figure 37. Species Composition of Bycatch Sharks Caught by Tuna Gillnet Landed at Cilacap-Central Java

Table 25. Dominant Species in the Percentage (by weight) of Shark Caught by Tuna Gillnet and Tuna Longline Landed at Cilacap-Central Java in 2006-2013 (Dharmadi, unpublish data)

Year	Tuna gillnet (% by weight)		Tuna longline (% by weight)		
	A. pelagicus	*A.superciliosus*	*Prionace glauca*	*A.pelagicus*	*A.superciliosus*
2006	57	30	55	10	19
2007	71	10	65	4	10
2008	59	21	70	10	15
2009	68	16	13	60	18
2010	58	11	34	15	26
2011	62	26	40	12	11
2012	49	23	63	7	15
2013	49	19	76	-	9
Ave.	**59,1**	**18,3**	**52**	**16,9**	**15,4**

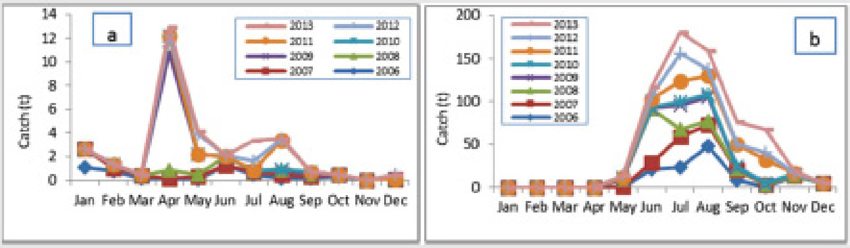


Figure 38. Monthly Fluctuation of Pelagic Thresher Caught by Tuna Longline (a) and Tuna Gillnet (b)

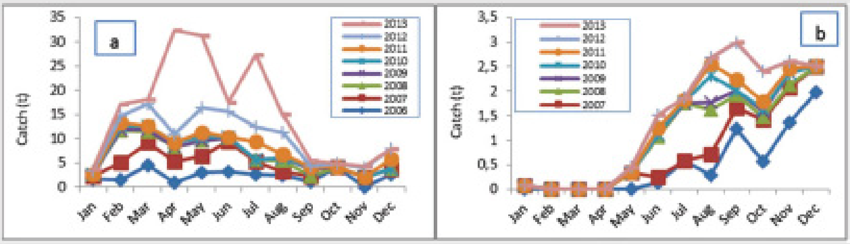


Figure 39. Monthly Catch Fluctuation of Blue Shark Caught by Tuna Longline (a) Gillnet (b)

Tabel 26. Percentage of Sharks in Tuna Longline and Tuna Gillnet in Cilacap-Central Java

Fishing gear type	Year									Average /year (%)	St. dev.
	2006	2007	2008	2009	2010	2011	2012	2013	Range (%)		
Longline	6.07	2.83	2.03	2.21	1.09	1.37	2.91	10.04	1-10	3.57	3.03
Gillnet	3.90	2.92	3.85	2.71	1.81	4.87	3.09	6.92	2-7	3.76	1.57

Tabel 27. Percentage of Sharks (by number) of Tuna Longline In Benoa-Bali

Year									St. dev.
2006	2007	2008	2009	2010	2011	2012	Range (%)	Average /year (%)	
6.02	3.41	2.97	2.02	0.08	0	0.64	0 - 6	2.16	2.18

Tabel 28. Percentage of Sharks (by number) of Tuna Longline In Bitung-South Sulawesi

Year								St. dev.
2007	2008	2009	2010	2011	2012	Range (%)	Average/year (%)	
5.64	5.90	6.82	4.58	12.24	7.57	4 - 12	7.13	2.71

Indonesia currently includes the world top five in terms of the size of tuna longline fleet (Zainudin *et al.*, 2007). The main fishing grounds of the tuna longline fleet in the Indian Ocean are scattered from the northwest tip of Sumatra Beach to the south of Java Waters, and eastwards Bali to southwest Timor Leste (extending along 150 ° south latitude) (Proctor et al., 2003). In addition to that location, the Banda Sea and the Western Pacific Ocean (north Sulawesi to Papua) is a longline tuna fishing location of Indonesia (Ingles et al., 2008). The location of this bycatch research is the territorial waters and the Exclusive Economic Zone of Indonesia represented by a fleet of longline tuna vessel based on the Port of Benoa, Bali and Bitung, North Sulawesi Zainudin *et al.* (2016).

The fleet of longline tuna based in Benoa Harbor, Bali was chosen as a sample for the longline tuna fleet that operates and has fishing locations in the Indian Ocean and Indonesian archipelagic waters (Banda, Flores, Maluku). While Bitung, North Sulawesi is samples for fleets of longlinge tuna vessel that operate and have catch locations in the Pacific Ocean (Figure 40).

Especially for sharks, observations were made on seven species of sharks that fishermen often use because of their high commercial fin value, as well as some shark species that have been regulated by national and regional legislation (Zaenudin, 2017). The seven species of sharks are blue sharks (*Prionace glauca*), bottle shark (*Centrophorus squamosus*), mako shark (*Isurus oxyrinchus*), tiger shark (*Galeocerdo cuvier*), hammerhead shark (*Sphyrna mokarran*), super shark (*Carcharhinus falciformis*), and threser shark (*Alopias pelagicus*).

During the study period there were 2,095 sharks caught unintentionally on tuna longline fishing gear, with location and hook rate of 0.2446. While the number of bycatch of seabirds, dolphins and whales in Indonesian longline fisheries is lower than in United States, so bycatch shark tends to be lower than the average hook rate bycatch of global sharks.

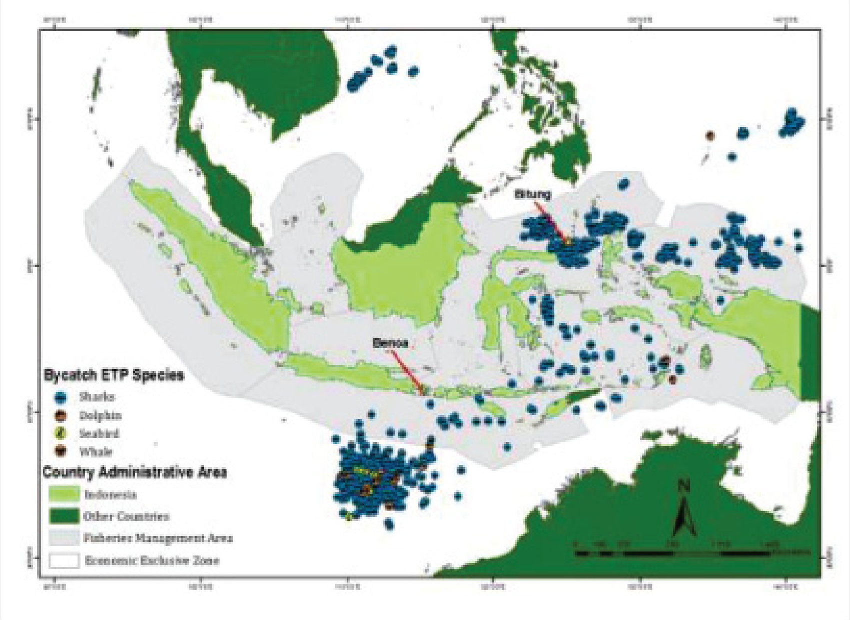


Figure 40. Shark Catch Area (blue color) in Longline Tuna Fisheries During Period 2006 – 2014 (WWF, 2014).

From the seven shark species that are identified in this study (Figure 41), blue sharks (*Prionace glauca*) are the most widely caught sharks of the Indonesian tuna longline fleet with a hook rate of 0.0751 (643 sharks), followed by super sharks (*Carcharhinus falciformis*) (hook rate 0.0636 or 545 sharks), thresher shark *Alopias pelagicus* (hook rate 0,0118 or 101 sharks), bottle shark, *Centhrophorus squamosus* (hook rate value 0.0063 or 54 sharks) , hammerhead shark, *Sphyrna mokarran* (hook rate 0,0029 or 25 sharks), mako shark, *Isurus oxyrinchus* (hook rate 0.012 or 10 sharks) and at least tiger shark, *Galeocerdo cuvier* (hook rate 0.0008 or 7 sharks).

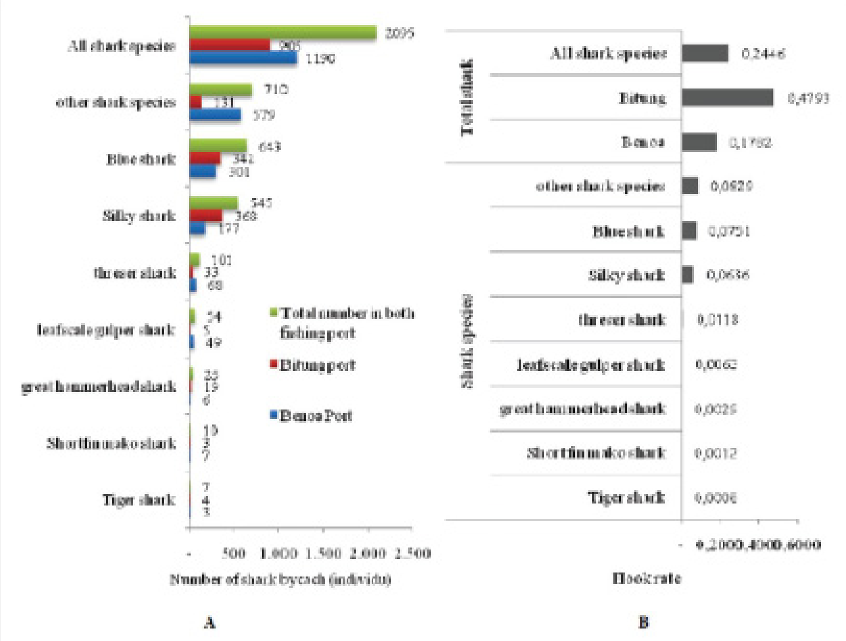


Figure 41. Number and Hook Rate Bycatch Shark from Longline Tuna That Base In Benoa and Bitung During Periode 2006 – 2014 (A: Number of bycatch & B: hook rate bycatch)

Sex ratio of caught shark were dominance by female shark with comparison 1: 0.91. Table 29 shows that male and female sex ratios is vary by shark type. In general, the male and female gender ratios caught on the longline tuna are almost balanced, but for hammerhead sharks the female is dominant (75%). Based on the level of shark maturity as measured by the size of the shark length (total fork length), 95.7% of caught adult sharks (juvenile and sub-adult) and only 4.3% are adult.

Table 29. Percentage of Type and Mature Genital Shark In Longline Tuna During Period 2006 – 2014 (Number of shark/ n = 1.820 sharks)

Species	Sex				Maturity			
	Female		Male		Adult		Juvenile	
	Individual	Percentage (%)	Individual	Percentage (%)	Individual	Percentage (%)	Individual	Percentage (%)
Blue shark	277	51.30	263	48.70	11	1.71	632	98.29
Leafscale gulper shark	17	53.13	15	46.88	1	1.85	53	98.15
Shortfin mako shark	4	50.00	4	50.00	1	10.00	9	90.00
Tiger shark	4	57.14	3	42.86	0	0.00	7	100.00
Hammerhead shark	18	75.00	6	25.00	3	12.00	22	88.00
Silky shark	224	47.86	244	52.14	5	0.92	539	99.08
Thresher shark	53	57.61	39	42.39	4	3.96	97	96.04
Other species	357	55.01	292	44.99	0	0.00	0	0.00
Total identified shark	**954**	**52.42**	**866**	**47.58**	**25**	**1.81**	**1359**	**98.19**

Some studies of vertical shark movement patterns indicate that the oceanic whitetip shark and silky shark are susceptible to capture in shallow fishing gear, while the blue shark dives in deep waters during the day and often comes to the surface of the waters at night to make this shark susceptible to both capture systems (deep or shallow), the thresher shark dives at depth during daytime and is very active in the dusk but rarely approaches the water surface, thresher sharks are particularly vulnerable to being caught by the longline setting in (Boggs , 1992; Nakano *et al.*, 2003; Weng and Block, 2004; Bonfil *et al.*, 2008; Musyl *et al.*, 2011). In general, the shallow setting of longline pelagic fishing gear has a higher average of shark catch rate than the inner setting system (Gillman *et al.*, 2007). Setting deep fishing gear (not installing branch strings in water depths less than 100 m) has been shown to reduce the number of bycatch sharks and turtles (Beverly *et al.*, 2007).

3.3.2. Pollution (e.g. oil & gas exploration, etc.)

Data and information related to the impact of pollutants and the presence of sharks and rays in Indonesian waters based on Fisheries Management Areas are not yet available. For that need a study of the pollution and population of sharks and rays.

3.3.3. Climate Change

Changes in temperature, freshwater input and ocean circulation will have the most widespread effects on top marine predator. Since, the freshwater/estuarine and reef associated sharks and rays are most vulnerable to climate change, and that vulnerability is driven by case-specific interactions of multiple factors and species attributes. This condition considering affected shark and ray population. Especially species that associated with specific zone, such as freshwater, estuarine, coastal, inshore, reef and shelf (Chin, 2010). Along with climate change and antropogenic pressure, it possibly has significant effect to sustain the population (Figure 42).

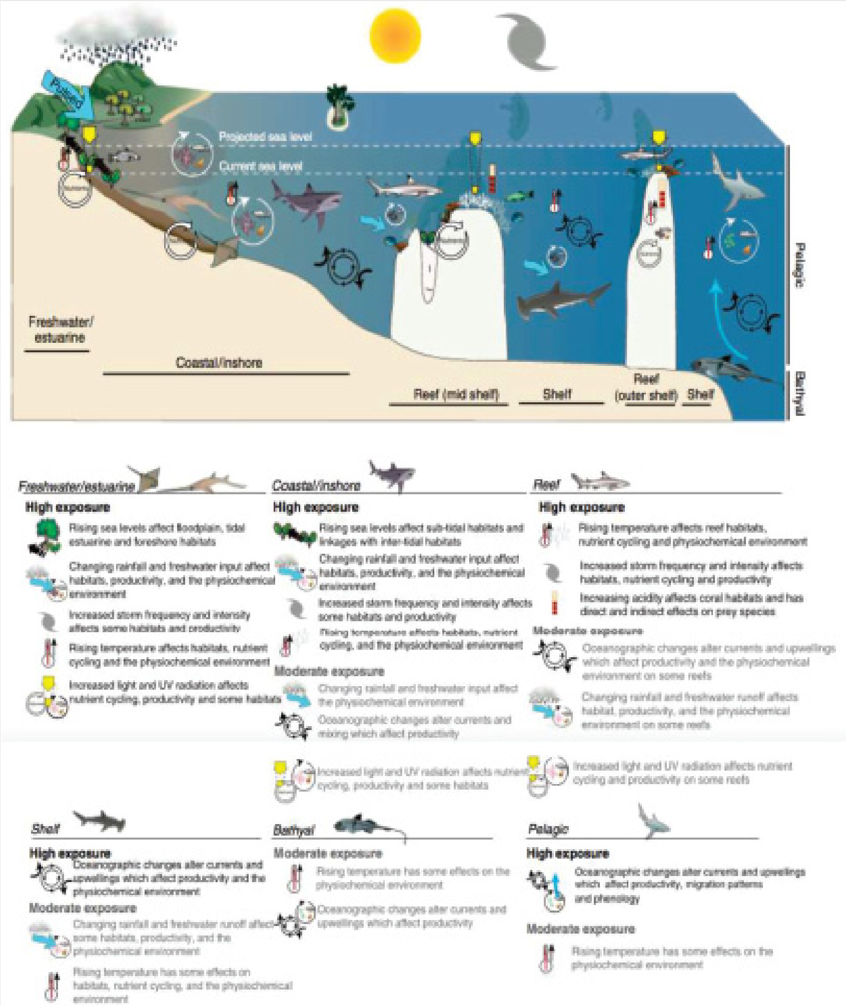


Figure 42. Conceptual Chart on the Exposure of Ecological Groups of Sharks and Rays to Climate Change Factors

3.3.4. Marine Debris

Data and information on the relationship between marine debris and the presence of sharks and rays in Indonesian waters based on Fisheries Management Areas are not yet available. Need a study of marine debris and population of sharks and rays.

3.3.5. Irresponsible Tourism

Indonesian waters are potential areas for migration purposes for biota feeding such as whale sharks and manta rays, this is related to the relatively high abundance of pelagic fish. Even in some water areas have become ecotourism that attracts attention for domestic and foreign tourists. Several waters areas in Indonesia that are both permanent and temporary habitats and as ecotourism for whale sharks and manta rays are presented in Figure 43 (Sianipar, 2015). The location of habitat and ecotourism, although economically give benefit to the local government but must be managed properly with regard to biological characteristics and biota behavior. As an example of the phenomenon of whale sharks in Botubarani-Gorontalo, since 2015 has become a tourist destination for local and even foreign communities and has been officially established by the local government of Gorontalo that Botubarani as the ecotourism location of whale sharks. The custom of domestic tourists by feeding whale sharks at these waters locations biologically will change the behavior of whale sharks. Handoko *et al.* (2017) stated that if we take into consideration the biological and ecological factors, whale sharks in the waters of Botubarani Gorontalo have experienced changes in whale shark behavior due to mistreatment of domestic tourists against whale sharks. Tourists who visit usually do the action by tapping the boat and whale sharks appear and then fed.

To keep the survival of whale sharks in Indonesian waters alive naturally then we need to adopt policies regarding the existence of whale sharks from other countries. In the Philippines has done a good management of whale sharks like in Donsol. In the area, it has been designated as an area that can not be visited. They still let the wild side of whale sharks and campaigned to stop feeding. In Indonesia, considering the income aspect for the local government, the existence of ecotourism is a hope that enough to provide benefits for the region and surrounding communities. However, in order for this activity to work properly, tourists that visit the site must comply with the regulations issued by KKHL-Directorate General of Sea Spaces Management (2014) related to the guidelines of whale shark tourism.

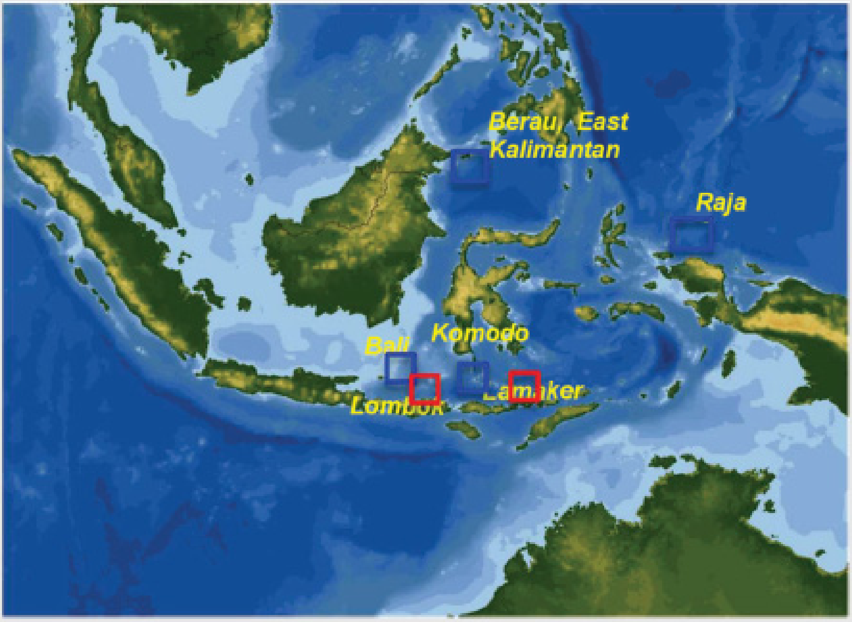


Figure 43. Location of Habitat and Ecotourism and Capture Location of Manta Rays

3.3.6 Illegal Trade

Since the issuance of Minister of Marine Affairs and Fisheries Decree on the export prohibition of shark and ray products that entered the appendix II CITES No. 34/ MEN.KP/ 2014 extended by No.59/MEN.KP/2015, there has been an illegal trade in shark and ray products in Indonesia. However, the incident has been successfully thwarted by the Government through good cooperation and coordination between the Directorate General of Marine and Fishery Resources Control, Water Police, Wild Crime Unit (WCU) -WCS, and the community.

The occurrence of some cases is due to the understanding of the regulation of ban on shark and ray products trading and CITES II Appendix. Some fishing communities, business actors, and officials in the field have not fully understood the regulation, resulting in mistakes in taking action on the ground in some areas. Different perceptions of society emerged as a result of socialization that has not been optimal (Dharmadi, 2016) because it has not reached all business actors and fishermen community of sharks and rays that are widespread on the coast of Indonesia. Therefore, the socialization of regulations related to shark and ray resources needs to be intensively and continuously carried out by the central and regional governments, especially in areas that are the center of shark and rays high production, for example in Jakarta, Bali, Sumatra, Lombok- NTB, Kupang-NTT, Kalimantan, and Sulawesi. A DNA barcoding based on a short fragment of the mitochondrial cytochrome oxidase I (COI) gene has been used to identify fins to species (Pinhak *et al.*, 2012; Sembiring *et al.*, 2015), this technique is not used to promote regulation of shark fisheries.

3.3.7. Poaching

Sedikit data dan informasi yang tersedia terkait dengan poaching on sharks and rays in Indonesia waters. In Lamakera poaching possibly occurred on whale shark using spear. It has been recorded in 2015 (4 individuals) and 2016 (2 individuals) (Misool BFTIN, 2017). However, this activity is debateable since it argued as part of traditional fishing right.

3.3.8. Trade and Utilization (e.g. Tradisional Use)

Trade of shark and ray products is quite high in Indonesia because in addition to demand from several importing countries as well because shark and ray products have a relatively high price in the international market. Figure 44 illustrates the purpose of exporting shark products to foreign countries. The volume trends of some shark and ray products exported to some countries in the period 2014-2016 are presented in Table 30. Almost all shark and ray products showed significant volume increases during the period. This illustrates that the high demand for global markets will have an impact on increasing exploitation of sharks and rays in nature. This condition requires serious attention to take management steps. High exploitation of fish groups that are vulnerable to extinction (elasmobranchs) if not balanced by management efforts will impact on the increasing scarcity of some sharks and rays in the nature and along with the increase in time, the extinction can be happened.

Table 30. Volumn of Shark and Ray Product that are Exported from Jakarta in 2014-2016 (LPSPL-Serang, 2017)

Product	2014	2015	2016	Total volume (kg)	Increased Volum (%)
Shark :					
Live	0	91.5	702.1	793.6	>100
Meat	0	952,487.4	1,544,473.5	2,496,960.9	>100
Fin	3,484.5	288,634.6	786,081.2	1,078,200.3	>100
Bone	0	77,178.2	246,926	324,104.2	>100
Skin	0	3,155	18,539	21,694	>100
Lever oil	0	50	0	50	-
Ray :					
Meat	0	228,655	405,075	633,730	>90
Gill raker	0	0	2,045	2,045	-
Web skin	0	18,844.7	80,844.7	99,839.7	>100
Dry skin (per sheet/ind)	400	24,360	72,851	97,611	>100

Note: Hongkong (24%), China (18%), Filipina (11%), Singapore (10%), Thailland (10%), Japan (6%), USA (4%), Malaysia (3%), Taiwan (2%), and Korea Selatan (2%).

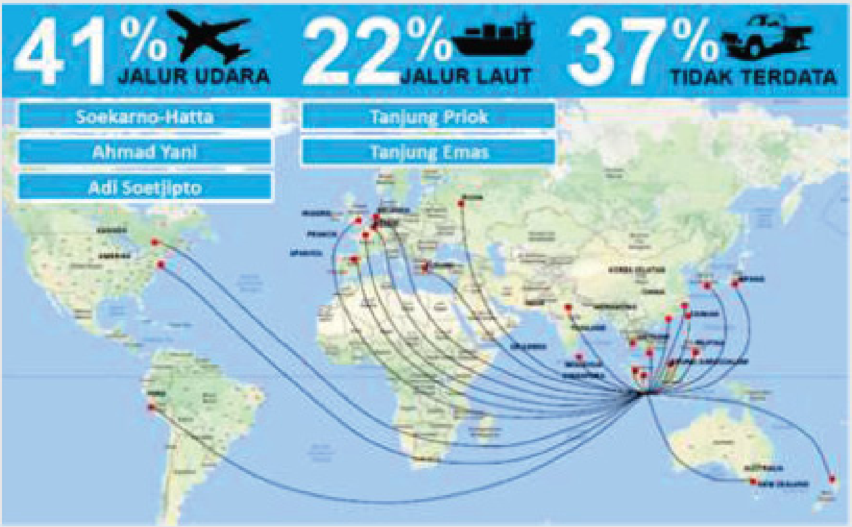


Figure 44. Export Destination Countries of Shark and Ray Product

While the shark utilization is traditionally done for generations by the fishermen of Lamalera Village, Wulandoni Sub-district, Lembata District, and Lamakera-NTT by doing whale hunting including whale sharks and manta rays. Traditional activities of biota hunting was conducted since the 1950s. So far the utilization of the hunt result is for the consumption of local communities around Lamalera and Lamakera villages. Traditional catch of marine mammal and whale shark and their use only for local consumption are still permitted by the Government, but in terms of conservation of fish resources, this has an impact on the declining populations of marine mammals, whale sharks and manta rays in nature. To overcome this problem, the efforts of socialization in building and raising awareness of local communities on the importance of marine biota resources existence must continue to be done. Meanwhile, the solution is needed to create alternative livelihood for the community especially for Lamalera and Lamakera villages.

3.3.9. Habitat Degradation

The elasmobranch population are morphologically and ecologically diverse, occurring in habitats ranging from freshwater river systems to pelagic waters and bathyal (deep-water) habitats of the continental slope. Many sharks and rays use specific habitats at various stages of their life cycle. For example, many species utilize estuaries and seagrass beds as nurseries or foraging grounds (Heithaus *et al*., 2002; Heupel *et al.*, 2007).

Mangrove forests in Indonesia contribute about 23% of mangrove ecosystem in the world (Giri *et al.*, 2011). The regionally vital mangrove ecosystems situated in Papua, Kalimantan and Sumatra (FAO, 2007). FAO (2007) stated Indonesia has lost 40 percent of its mangroves in the recent three decades. That implies have the fastest rate of mangrove destruction in the world (Campbell and Brown, 2015). Moreover, logging and conversion of land to agriculture or salt pans (Java and Sulawesi) and degradation due to oil spills and pollution (East Kalimantan) also contribute to habitat loss of mangrove forest (FAO, 2007). Therefore, a proper action needed to minimize habitat degradation to ensure the sustainability of elasmobranch population.

3.3.10. IUU Fishing

There is no case for this species group.

3.3.11. Habitat Conversion

Many sharks and rays use specific habitats at various stages of their life cycle (FAO, 2007). Mangrove conversion to shrimp ponds argued as one of main factors, such as Sumatra, Sulawesi and East Java. It possibly affected elasmobranch population in that area.

3.3.12. Overlapping/Conflicting National Policies and Regulation

There is no case for this species group.

IV
Initiative

4.1 Management and Protection Initiative by Country

Indonesia adopts three pillars of marine conservation paradigm namely: protection, preservation and utilization. Under this regime, conservation policy does not entirely consist of prohibition and restriction. Instead, the conservation management also provides opportunity for people to make use of the available resources but with strict conditions. Additionally, marine species protection status generally divided into two categories namely: partially protected species and fully protected species. The earlier involves both temporal and spatial species protection while the latter rules comprehensive protection toward a marine species.

All species of sea turtles and marine mammal encountered in Indonesia are fully protected by law according to Government Regulation No 7 Year 1999. That said, direct use of any kind toward the species listed in the regulation is totally prohibited except for research and education. A very limited indirect use of sea turtles and marine mammals, however, is still possible (for example: turtle watching and dolphin watching) but with strict supervision under relevant authority.

Of all shark species found in Indonesia, whale shark is the only species that is fully protected while for the rays, manta rays are included in the full protection list. With regard to CITES regulation, the international trade of all sharks and rays that are listed in the CITES appendices have been controlled. For instance, sphyrna spp and charcharinus longimanus have been banned for export ever since the species listed in CITES Appendix II in 2013.

As part of management response, national action plan for either sharks/rays, marine mammals and sea turtles are already in place and being implemented. The Government of Indonesia have been working closely with community, local government, NGOs and environmentalists in order to run the action plan that valid for five years more effectively.

In addition to the species protection, Indonesia also combines the initiatives with habitat protection through the development of marine protected area (MPA). The country has declared its commitment to develop 30 million hectares of MPA by 2030. With support of local governments, to date, we have established more than 19 million hectares of MPA. All of this effort is expected to supplement the species conservation action through the protection of key habitats like nursery ground, feeding ground and spawning ground.

4.1.1. Species Protection

Protection activity aim to avoid species extinction in natural habitats. There are two approaches used by determining the status of the species become the protected species and the provision of suitable habitats to support life of the species.

Through Government Regulation Number 7 Year 1999 more than 200 endangered species have been established the status of protection, about 43 species are aquatic species, such as: turtles, whales, dolphins, lola, and others. Until now these regulations are still valid, no new species have been added yet and no species have been removed from the list of protected species.

Furthermore, referring to Government Regulation Number 60 Year 2007 regarding "Conservation of Fish Resources" and Regulation of Minister of Marine Affairs and Fisheries Number 3 Year 2010 as amended by Regulation of Minister of Marine Affairs and Fisheries Number 35 Year 2013, Ministry of Marine Affairs and Fisheries has set 6 (six) endangered species into protected species, namely: terubuk fish, whale shark, napoleon fish, manta rays, and sea bamboo.

In addition to protection effort, conservation is also undertaken and aim to increase populations of protected or endangered species in natural habitats. There are three main efforts that undertaken in the framework of species conservation: population increase in natural habitat, rescue of stranded species and by-catch in fishing activities.

Indonesian waters are habitats and ruaya paths of various types of protected biota, in the ruaya process the stranded incidents are often occured. This incident generally results in the death of the species. For the rare species, the large number of deaths are caused by the stranded incidents can be a serious threat to the sustainability of its generation. Currently, the rescue efforts of this stranded species have been carried out through several activities, including: the provision of stranded species handling guidelines, the development of stranded species handling networks in the area and the technical guidance on stranded species handling. Since 2013 until 2015 the network of stranded mammal waters rescue has been initiated in 12 (twelve) provinces and the number of trained stakeholders reaches more than 700 people. Some locations that have been initiated include: West Kalimantan, East Kalimantan, East Nusa Tenggara, Bali, Riau Islands, Yogyakarta, Banten, West Sumatra, Bangka Belitung, West Papua, Central Sulawesi and North Sulawesi.

Protected and endangered species habitat are also a catching area for various types of fishing gear, in fishing activities often encountered protected species are also caught as by-catch. Many turtles are caught as by-catch in the operation of shrimp trawls, gill nets and longlines. Some effort that were already conducted by government to reduce by-catch turtles in shrimp trawl operations are required all shrimp trawling fleets using Turtle Excluder Devices (TEDs), and the use of "circle hook" on the operation of the longline tuna.

- Handling of turtle sampling should be conducted outside the area; KPA (TN, TWA, THR), KSA (CA, SM) and TB based on KEPMENHUT 447 / Kpts-II / 2003 and obtained a license. (Catching/taking of commercial and non-commercial wild plants and animals from natural habitats can only be conducted outside the Conservation Area /KPA (TN, TWA, THR) and KSA (Nature Reserve, Wildlife Sanctuary) or Taman Buru in accordance with Article 5 paragraph (1) KEPMENHUT no 447/Kpts-II/ 2003 and shall obtain a permit under section 26 (1).

- Permit of sea turtle catch as protected animals are only given by the Minister of Forestry with the recommendation of LIPI (Indonesian Institute of Science) as Sciencetific Authority that set in section 29 Kepmenhut 447 / Kpts-II / 2003. So that the UPT underneath has no authority to issue turtle fishing permit.

4.1.2. Habitat Protection

Protection efforts of endangered species are also conducted through the provision of suitable habitats to support the life of endangered species, spawning ground, nursery ground and feeding ground and spawning endangered species as conservation areas. Until now coral reef habitats, seagrass and mangrove become the main basis in determine conservation areas.

The Government of Indonesia has committed to establish Marine Protected Area throughout Indonesia for 20 million hectares by 2020. This intention was conveyed by the President of the Republic of Indonesia at the World Ocean Conference (WOC) and Coral Triangle Initiative (CTI) Summit in Manado in 2009. Based on MMAF data, until now has built 165 water conservation areas with an area of 17, 98 million ha. Furthermore, the Government of Indonesia is committed to protect and conserve the whales and dolphins. In addition to establish all types of whales and dolphins as protected biota, the government has also established several conservation areas that been designated as a habitat protection area and ruaya path.

Establishment of Sawu Sea as National Marine Protected Areas (NMPAs) Sawu Sea that located in East Nusa Tenggara Province is intended to protect the habitat and migration path of whales that routinely perform ruaya in the territorial waters. The area of KKPN of Sawu Sea reaches 3.5 million hectares and is the largest waters conservation area in Indonesia. In addition, the government also initiated the protection of dolphin habitats in the waters of Kiluan Bay, Lampung Province, Lovina (Bali), and Badung (Bali).

In addition to the development of marine conservation areas, several local governments in Indonesia, in particular: Raja Ampat District in West Papua Province and West Manggarai Regency in East Nusa Tenggara Province have issued a regional regulation regarding the ban on shark fishing in its waters. The areas that set the ban on shark fishing are driven by marine tourism activities, where sharks are also one of the diving attractions in the region.

4.1.3. Genetic Conservation

Turtle Genetic. Handling of turtle sampling should be conducted outside the area; KPA (TN, TWA, THR), KSA (CA, SM) and TB were performed under KEPMENHUT 447/Kpts-II / 2003 and obtained a license. The collection and capture of both commercial and non-commercial wild plants and wildlife from natural habitats can only be conducted outside the Conservation Area/KPA (TN, TWA, THR) and KSA (Nature Reserve, Wildlife Sanctuary) or Taman Buru pursuant to Article 5 paragraph (1) KEPMENHUT no 447 / Kpts-II / 2003 and shall obtain a permit under section 26 (1).

Permit of sea turtle catch as protected animals are only given by the Minister of Forestry with the recommendation of LIPI (Indonesia Institute of Science) as Sciencetific Authority that set in section 29 Kepmenhut 447/Kpts-II/2003. So that the UPT underneath has no authority to issue turtle fishing permit.

4.2. Support by Developments Partners and Institutions

4.2.1. Development of Shark Bycatch Mitigation Technology

Since 2015 WWF and KKP have initiated an environmentally friendly fishing gear competition. The first winner was a innovator of shark bycatch mitigation technology with electricity usage. Technological development since that year continues to be conducted. Applied field testing has been done with effective results to avoid elasmobranch, construction and mitigation development efforts on certain shark species will be done in the next period

4.2.2. Carrying Capacity of Fisherman in Shark Bycatch Handling

Awareness efforts in the handling of shark bycatch will continue to be conducted. At least until now has more than 500 fishermen been trained in various fishing ports. In the future, WWF will continue to assist fishermen with the main focus currently on the West Manggarai regency area which related with the shark important habitat in the location.

4.2.3. Protection of Shark Important Habitat

WWF encourages the existence of area based shark management that is identified as an important shark habitat area such as nursery ground. The management focus is driven by the WWF in 4 main locations ie in Wakatobi National Park, Komodo National Park, Cendrawasih Bay National Park and East Flores Regency.

4.3. Policies Legislated or Enacted

a. Law Number 5 Year 1990 on the Conservation of Natural Resources and Ecosystems. This law regulates provisions on conservation steps so that the natural resources and ecosystems are always maintained and able to realize the balance and related with the development itself. The animals that are organized include all types of animal natural resources that live on land, and or in water, and or in the air.

b. Law Number 31 Year 2004 on Fisheries as amended by Law Number 45 Year 2009. This Law regulates all activities related to the management and utilization of fish resources and the environment, including the conservation of fish resources such as sea turtles, marine mammals etc. This law provides the basis for determining the size of fish species to be caught, water areas, protected fish species, waters conservation areas, and sanctions related to IUU violations.

c. Government Regulation Number 7 Year 1999 on the Preservation of Plant and Wildlife Species. This Regulation on the Preservation of Plant and Animal Types is derived from Law Number. 5 year 1990 on the Conservation of Natural Resources and Ecosystem. The attachment of this government regulation contains a list of protected species of plants and wild species, including turtles, whales, dolphins, dugongs and saw rays.

d. Government Regulation Number 8 Year 1999 on the Utilization of Wild Plant and Wildlife Species. This Regulation arrange the utilization of natural resources of both plants and wildlife and/or its parts and the results thereof in the form of assessment, research and development, breeding, hunting, trade, demonstration, exchange and maintenance for pleasure.

e. Government Regulation Number 60 Year 2007 on Conservation of Fish Resources. This regulation is derived from Law Number 31 Year 2004 regarding Fisheries. The content manage the protection, conservation and utilization of fish resources, including ecosystems, species and genetics to ensure their existence, availability and sustainability while maintaining and enhancing the value and diversity of fish resources.

f. Decree of the Minister of Marine Affairs and Fisheries Republic of Indonesia Number 18 /KEPMEN-KP/2013 on Determination of Whale Shark Fully Protection Status (*Rhincodon typus*). Based on this Decree of the Minister of Marine Affairs and Fisheries, whale sharks are designated as fully protected fish species, and extractive use of whale sharks and their parts is prohibited under legislation

g. Decree of the Minister of Marine Affairs and Fisheries Republic of Indonesia Number 4/ KEPMEN-KP/2014 on Establishment of Fully Protection Status for Manta Rays. This rule contains the determination of the full protection status of manta rays (*Manta spp*.). The manta rays consist of two species: *Manta birostris* and *Manta alfredi* that have been designated as fully protected fish species. With such a decision, the arresting and trading activities of manta rays parts of body and its derivative products are declared to be prohibited activities.

h. Regulation of the Minister of Marine Affairs and Fisheries Republic of Indonesia Number 12/PERMEN-KP/2012 on Fishing Activities in the Open Seas. It is stipulated that every fishing vessel on the open seas that obtained bycatch that ecologically related species of tuna fisheries in the form of sharks, seabirds, sea turtles, marine mammals including whales, and monkey sharks are required to take conservation measures.

i. Regulation of Minister of Marine Affairs and Fisheries Number 57/PERMEN-KP/ 2014 on 2nd revision of Regulation of Minister of Marine Affairs and Fisheries Number 26/ PERMEN-KP / 2013 on Fishing Activity in WPP Republic of Indonesia. The substance that set forth in this regulation is about the obligation to release thresher sharks that caught in living conditions and the obligation for fishermen to report thresher sharks that caught in dead condition.

j. Regulation of Minister of Marine Affairs and Fisheries Number 59 / PERMEN-KP /2014 jo regulation of Minister of Marine Affairs and Fisheries Number 34 / PERMEN-KP/2015 jo Regulation of MMAF Number 48/PERMEN-KP 2016 on the Prohibition of Hammerhead Shark and Oceanic whitetip Shark Out of Indonesia Area. In response to the enactment of CITES rules on trafficking of three hammerhead sharks and oceanic whitetip sharks into the Appendix II list of CITES in 2014, the Indonesian government through the Ministry of Marine Affairs and Fisheries had issued a rule prohibiting the export of all forms of hammerhead shark and oceanic whitetip sharks, derivative products, but still permit the capture and utilization of its products for domestic trade.

k. Regulation of Minister of Environment and Forestry Number P.20/MENLHK/ SETJEN/KUM.1/6/2018 on Protected Species of Plants and Wildlife Species. When this Ministerial Regulation comes into force, the attachment of Governemnt Regulation Number 7 Year 1999 revoked and declared invalid.

4.4. StatusofEnforcement

In Indonesia, all 6 species of turtle are categorized to protected wildlife based on Law No. 5 Year 1990 on the Conservation of Natural Resources and Ecosystem. The law states that everyone is prohibited from capturing, harming, killing, storing, possessing, maintaining, transporting and committing protected animals to death or living, of all parts or parts of the body. With a criminal penalty of 1 year imprisonment or a fine of IDR 50 million.

Although the legal rules on turtle have been very clear, but the illegal use of turtle either in the activity of illegal hunting of adult turtle or turtle egg and turtle trade are still often happened. The Ministry of Forestry has often conducted curbing operations for egg thieves and illegal trade of eggs and turtles (both dead and alive). Figure 45. shows that turtle trade (meat, carapaces, eggs) occured almost throughout Indonesia. East Kalimantan and Bali provinces became the center of trade, as seen from the many cases in both regions for the period 2007-2012. East Kalimantan recorded as the highest number of cases in which 387 violations and second place was Bali as many as 62 cases (Statistics Ministry of Forestry, 2013).

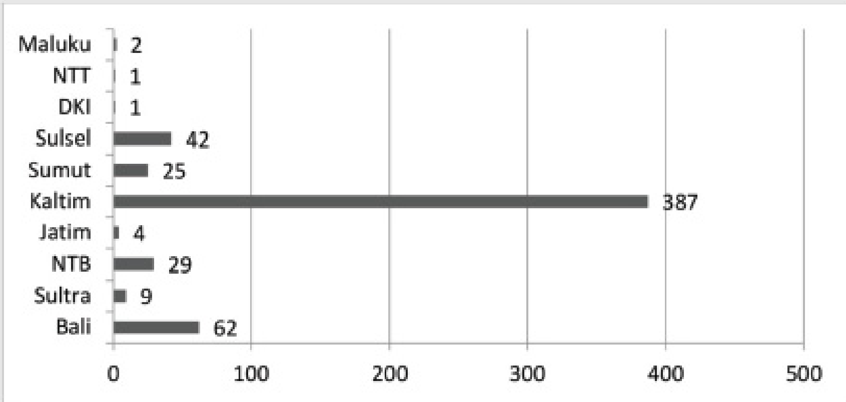


Figure 45. Recapitulation Graph of Arrested Turtle Trade Case (2007-2012). Source: Statistic Data Dit. PPH-PHKA

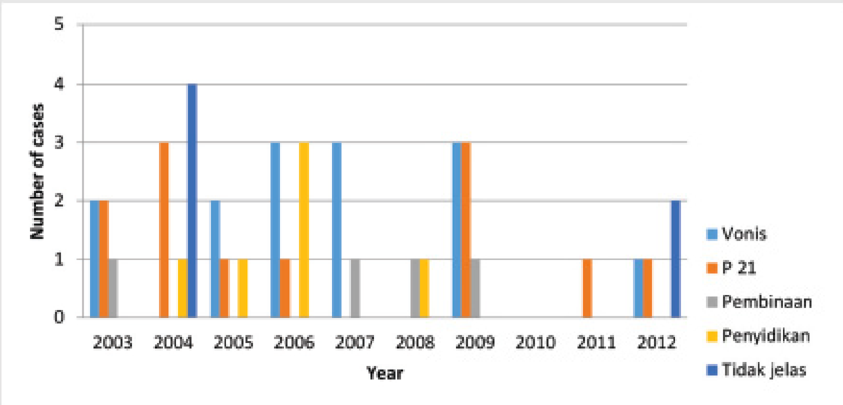


Figure 46. Graph of Law Case and Handling of Turtle Trade Case (2003-2012)Source: Statistics Data – Ministry of Forestry (2013)

Figure 46 shows that in 2003 the court sentenced 14 turtle trading cases and 12 cases in stage P.21 (case files are complete and ready to be brought to court). Nevertheless there are also several cases where the law enforcement process is not yet complete, unclear and only a form of coaching sanction. This is generally caused by incomplete evidence and weak law enforcement related to environmental crimes.

For the handling of turtle egg trade cases, law enforcement efforts are implemented throughout turtle egg trade centers, among others in West Sumatra, West Java, Kalimantan Tmur, East Java, Bali and several other areas

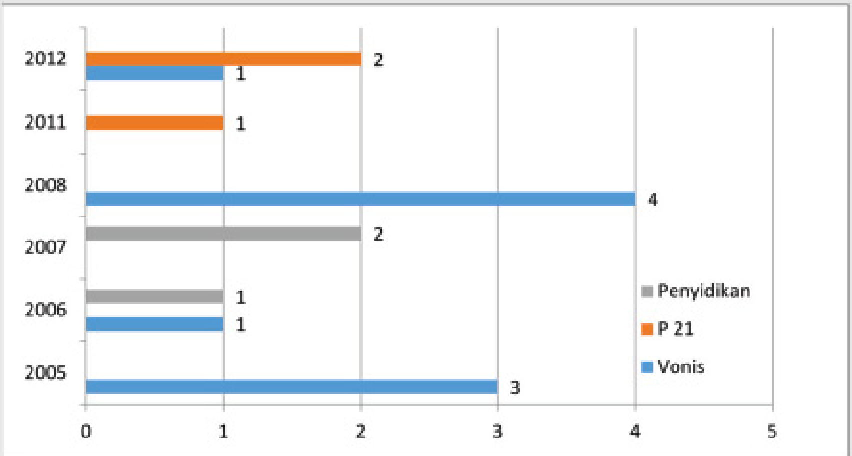


Figure 47. Recapitulation Graph of Turtle Egg Trade Case Handling In East Java Province During 2005 – 2012. Source : Statistics Data – Ministry of Forestry, 2013

Figure 47 shows the handling of turtle egg trade cases in East Java from 2005 to 2012 conducted by the Ministry of Environment and Forestry. The number of turtle egg trade cases handled is quite fluctuate each year, but every year there are cases that can be processed completely to the level of the legal verdict. Most cases of law occurred in 2008 and the whole case received a legal verdict. However, the number of handled cases has not shown the actual conditions for violations of law both hunting turtle and harvesting turtle eggs. The phenomenon of "iceberg" also occurs in the case of turtles, where cases of illegal use of turtles and eggs that appear on the surface and handled by law enforcers are very different from the actual case. Comprehensive law enforcement, coordination among law enforcers and synergy among all stakeholders is urgently needed to address cases of environmental crime related to sea turtles. It is therefore necessary for regional cooperation between countries to be strongly committed in the eradication of shops that selling turtle products.

Furthermore, since the issuance of export ban regulations for oceanic whitetip sharks and hammerhead sharks, and full protection of manta rays, surveillance and law enforcement has been conducted for the circulation of shark and ray species. Based on CTF data, from 2014 to January 2017, there were 19 incidents smuggling twarthed of hammerhead shark fins, oceanic whitetip sharks, and manta rays. Detailed information on illegal trade in shark and mantas products can be seen in Table 31.

Table 31. Several Cases of Ilegal Trading of Shark and Ray Product During Period 2014-2017

No.	Case	Period	Incidents Location	Decision/Sanction
1	Trading of 53 saw shark muzzle	August 31,2014	Tanjung Benoa-Bali	Inprisonment 18 monts, fine IDR 10,000,000.00
2	Trading of ± 6 kg manta rays gill in dry form.	August 22,2014	Surabaya	Fine IDR 5,000,000.00 (five million rupiah)
3	Smuggling ± 226 kg manta rays gills in dry form	September 21, 2014	Surabaya	Fine Rp. 20,000,000.00 (twenty million rupiah)
4	Trading of one complete manta rays	September 26, 2014	Indramayu	Inprisonment for 10 months and fine IDR 10,000,000.00
5	Trading of ± 26 kg manta rays gills in dry form	October 3, 2014	Indramayu	Inprisonment for 1 year and 4 month and fine IDR 50,000,000.00
6	trading of 3 shark fins and 2 saw shark muzzle, 30 packs of turtle meat	October 31, 2014	Kuta-Bali	Inprisonment for 6 month and fine IDR 10,000,000.00 (ten million rupiah) subsidair 2 month
7	Trading of ± 103 kg manta rays gills in dry form	September 7, 2014	Jembrana, Bali	Inprisonment for 8 month and fine IDR 50,000,000.00 (fifty million rupiah)
8	Smuggline ± 2 kg manta rays dry gill	June 3, 2015	Lebakk	Coaching
9	Distribution/transaction form protected animal in the form of manta rays gills	June 19, 2015	Tanah Gadang II, Desa Rumbuk, Kec. Sakra Kab. Lombok Timur	In the court process

No.	Case	Period	Incidents Location	Decision/Sanction
	Distribution/buy and sell transaction of 2 set of whale shark fin and manta rays bones.	June 22, 2015	Tanah Gadang II Desa Rumbuk Kecamatan Sakra Kabupaten Lombok Timur	Inprisonment for 5 (five) month cutting custody and fine each IDR 2,000,000.00 (two million rupiah) subsidair 1 (one) month confinement
11	Distribution/buy and sell transaction of protected animals in the form of manta rays gills.	June 22, 2015	Kampung Koko, Desa Tanjung Luar, Kecamatan Keruak, Kabupaten Lombok Timur	Inprisonment for 4 (four) month cutting custody and fine IDR 2,000,000.00 (two million rupiah) subsidair 1 (one) month confinement
12	Trading of 10 packs or ±274 Kg hammer head shark fin, ±1,2 Kg oceanic whitetip shark fin	June 26, 2015	Surabaya	Fine IDR 50,000,000.00 (fifty million rupiah)
13	Tradingof 2 tons hammerhad shark and oceanic whitetip shark fins	October 5, 2015	Bandara Soeta-Jakarta	P-21
14	Trading of 274 kg hammerhead shark fins and 1.2 kg oceanic whitetip shark fins	October 15, 2015	Tanjung Perak-Surabaya	PN court process Surabaya
15	Trading of Manta Rays Gills. Evidence 10 kg of dry manta rays gills	May 17, 2016	Pelabuhan Ratu	Investigation
16	Trading of shark whale	May 26, 2015	Maluku	Investigation
17	Trading of 340 kg manta rays bones	July 18, 2017	Surabaya	Investigation

No.	Case	Period	Incidents Location	Decision/Sanction
18	Trading of 25 kg manta ray dry gills	November 23, 2016	Lembata	Investigation
19	Trading of 1.7 kg manta rays dry gills, 3 sacks (210 kg) of mix rays bones and 1 set of whale shark fins	January 16, 2017	Jember	Investigation

V
Way Forward

5.1. Strengthening Data and Information on Endangered Species

Strengthening data and information on endangered species aims to prepare a database of endangered species. Types of data and information that need to be strengthened include: population status data, data utilization, data distribution, data threats and other related data. This data and information is expected to be the basis for policy making regarding the conservation of endangered species, whether for the purpose of protection or sustainable use of resources.

Until now, shark and ray fishery data are still a major obstacle, therefore the strengthening of data and information on shark and ray fishery becomes one of the main strategies in this NPOA. The main objective of comprehensive baseline data is indicated by the standardized shark and ray fishery data and information which accessible through the official website of the Ministry of Marine Affairs and Fisheries. In order to create the standardized and valid data for shark and ray fisheries, optimization of the utilization of general manuals for shark and ray species identification is vital.

In addition, the improved quality of the resulting data can be increased for certain species, and available to the species level through standardization of shark and ray data formats that are connected to the database system, particularly at the main landing sites of sharks and rays.

One method to measure the success of sea turtle conservation is through the activity of turtle nest egg data on the beach and the calculation of the average power hatch of hatchlings. The more nests recorded, the larger the turtle population is predicted and the more hatchlings to be produced from the turtle nesting beaches. Therefore it is important in a turtle conservation management both locally and internationally to collect data with the same methodology in order to analyze its population status and success rate of hatchlings in an attempt to measure the success of sea turtle conservation in the longstanding Coral Triangle region, especially for green turtle species and hawksbill turtles that common found in the region. Nevertheless, hawksbill is a type of turtle that has a critical status so that the joint challenge is how to stabilize the existing population and continue to collect population data.

5.2. Research Development

The development of shark and ray research needs to be conducted in Indonesia, considering that shark and ray fishery have lasted long and involving traditional fishermen and subsistence fishermen. Therefore, shark and ray research are expected to address the constraints related to biological, management, social and economic aspects so can assist the government in formulating policies on the management of sharks and rays.

Development of sea turtles research. During this time, sea turtle research is generally carried out in nesting beaches. This is done considering the nesting habitat as the most accessible habitat and an important habitat to ensure turtle regeneration, so that various studies have been done in this habitat. While other important habitats are feed habitat (still conducted minimal), good distribution, the area, its condition and the threat.

Turtles can not be separated from their feeding habitat. But allegedly the current availability of feed decline, this impact to the green turtles that are found to eat seaweed belonging to the farmers so that is very harm. Although the feed for the green turtle should be seagrass. Therefore, it is allegedly that there has been a shifting pattern of feeding types due to the depleted availability of seagrasses.

Therefore, the development of research toward turtle feeding habitat becomes quite important to be done and mapped both nationally and internationally. Given the turtle has no territorial boundary in selecting the feeding habitat. To ensure the availability of feed is to conduct research in order to ensure every regeneration of born turtles can survive to adult. In addition, the development of turtle genetic research is also necessary in every country in the Coral Triangle region both for turtle breeding and feed habitats. This research is expected to be the base of reference in efforts to conserve the genetic turtle and determine the unit management of a habitat. The results of this genetic research between countries are expected to be conducted annual information exchange to be able to arrange the Turtle "Genetic Bank" or genetic map in the Coral Triangle region.

Currently, the bycatch turtles by fishing gear is increasing. Therefore, the research development of fishing gear-friendly for turtle and other megafauna species is needed to reduce bycatch rate. Although some modification of fishing gear has begun to be developed but further research still needs to be piloted to be truly effective and efficient in reducing bycatch levels but can increase the number of fish catches for fishermen.

Development of marine mammal research. One of important research to do in the CTI area is to understand the migration route. The research proposed here is expected to include the member countries of CTI with come up with the results to develop the conservation of marine mammals in the regional level.

Development of shark and ray research. It begins with the formulation of practical research roadmap involving board range of aspects, biology and ecology, social-economics and institutionalization, and conservation and management. Research roadmap is expected to showcase the constraints of resources in conducting research, and also integrate potential research study in particular area. In order to generate more aspiring scientist whose research will supporting the government in policy-making process for sustainable management of sharks and rays. It is imperative for collaboration in conducting stock assessment on sharks and rays, especially for shared stock species.

In the latest National Symposium of Sharks and Rays in Indonesia, held in 2018, the result of submitted papers were only 15% for the theme of social-economics and institutionalization, followed by conservation and management (25%) and biology and ecology as the most researched topic (59%). Hence, research on socio-economic and institutional aspects of shark and ray demand for resources is still not widely explored in the context of ecosystem services, as well as the study of the economic value of each species. Nevertheless, the need to switch the exploitative fisheries activity are also should be considering ranges of ecological functions, tourism benefits, fisheries characteristics, protein fulfillment and livelihoods.

5.3. Carrying capacity of human resources

Increased of human resource capacity, particularly on data collection and control officers of shark and ray utilization, that targeted to recognize/identify protected shark and ray and/or whose utilization is regulated by RFMOs/conventions. It aims to improve the quality of the resulting data for the sustainable and effective management of sharks and rays.

Several current program activities that have been undertaken, including: (i) initiating regional tranning centers through the Indonesian Institute of Sciences; (ii) developing cooperation in capacity building of human resources through collaboration of training on monitoring of endangered species and the handling of stranded marine mammals; (iii) enhancing regional capacity in the identification of shark and ray species, including identification of shark and rays derivative product (fin, skin, bone, teeth); and (iv) enhancing turtle monitoring capacity for community-based and managerial units.

Currently, turtle nesting monitoring activities have been conducted by both government and community. But often turtle monitoring activities are accompanied by relocation of the nest as an effort to prevent hunting or to facilitate monitoring of hatchlings for tourist destinations. However, relocation efforts that are not accompanied by good skill or capacity often cause a malfunction in the relocated egg nest. In addition, in the turtle monitoring activities undertaken by the community there is often a misidentification of the type of turtle and there is a difference in the data collection system. Therefore, the need to standardize and improve the capacity of the turtle monitoring team in various turtle nesting beaches.

5.4. Awareness

Several endangered species have been protected and their presence has an important role in the marine ecosystem. However, many people do not understand the importance of conservation of endangered species. Therefore, continuous socialization and awareness of the community to raise an understanding of the importance of conservation of endangered species is required, particularly related to traditional uses and customary needs. The awareness activities in Indonesia are mostly done for sea turtle groups. Activities that can be undertaken include: (i) promoting a standardized turtle education and conservation center; (ii) initiate a conservation awareness community-based campaign of whale sharks and manta rays; and (iii) carrying out an endangered species awareness campaign on CT Day, SOM (photo booth and mascot).

Various community awareness efforts of the endangered species conservation, especially turtles have long been conducted. But so far there has been no standardized turtle education and conservation center to become a recommended learning location. Therefore, in every country, it is important to have a standard network of sea turtle education and conservation centers and to exchange information and expertise related to good and procedural turtles. One of the centers of education and conservation that has been built in Indonesia is the Turtle Conservation and education center (TCEC).

Turtle Conservation and Education Center (TCEC) is a group of turtle conservation in Serangan Island. TCEC established since January 20, 2006, TCEC officially opened by the Governor of Bali, Dewa Barata. The establishment of TCEC in Serangan received support from NGOs and government such as WWF, Denpasar Mayor, Bali Governor and BKSDA. TCEC activities are growing in line with support from other parties such as Polair and BPSPL Denpasar.

Formerly Bali was hit by the problems of catching and trading of turtle on a large scale. Some cases occured under the pretext of the interests of religious and cultural rituals. The impact of illegal turtle trading activities is about 10,000 turtles were consumed per year. TCEC stands as one of the strategies to reduce turtle trade. In order to overcome the need of turtle for customary ritual needs, TCEC acts as an institution providing turtle needs, of course the use of turtles as a means of this ritual continues to be restricted as an effort to preserve turtles. In line with this, TCEC continues to encourage people not to consume turtle products, either ritual or other necessities.

The mission in TCEC's turtle management is 3E, namely Education, Ecology and Economics. Turtle ecotourism activities is one of the efforts to introducing turtles to visitors with the hope of being able to form an awareness to preserve turtles. TCEC seeks to support livelihood alternatives in addition to turtle trade through ecotourism activities and the adoption of hatchlings as revenue of the institutions and surrounding communities.

TCEC facilities include Hatchery, rehabilitation pond and 16 temporary post-hatch ponds. This facility supports to do the effort of sea turtle spawning. Some other supporting facilities such as Hall, Mess, public toilet and Rescue Car are provided to support education activities and other activities in turtle conservation efforts. TCEC turtle conservation efforts extend beyond the Serangan island. Turtle eggs from several nesting beaches in Bali to several locations of Java Island in the TCEC Serangan as an effort to reduce hunting and turtle egg trade practices.

5.5. Supervision and Law Enforcement

As a follow-up to the protection of endangered species, a series of socialization activities to related institutions such as: Department of Marine and Fishery, Fisheries Supervisor, Water Police, Quarantine and fishermen and other related stakeholders are continuously conducted. However, based on information from monitoring and reporting officials in various media, cases of illegal use are still easily found in the field. The synergies of various oversight and law enforcement agencies are indispensable in the context of achieving the objectives of protection of endangered species.

Supervision and law enforcement of sea turtles require strong cooperation and commitment from CTI member countries to save turtles from extinction, because they are migratory (cross-country) animals, which can reach thousands of kilometers between nesting beaches and feeding ground . So that turtle rescue should be done jointly with the unanimous determination of all CTI member countries, such as eradicate the shops/kiosks sellers of turtle products in their respective countries. So the demand for turtle products can be minimized as much as possible, so turtle products are not worth more commercial. which ultimately led to the loss of people desire to hunt turtles, because it is not profitable. Similarly, the presence of ASEAN Wildlife Endangered Network (WEN) which still has not included turtles as a target animal of its operations, therefore the CT-6 countries urged that ASEAN WEN through its Special Investigation Group conduct regular operations on turtle products as an illegal trade in the scope of ASEAN countries.

5.6. Establishment of Network on Stranded Marine Mammals Handling

Indonesia marine waters are migration route areas of various types of cetaceans, during which many cetaceans are stranded. The frequency of occurrence of the stranded has a tendency to increase. The incidence of stretching and the location of the incident stranded to the present can not be predicted. The cappacea that was stranded at the time of its discovery was in dead condition and some were in living condition. The extent of coastal areas with potential for smuggling causes rescue of stranded mammals in difficult living conditions. To anticipate the problem, it is necessary to develop a network to carry out rescue program of stranded waters biota. Furthermore, a mechanism for sharing knowledge about the handling of marine mammals in the regional forums (workshops, conferences) is required.

5.7 Developing Sustainable Tourism as the Alternative Livelihoods

In Indonesian context, the charm of sharks and rays got famous as there were several tourism operators who offer the service to dive, interact, and observe with the charismatic species. Indonesia becomes top three destination of manta ray watching in the world, with 4 key locations in 11 sites. The economic potential of sharks and rays irresponsible tourism in Indonesia is supported by several studies about willingness to pay (WTP) value from marine protected area visitors. A site-based study in Labuan Bajo, Komodo National Park, East Nusa Tenggara, resulted in majority of visitor's willingness to pay additional fees for sharks, rays, and megafauna species conservation. According to existing studies, the most important reason of visitor willingness to pay was the will to contribute in conservation, so that they can seek the experience to encounter with charismatic species and to enjoy marine ecotourism in general. If sharks and rays sustainable management implemented effectively, then incentives from WTP value will provide advantages for community based tourism in marine protected area.

The initial stages of developing sustainable tourism as an alternative livelihood for people is the practice of community-based sustainable tourism, which, initiated the collaboration between key stakeholders such as local government authorities, local community, private tourism operators, and conservation organizations. Moreover, carrying capacity model in tourism landscape is one of the alternatives to put sustainable tourism into practice, for example by formulating Standard Operation Procedure (SOP) and Code of Conduct, an instrument to protect the sustainability of tourism site.

Reference

Acuña-Marrero, D., Jiménez, J., Smith, F., Doherty, P.F. Jr., Hearn, A., Green, J.R. (2014). Whale Shark (*Rhincodon typus*) Seasonal Presence, Residence Time and Habitat Use at Darwin Island, Galapagos Marine Reserve. PLoS ONE 9(12): e115946. https://doi.org/10.1371/journal.pone.0115946.

Allen, G. R. and Erdmann, M. V. (2007). Two new species of bamboo sharks (Orectolobiformes: Hemiscylliidae) from Western New Guinea. Aqua Special Publication vol. 13 no. 3-4. http://www.aqua-aquapress.com/pdf/13-Spec_Shark.pdf.

Allen, G.R. and Erdmann, M.V. (2008). Two new species of bamboo sharks (Orectolobiformes: Hemiscylliidae) from Western New Guinea. *Aqua, International Journal of Ichthyology*, 13 (3–4): 93–108.

Allen, G. R., Erdmann, M. V., and Dudgeon, C. L. (2013). Hemiscyllium halmahera, a new species of Bamboo Shark (Hemiscylliidae) from Indonesia. Aqua International Journal of Ichthyology vol. 19 no. 3. https://aqua-aquapress.com/hemiscyllium-halmahera-a-new-species-of-bamboo-shark-hemiscylliidae-from-indonesia/.

Ali, A., Lim, A.P.K., Fahmi and Dharmadi. (2013). Field Guide to Look-alike Sharks and Rays Species of the Southeast Asian Region. SEAFDEC/MFRDMD/SP/22: 107 pp.

Anna, Z and Saputra, D.S. (2017). Economic valuation of whale shark tourism in Cenderawasih Bay National Park, Papua, Indonesia. *Biodiversitas* 18 (3): 1026-1034.

Bahri, S. (2017, in Indonesian). Population Structure and genetic diversity of olive Ridley turtle (*Lepidochelys olivacea*) and its relationship with water current circulation in Indonesia. Thesis. Bogor Agriculture Institute. http://repository.ipb.ac.id/handle/123456789/88756.

Baum J.K. and Worm, B. (2009). Cascading top-down effects of changing oceanic predator abundances. Journal of Animal Ecology 78(4): 699-714. doi: 10.1111/j.1365-2656.2009.01531.x

Blaber, S. J. M., C. M. Dichmont, W. White, Buckworth, L. Sadiyah, B. Iskandar, S. Nurhakim, R. Pillans, R. Andamari, Dharmadi and Fahmi. (2009). Elasmobranchs in southern Indonesian fisheries: The fisheries, the status of the stocks and management options. *Rev. Fish. Biol. Fisheries* 19: 367–391.

Camhi, M., Fowler, S.L., Musick, J.A., Bräutigam, A. and Fordham, S.V. (1998) *Sharks and their Relatives – Ecology and Conservation*. IUCN/SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. iv + 39 pp.

Chodrijah, U and Faizah, R. (2015). Struktur ukuran dan nisbah kelamin ikan cucut kejen (carcharhinus falciformis) di perairan selatan nusa tenggara barat size distribution and sex ratio of silky shark (*Carcharhinus falciformis*) in the southern Nusa Tenggara Barat waters. Prosiding Simposium Hiu dan Pari. KKP-WWF.

Compagno, L.J.V. (1999a). Checklist of living elasmobranchs. In: Hamlett, W.C. (ed). Sharks, skates, and rays: the biology of elasmobranch fishes. Maryland: John Hopkins University Press. p 471–498.

Compagno, L. J. V. (1999b). Sharks. In: K E. Carpenter and V. H. Niem (eds.). FAO Species Identification Guide for Fishery Purposes. The living marine resources of the Western Central Pacific. Volume 2. Cephalopods, Crustaceans, Holuthurians, and Sharks. FAO, Rome. pp. 1193-1366.

Compagno, L.J.V. (2001). Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Volume 2. Bullhead, mackerel and carpet sharks (Heterodontiformes, Lamniformes and Orectolobiformes). FAO Species Cat Fish Purposes 2(1):1–269.

Compagno, L.J.V. (2002). Freshwater and estuarine elasmobranch surveys in the Indo-Pacific region: threats, distribution and speciation. In: Elasmobranch Biodiversity, Conservation and Management. Proceedings of the conference on Shark and Ray Biodiversity, Conservation and Management, Sabah, Malaysia, July 1997. IUCN, Gland, Switzerland: 168–180

Compagno, L.J.V. & Didier, D.A. & Burgess, G.H. (2005). Chapter 2. Classification of Chondrichthyan Fish. In: Fowler, S.L., Cavanagh, R.D., Camhi, M., Burgess, G.H., Cailliet, G.M., Fordham, S.V., Simpfendorfer, C.A. and Musick, J.A. (comp. and Ed.). *Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Status Survey.* IUCN SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK: 4–11.

Couturier, L.I.E., Marshall, A.D., Jaine, F.R.A., Kashiwagi, T., Pierce, S.J., Townsend, K.A., Weeks, S.J., Bennett, M.B., and Richardson, A.J. (2011). The Biology and Ecology of the Mobulidae. In: Journal of Fish Biology.

Couturier LIE, Marshall AD, Jaine FR, Kashiwagi T, Pierce SJ, Townsend KA, Weeks SJ, Bennett MB, and Richardson, A.J. (2012). Biology, Ecology and Conservation of the Mobulidae. *Journal of Fish Biology* **80**: 1075–1119.

Damora,A and Yuneni, R.R. (2015). Growth, mortality and exploitation estimates of silky shark (C*archarinus falciformis*) landed in Banyuwangi, East Java. Proceedings of Shark and Ray Symposium, KKP-WWF. p. 1-8.

Deakos, M., Baker, J., and Bejder, L. (2011). Characteristics of a manta ray (Manta alfredi) population off Maui, Hawaii, and implications for management. Marine Ecology Progress Series, 429: 245-260.

de Iongh, H. H. (1996). *Plant-herbivore interactions between seagrasses and dugongs in a tropical small island ecosystem*. [Sl: sn].

de Iongh, H. H., Wenno, B. J., & Meelis, E. (1995). Seagrass distribution and seasonal biomass changes in relation to dugong grazing in the Moluccas, East Indonesia. *Aquatic Botany*, *50*(1), 1-19.

de Iongh, H. H. D., Langeveld, P., and van der Wal, M. (1998). Movement and home ranges of dugongs around the Lease Islands, East Indonesia. *Marine Ecology*, *19*(3), 179-193.

de Iongh, H. H., Kiswara, W., Kustiawan, W., and Loth, P. E. (2007). A review of research on the interactions between dugongs (Dugong dugon Müller 1776) and intertidal seagrass beds in Indonesia. *Hydrobiologia*, *591*(1), 73.

Dermawan, A (Ed). (2015). National Action Plan of Turtle Conservation for period of 2016 – 2020. Direktorat Keanekaragam Hayati dan Laut Direktorat Jenderal Pengelolaan Ruang laut Kementerian Kelautan dan Perikanan. Jakarta.

Dethmers, K.E.M., D. Broderick, C. Moritz, N.N. FitzSimmons, C.J. Limpus, S. Lavery, S. Whiting, M. Guinea, R.I.T. Prince, and Kennett, R. (2006). *The Genetic Structure of Australasia Green Turtle (Chelonia mydas): exploring the geographical scale of genetic exchange*. Moleculer ecology 15, 3931-3946.

Dharmadi, Mahiswara, and Kasim, K. (2016). Catch composition and some biological aspects of sharks in western sumatera waters of Indonesia. *Ind. Fish. Res. J.*, Vol. 22(2): 99-108.

Dharmadi, Fahmi, and Sumadhiharga, O.K. (2008). Artisanal Shark and Ray Fisheries in South of Indonesia.

Dharmadi, Fahmi, and Wiadnyana N.N. (2012). Identification of Vulnerable Species and Biological of Sharks from the Indian Ocean. Proceeding of the 7th International Symposiumof SEASTAR2000 and ASIAN Biologging Science *(The 11th SEASTAR2000 Workshop)*, March 8-9, 2011, Bangkok. Thailand. 67 p.

Dharmadi, Fahmi, and Satria, F. (2015). Fisheries management and conservation of sharks in Indonesia. *African Journal of Marine Science*. ISSN 1814-232X EISSN 1814-2338. http://dx.doi.org/10.2989/1814232X.2015.1045431. 2015, 37(2): 249–258.

Dicken, M.L. and Hosking, S.G.(2009). Socio-economic aspects of the tiger shark diving industry within the Aliwal Shoal Marine Protected Area, South Africa, African Journal of Marine Science, 31:2, 227-232, DOI: 10.2989/AJMS.2009.31.2.10.882.

Diekert, F. K., Eikeset, A. M., and Stenseth, N. C. (2010): Where could catch shares prevent stock collapse? Marine Policy 34, 710–712.

Dio, S.M., Adnyana I.B.W, Mahardika, I G.N.K. (2014). Genetic Structure of Green Turtle (*Chelonia mydas)* In The Paloh (West Kalimantan) Nesting Beach. Essay. Faculty of Veterinary Medicine Udayana University, Denpasar, Bali.

Dio, S.M., Adnyana I.B.W, **and** Mahardika, IGNK. **(**2017**)**. Investigation of GreenTurtles (*Chelonia mydas*) Genetics That Being Smuggled to Bali Island During 2015 – 2016. Thesis. Faculty of Veterinary Medicine Udayana University, Denpasar, Bali.

DGCF. (2015). Ministry of Marine Affairs and Fisheries. Fisheries Statistics Data; MMAF: Jakarta, Indonesia. *ISSN :1858-0505. 325 p.*

Dulvy, N.K., C.A. Simpfendorfer, Lindsay, N.K. Davidson, S.V. Fordham, A Br€autigam, G. Sant, and Welch, D. J. (2017). Challenges and Priorities in Shark and Ray Conservation. Current Biology Minireview. CellPress. Current Biology 27, R565–R572, June 5, 2017 ª 2017 Elsevier Lt. http://dx.doi.org/10.1016/j.cub.2017.04.038.

Dutton P. H., Hitipeuw C., Zein M., Benson S. R., Petro G., Pita J., Rei V., Ambio L., and Bakarsbessy, J. (2007). Status and genetic structure of nesting populations of leatherback turtles (*Dermochelys coriacea*) in the Western Pacific. Chelonian Conservation and Biology 6(1): 47–53.

Fahmi. (2010). Sharks and rays in Indonesia. *Mar. Res. Indonesia*, 35(1):43-54.

Fahmi. (2011, in Indonesian). Sharks Resources In Indonesia: Reference collection of marine biota.

Fahmi, and Adrim, M. (2009). The first record of a shark of the genus Glyphis in Indonesia. *Raffles Bulletin of Zoology*, *57*(1), 113-118.

Fahmi and Dharmadi. (2013). *A review of the status of shark fisheries and shark conservation in Indonesia* (p. 187) [in Indonesian]. Jakarta: Direktorat Konservasi Kawasan dan Jenis Ikan, Kementerian Kelautan dan Perikanan.

Fahmi and Dharmadi. (2015). Pelagic shark fisheries of Indonesia's Eastern Indian Ocean Fisheries Management Region. In: Ebert DA, Huveneers C, Dudley SFJ (eds), *Advances in shark research*. *African J. Mar. Sci.*, 37: 259–265.

Fahmi and Sumadhidarga, O.K. (2007). Size, sex and length at maturity of four common sharks caught from western Indonesia. *Mar. Res. in Indonesia*, 32: 7–9.

Fahmi and White, W. T. (2015). Atelomycterus erdmanni, a new species of catshark (Scyliorhinidae: Carcharhiniformes) from Indonesia. Journal of Ocean Science Foundation 2015 Vol. 14. http://www.oceansciencefoundation.org/josf/josf14b.pdf.

Farias J.F.M. and Geniz, J.L.C. (1998). Fishery biology and demography of the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, in the southern Gulf of Mexico. Elsevier. Fish. Res., 39: 183-198.

Germanov E.S. and Marshall A.D. (2014). Running the Gauntlet: Regional Movement Patterns of *Manta alfredi* through a Complex of Parks and Fisheries. PLOS ONE 9(10): e110071. https://doi.org/10.1371/journal.pone.0110071.

Harlyan, L.I., A. Kusumasari, M. Anugrah, and Yuneni, R. R. (2015). *Shark enumeration in muncar fishing port*, Banyuwangi. Proceedings of Shark and Rays Symposium, KKP-WWF. p. 23-32.

Heupel, Michelle R., Carlson, J.K., and Simpfendorfer, C.A. (2007). "Shark Nursery Areas Concepts, Definition, Characterization, and Assumptions, Mar. Ecol. Prog. Ser., 337 (Nmfs 2006) : 287 – 97. https://doi.org/10.3354/meps337287.

Herandarudewi S.M.C., Juraij, Munandar E., Riswanto, Arifin A., Anggraeni F., Suhardi, Suprapti D., Endano Y., and Hadinata S. Y. (2016a). Preliminary Field Survey on Dugong and Seagrass Habitat. Tolitoli 19-26 September 2016. 66pg.

Herandarudewi S.M.C., Juraij, Khalifa M., Riswanto, Arifin A., Anggraeni F., Suhardi, Tania S., and Hadinata S. Y. (2016b). Preliminary Field Survey on Dugong and Seagrass Habitat. Kotawaringin Barat, 10-16 Oktober 2016. 62pg.

Herandarudewi S.M.C., Wouthuyzen S., Arifin A., Sepa N.R., Sunuddin A., Juraij, Azizah N. N., Tania C., and Riswanto. (2016c). Preliminary Field Survey on Dugong and Seagrass Habitat. Bintan, 22-27 Agustus 2016. 62pg.

Herandarudewi et. al. *(In Press). Guideline for survey-monitoring of dugong and seagrass.*

Heupel, Michelle R., Carlson, J.K., and Simpfendorfer, C.A. (2007). "Shark Nursery Areas Concepts, Definition, Characterization, and Assumptions." Marine Ecology Progress Series 337 (Nmfs 2006) :287 –97. https://doi.org/10.3354/meps337287.

Himawan, M.R., Tania, C., Noor, B.A., Wijonarno. A., Subhan, B., and Madduppa, H. (2015). Sex and size range composition of whale shark (Rhincodon typus) and their sighting behaviour in relation with fishermen lift-net within Cenderawasih Bay National Park, Indonesia. *AACL Bioflux*. 8(2):123-133.

Jaiteh, V.F., Adrian R. H., Matıas, Carol, W., and Neil R. L. (2016). Shark finning in eastern Indonesia: assessing the sustainability of a data-poor fishery. ICES Journal of Marine Science (2016), doi:10.1093/icesjms/fsw170. 12p.

Juraij. (2016). Dugong dan Habitat Lamun. Sangihe, 25 Juli-6 Agustus 2016. WWF Indonesia. IV+ 22 hal

Juraij, D. Suprapti, C. Tania, T. Wijanarko, Khaifin, V. Santiadji, Z. Atapada, S.Y. Hadinata, M.J. Jamal, Mahfud, Z. Abidin, M.D. Suhendro, Fahrullian, Y.L. Sailana, O. Laa. 2017. Report of Dugong and Segrass Habitat Survey. WWF Indonesia. V+40 hal.

Kamal, M.M., Wardiatno, Y., and Noviyanti, N.S. (2016). Habitat conditions and potential food items during the appearance of whale sharks (*Rhincodon typus*) in Probolinggo waters, Madura Strait, Indonesia. *QScience*. qproc. 2016.iwsc4.27.

Kashiwagi, T., Marshall, A. D., Bennett, M.B., and Ovenden, J.R. (2012). The genetic signature of recent speciation in manta rays (Manta alfredi and M. birostris). Molecular Phylogenetics and Evolution, 64(1): 212-218.

Khalifa, M.A., T. Hestirianoto, A. Sunuddin, and Kawaroe, M. (2016, unpublished paper). The behaviour of dugong in the aquarium of Indonesia Sea World. Dalam Prosiding National Symposium of Dugong and Segrass Habitat, held in 2016.

Kitchen-Wheeler, A. (2010). Visual identification of individual manta ray (Manta alfredi) in the Maldives Islands, Western Indian Ocean. Marine Biology Research, 6(4):351-363

Kreb, D. and Lim, I. S. (2009). Balikpapan Bay Irrawaddy dolphin Project 2008. *Conservation and diversity of cetaceans in and near Balikpapan Bay, East Kalimantan, Indonesia*.

Kreb, D., & Lim, I. S. (2009). Balikpapan Bay Irrawaddy dolphin Project 2008. *Conservation and diversity of cetaceans in and near Balikpapan Bay, East Kalimantan, Indonesia*.

Lanyon, J. (1991). *The nutritional ecology of the dugong (Dugong dugon) in tropical north Queensland* (Doctoral dissertation, Monash University).

Last, P.R. and Compagno, L.J.V. (2002). “Review of Biodiversity of Rays in the South China Sea and Adjacent Areas.” In *Elasmobranch Biodiversity, Conservation and Management: Proceeding of the International Seminar and Workshop in Sabah, July 1997*, edited by S.L. Fowler, T.M. Reed, and F.A. Dipper, 64–69. Gland, Switzerland and Cambridge, UK: IUCN SSC Shark Specialist Group. IUCN.

Mahardika G.N., I.A.C. Dewi, K.D. Nursanty, Y.L. Kote, D. Cahyani, A.S. Kendran, and Nindhia, C.S. (2007). Mapping of the genetic stocks of green and hawksbill turtles in Derawan Islands, Berau, East Kalimantan. Project Report. Conservation International Indonesia– Animal Medical, Molecular Biology and Genetic Research Center Faculty of Veterinary Medicine Udayana University, Denpasar, Bali, pp. 1 – 40.

Marsh, H. (2002). *Dugong: status report and action plans for countries and territories*. UNEP/Earthprint.

Marsh, H. and Rathburn, G.B. (1990). Development and Application of Conventional and Satellite Tracking Techniques for Studying Dugong Movements and Habitat Use. Aust. WIldl. Res. 17:83-100.

Marshall, A.D. (2012). The use and abuse of photographic identification in sharks and rays. J Fish Biol, 80 pp.

Marshall, A.D., Compagno, L.J.V., and Bennett, M.B., (2009). Redescription of the Genus Manta with resurrection of Manta alfredi (Krefft, 1868) (Chondrichthyes: Myliobatoidei: Mobulidae). Zootaxa, 2301:1-28.

Marshall, A., Bennett, M.B., Kodja, G., Hinojosa-Alvarez, S., Galvan-Magana, F., Harding, M., Stevens, G. & Kashiwagi, T. (2011c). Manta birostris. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.

Marshall, A.D., Dudgeon, C.L. and Bennett, M.B. (2011a). Size and structure of a photographically identified population of manta rays Manta alfredi in southern Mozambique. Marine Biology, 158 (5): 1111-1124.

Marshall, A., Kashiwagi, T., Bennett, M.B., Deakos, M., Stevens, G., McGregor, F., Clark, T., Ishihara, H. & Sato, K. (2011b). Manta alfredi. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.

Maslim, Achmad Farajallah, and Zamani, N.P. (2016). Leatherback turtle (*Dermochelys coriacea*) populations in Sumatra: genetic diversity and connectivity pattern. AACL Bioflux. 9(2):276-283.

Moritz, C., D. Broderick, K. Dethmers, N.N. FitzSimmon, and Limpus, C. (2002). Population Genetics of Southeast Asian and Western Pasific Green Turtles, *Chelonia mydas*. Final Report to UNEP/CMS.

Musick, J. A., Burgess, G., Cailliet G., Camhi, M., and Fordham, S. (2000). Management of sharks and their relatives (Elasmobranchii). *Fisheries* **25,** 9–13.

Musick, J.A. and Harbin, M.M. (2003). Historical zoogeography of the Selachii Abstract *American Elasmobranch Society 19th Annual Meeting, Manaus, Brazil.*

Musick, J. A., Burgess, G., Cailliet G., Camhi, M., and Fordham, S. (2000). Management of sharks and their relatives (Elasmobranchii). *Fisheries* 25: 9–13.

Norman, B. (2016). Integrating citizen science and telemetry techniques in understanding the movement patterns of the whale shark (Rhincodon typus). PhD thesis, Murdoch University.

Norman, B. M. and Stevens, J.D. (2007). Size and maturity status of the whale shark (Rhincodon typus) at Ningaloo Reef in Western Australia. Fisheries Research. 84. 81-86. 10.1016/j.fishres.2006.11.015.

O'Malley, M. P., Lee-Brooks, K., Medd, H. B. (2013). The Global Economic Impact of Manta Ray Watching Tourism. PLoS ONE 8(5): e65051. https://doi.org/10.1371/journal.pone.0065051.

Prabuning, D., Setiasih, N., Ningtias, P., Yahya, Y. and Harvey, A. (2016). Rantai Perdagangan Hiu dan Pari di Provinsi NTB (Nusa Tenggara Barat) dan NTT (Nusa Tenggara Timur). Prosiding Simposium Hiu dan Pari di Indonesia. Bogor, 10 Juni 2015. 127-134

Purwanasari, H.N and Adnyana, I.B.W. (2010). Identification of the Stock Population of Green Turtle (*Chelonia mydas)* In The Sukamade (East Java) Nesting Beach. **Ecotrophic (Journal of Environmental Science)**, 5(2): 116 – 118.

Rowat, D. and Engelhardt, U. (2007). Seychelles: A case study of community involvement in the development of whale shark ecotourism and its socio-economic impact. Fisheries Research 84 (1): 109-113.

Sentosa, A. A., Widarmanto, N., Wiadnyana, N. N., and Satria, F. (2016, in Indonesian). The shark cath composition differences of drift and bottom longline based in Tanjung Luar, Lombok. *J.Lit.Perikan.Ind.*, *22*(2), 105–114.

Stevens, J. D., Bonfil, R., Dulvy, N. K. & Walker, P. A. (2000). The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems. *ICES Journal of Marine Science* 57, 476–494.

Simeon, B.M., Agustina, S., Muttaqin, E., Ichsan, M., and Yulianto, I. (2017). Technical Report of Sharks and Rays Fisheries in West Nusa Tenggara; Wildlife Conservation Society: Bogor, Indonesia.

Simeon, B.M., Muttaqin, E., Ichsan, M., Tarigan, S., Hernawati., and Yulianto, I. (2018, in Indonesian). Technical Report of assessment on important habitat of sharks and rays in Lunyuk, Sumbawa, Provinsi Nusa Tenggara Barat. Wildlife Conservation Society – Indonesia Program, Bogor, Indonesia.

Stobutzki, I. C., Miller,M. J., Heales, D. S., and Brewer, D. T. (2002). Sustainability of elasmobranchs caught as bycatch in a tropical prawn (shrimp) trawl ûshery. *Fish. Bull.*, *100*, 800–821.

Suprapti, D. (2008). Ratio sex identification of green turtle *Chelonia mydas*) and leatherback turtle (*Dermochelys coriacea)* hatchlings in various main nesting beaches of Indonesia. Desertation for Post Graduate Program. University of Udayana, Bali.

Supriyadi. (2016). Paper presented in the National of Dugong and Segrass Habitat.

Tania, C. and Himawan, M.R. (2017). Other perspective of behind whale shark occurrence in Gorontalo. www.wwf.or.id. Posted on 29 Agustus 2017.

Tania, C., Blæsbjerg, M., Himawan, M.R., Noor B.A., Suruan, S.S., Pranata, B., and Stewart, B.S. (2016). Characteristics of whale sharks (Rhincodon typus) in Teluk Cenderawasih National Park, Indonesia. QScience Proceedings (The 4th International Whale Shark Conference) 2016:iwsc4.62 http://dx.doi.org/10.5339/qproc.2016.iwsc4.62.

Tapilatu R, Wona H, and Batubara P.P. (2013). Status of sea turtle populations and its conservation at Bird's Head Seascape, Western Papua, Indonesia. *Biodiversitas*. Vol 18 :129-136.

Velez-Zuazo X, IGNK Mahardika, F Ballamu, G Gearheart, AS Kendran, CS Nindia, A Suartini, and Cahyani, D. (2006). Genetic Composition of the Nesting Aggregation of Green Turtles (Chelonia mydas) in the Archipelago of Raja Ampat, Indonesia. A Final Report to Conservation International Indonesia. The Faculty of Veterinary Medicine Udayana University, Denpasar, Bali, 29 p.

Widodo. J and Suadi. (2006, in Indonesian). Management of Marine Fisheries Resources. Gadjah Mada University Press. Yogyakarta.

Wiradharma, I.G.A & Adnyana, I.B.W. (2010). Genetic Structure of Olive Ridley (*Lepidhochelis olivacea*) In The Perancak, Kuta and Serangan (Bali) Nesting Beach. Essay. Faculty of Veterinary Medicine Udayana University, Denpasar, Bali.

White, W. T. (2007). Catch composition and reproductive biology of whaler sharks (Carcharhiniformes: Carcharhinidae) caught by fisheries in Indonesia. *Journal of Fish Biology* **71,** 1512–1540.

White, W. T., P. R. Last, J. D. Stevens, G. K. Yearsley, Fahmi, and Dharmadi. (2006). *Economically important sharks and rays of Indonesia*. National Library of Australia Cataloging-in-Publication entry. Australia. 329 p.

White, W.T. & Baje, L. & Sabub, B. & Appleyard, S.A. & Pogonoski, J.J. & Mana, R.R. (2017). Sharks and rays of Papua New Guinea. *ACIAR Monograph No. 189. Australian Centre for International Agricultural Research:* Canberra. 327 pp.

WWF Indonesia. (2014). Guideline for turtle handling as bycath. Jakarta.

WWF-Indonesia. (2017). Turtle Population status of 12 priority provinces in Indonesia. WWF Indonesia. Jakarta.

Zainudin, I.M. (2011, in Indonesian). Fisheries management of shark based on ecosystem in Indonesia. Thesis of Graduate Program, Indonesia University, Depok, Indonesia.